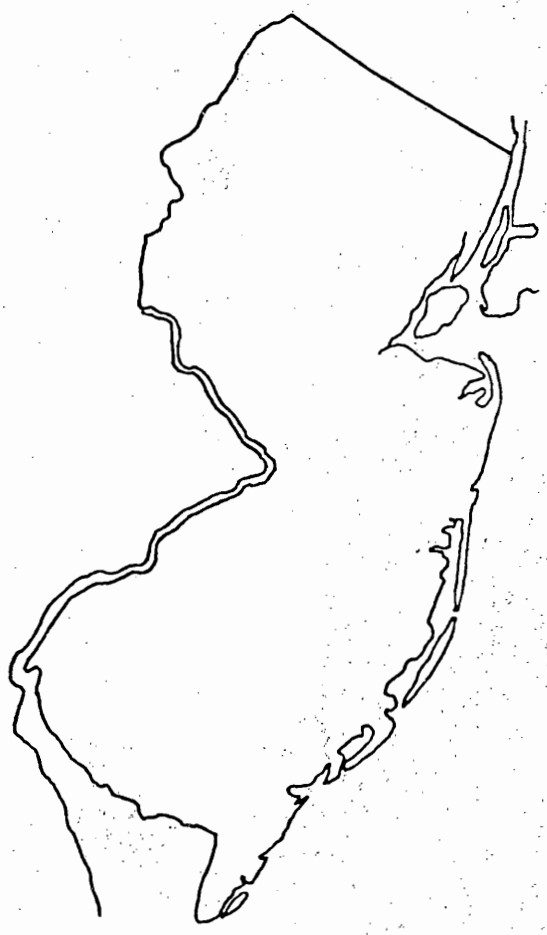
SOURCE MATERIAL
TASK III -DEVELOPMENT STUDIES
Prepared by Consultants



FOR

THE NEW JERSEY STATEWIDE WATER SUPPLY PLAN
JUNE, 1980

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

HAVENS AND EMERSON, INC.
PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.
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STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
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P.O. BOX 1390
TRENTON, N.J. 08625
609-292-2885

Dear Citizen:

The Department of Environmental Protection is pleased to share with you this volume of source material prepared by consultants for the New Jersey Statewide Water Supply Plan. The information contained in Task 3 represents the consultants' efforts to inventory, analyze and recommend water supply development alternatives to meet the State's needs through the year 2020.

This document is one of twelve outputs prepared over the course of this planning effort, which seeks to provide a framework for future water supply decision making in our state. These twelve outputs form the basis for the Summary of Consultants' Findings, which is being published as a separate volume, as are the other eleven task outputs.

Thank you for your interest in New Jersey's water supply needs.

Sincerely,

Jerry Fitzgerald English

Jerry Fitzgerald English
Commissioner

Attachment

NEW JERSEY
STATEWIDE WATER SUPPLY MASTER PLAN

HAVENS AND EMERSON, INC.
PARSONS, BRINCKERHOFF, QUADE & DOUGLAS, INC.
WESTWATER, GASTON & DUNKA
WATER RESOURCES ENGINEERS, INC.
GERAGHTY & MILLER, INC.
— In Association —

Reply to: Brook-Mayhill Building
299 Market Street
Saddle Brook, N. J. 07662
Tel. (201) 845-0470

3-1188-32-1

June 1980

TASK III - DEVELOPMENT STUDIES

This output has been prepared by the Association in response to the Scope of Work for this Task. It is one of twelve tasks listed overleaf which, together with a "SUMMARY OF FINDINGS," form the complete New Jersey Statewide Water Supply Master Plan.

The Plan was prepared over a 3 1/2 year period, therefore, various parts of this particular Task were submitted to the State Department of Environmental Protection at different times and were followed by public meetings held by the DEP.

In order to catalog the chronological sequence of events, this final Task output includes a copy of the original sub-task cover sheets to identify the date of submittal for the DEP review and public comment. Also included is the letter of transmittal, which indicates the appropriate excerpt from the Scope of Work to assist in orienting the reader to the extent of the Association's planning work.

The final documents were completed in June 1980 and are responsive to the comments received during the State review and public participation process. We are confident their valuable findings will be of interest and use to all concerned with water supply planning in New Jersey.

For the Association,

Peter W. Doe
Project Manager

sf

NEW JERSEY WATER SUPPLY MASTER PLAN

STATE WATER SUPPLY MASTER PLAN
PROGRAM DESIGN
TASK ACTIVITIES

TASK I	Data Base
TASK II	Needs Assessment
TASK III	Development Studies
TASK IV	Interconnections
TASK V	Contingency Plans
TASK VI	Conservation Plans
TASK VII	Watershed Management
TASK VIII	Regulatory & Administrative
TASK IX	State Utility Operations
TASK X	Legal Factors
TASK A	Data Information System
TASK B	System Analysis

NEW JERSEY
STATEWIDE WATER SUPPLY MASTER PLAN

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October 1978

Letter of Transmittal:

This report is our draft submission for Subtask 3A - Inventory of Alternatives, Subtask 3B - Additional Alternatives, and Subtask 3C - Project Data File. Under Subtask 3A available water supply projects are identified, and a list of references and project location map are presented. Projections of purveyor water supply need are made based on results of Tasks 1 and 2. Under Subtask 3B additional alternatives are identified considering purveyors' plans and related Task 6, Conservation and Subtask 7C, Groundwater Management. Subtask 3C presents available data and maps for water supply projects identified by Subtasks 3A and 3B, and reports the results of project screening to reduce to a manageable number those projects to be evaluated in Subtask 3D, Project Evaluation. Project screening is the first step of a three step evaluation process delineated in Subtask 3G, Recommended Plan Selection Methodology. The Subtask 3C report as transmitted is a partial output, to be completed with additional data developed for use in a computerized model of river basin hydrology.

To orient the reader to the consultant's responsibilities, the following excerpt from the Scope of Work represents the contractual responsibilities for Subtasks 3A, 3B and 3C.

TASK 3.A

"This activity includes the inventory of surface and ground water development and management alternatives, and major water supply issues in each of the six water-planning regions. In addition, each of the regions would be further subdivided into subregions consistent with certain hydrologic and hydrogeologic features for use in later evaluations.

"It is anticipated that those issues and alternative projects listed in Exhibit 5 of the State Water Supply Master Plan RFP, would be used as the base in preparing the inventory.

TASK 3.B

"Beyond the existing alternatives, the Consultant would investigate and identify other possible surface and ground water alternatives (approximately 20).

"The identification of 'additional projects' in this subtask is seen as a cooperative effort including: review of data assembled in Task 1; a review with utilities which have performed considerable research into importation and pumped storage projects; spray irrigation, basin recharge and well injection of plant effluents, and reuse of other wastewaters would also be evaluated.

"Effort in this area can be simplified to some degree through the expeditious processing of data collected in Task 1. Specific information is to include: yields and storage required to expand yield levels; areas, volumes and locations for effective well injection schemes; areas capable of utilizing spray irrigation and estimated volumes which could be utilized; potential uses of secondary wastewaters including agricultural use and industrial reuse and the physical relationship of use areas to the areas in which wastewaters are generated."

TASK 3.C.

"The purpose of this Task is the generation of a file compendium of pertinent water supply data to be used in the analyses of alternatives. The data will provide the basis for subsequent analysis including possible development of conceptual models of the surface water systems and, as required, the identification of problems and problem areas. Analytical procedures for analysis of the ground water system will also be developed.

"This task will organize data on each of the identified alternatives. Here the transfer of data from the individual reports and studies into the overall data bank will be carried out. The particular data will be that data identified in Task 3.G. as required for the selection methodology. As in Task 1, the approach will be to first complete the data bank as nearly as possible with existing data.

"The data gathered from existing reports will include engineering, environmental and socioeconomic data. Tangible effects will be quantified to the extent possible; however, intangible effects will be entered in description or narrative form. No attempt will be made to index nonquantifiable items such as visual beauty. Other judgemental factors, such as staging flexibility, will be included.

"Consideration shall be given for inclusion of:

1. Flexibility under varying future demands,

2. Phased development potential,

3. Probability of land use change impacting on quality or quantity of water supply,

4. Projects which reflect major directions in decision-making.

"Among the many data requirements, the following local ground water information will be obtained and used in the analysis of the various alternative plans:

1. Sources, movement, and storage of ground water,
2. Ground water boundary conditions,
3. Designation of recharge areas,
4. Designation of discharge areas,
5. Pumpage effects:
    a. Water levels
    b. Influence on surface water (streams and marine environments)
6. Areas for potential recovery of water losses,
7. Potential underground water storage areas:
    a. Unsaturated zones
    b. Aquifer zones
8. Areas where ground water may be considered as a supplement to surface water supplies,
9. Water quality relationships."

STATE OF NEW JERSEY
WATER SUPPLY MASTER PLAN

TASK 3, WATER SUPPLY DEVELOPMENT STUDIES

SUBTASK 3A. INVENTORY OF ALTERNATIVES
SUBTASK 3B. ADDITIONAL ALTERNATIVES
SUBTASK 3C. PROJECT DATA FILE

SUBTASK 3ABC

SUMMARY

This report on Water Supply Development Studies, Subtasks 3A, 3B and 3C, inventories water supply development alternatives to meet projected water supply needs. Information presented is the basis for the evaluation of alternatives and regional water management programs in Subtasks 3D and 3E.

Available water supply projects were identified through examination of more than 75 reports and other documents. A total of 125 projects are identified and described by a project list.

Projections of purveyor water supply demand were made using Subtask 2A* projections of purveyor fresh water intake along with data from purveyor questionnaires used to estimate regional distribution losses, deficits and surpluses. Need for additional supply in the State ranges from a high projection of 347 mgd (year 2020) to a low projection of 103 mgd. The high projection assumes that areas of surplus supplies cannot transfer those supplies to need centers. Low projections assume that transfers are maximized on an intra-county basis.

Issues identified by the Subtasks 2B and 2C report were evaluated for each region and analyzed for their effect on projected demand. Generally, these issues indicate that the high projection of 347 mgd is more realistic. Figure 1 reports purveyor water supply demand projections recommended for use in the Master Plan. These demand projections are substantially lower than previous water supply planning demand projections, and result from recent changes in population trends and different assumptions concerning the future of self-supplied water use.

*As revised by State DEP, Division of Water Resources

PURVEYOR WATER SUPPLY (MGD)

REGION	RETAIL DEMAND 1976	INCREASED DEMAND 2020
1	760	202.6*
2	79	50.0
3	28	22.2
4	20	8.6
5	106	36.3
6	57	26.9
STATE	1050**	346.6

*Includes 55 mgd deficit 1976.
**Regional figures rounded
Actual State total 1,047 mgd

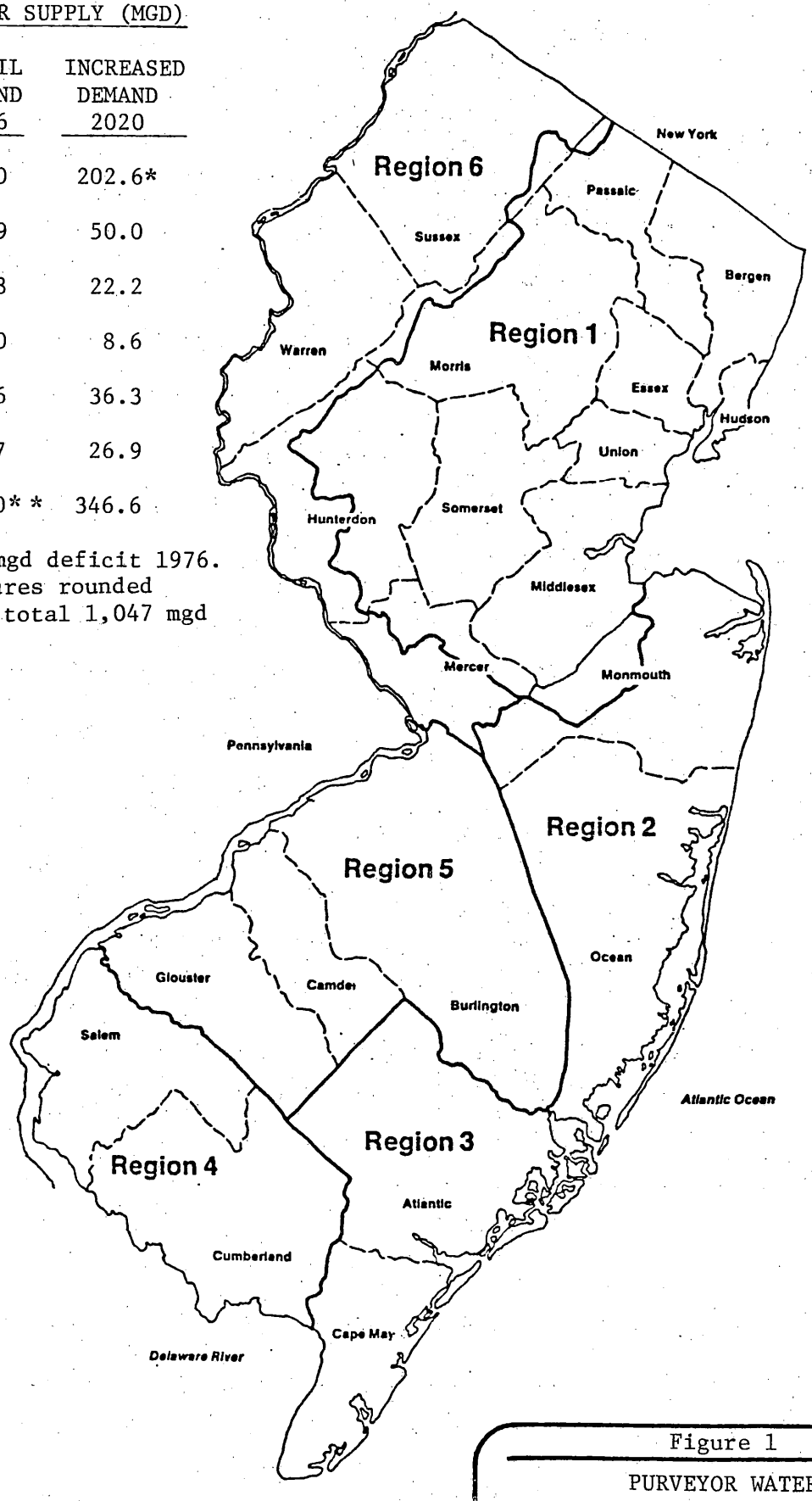

Figure 1

PURVEYOR WATER SUPPLY DEMAND

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

Several additional water supply alternatives (Subtask 3B) were reported by purveyors in the questionnaires and discussed at meetings in May 1978. Specific surface water projects were identified and ground water alternatives were identified. Specific ground water projects involving recharge, well injection and conjunctive use are identified based on the results of Subtask 7C, Groundwater Management. Additional alternatives also involve reuse, and specific projects for direct or indirect reuse are identified and evaluated in Task 6.

A project data file, Subtask 3C, on available and additional projects has been prepared comprising project description forms for each project. A project screening was performed to eliminate those projects that for environmental, technical or implementation reasons are obviously unworthy of further consideration. As indicated by Table 1, a total of 60 available projects are considered realistic, and along with additional projects, will be evaluated in Subtask 3D. This Subtask 3C output is a partial output, complemented by additional hydrologic data developed for use in a computerized river basin model.

TABLE 1

AVAILABLE PROJECT SCREENING

REGION	UNREALISTIC PROJECTS	REALISTIC PROJECTS
1	26	44
2	3	6
3	2	4
4	10	1
5	14	4
6	16	22
STATE*	65	60

*Several projects affect more than one region.

Subtasks 3A, 3B and 3C represent the first step of a three step plan selection methodology. Step two, project evaluation, is performed under Subtask 3D. Step three, regional program evaluation and presentation of results, is performed under Subtasks 3E and 3F. The three step plan selection methodology is illustrated by Figure 2, which is included here to clarify subtask relationships.

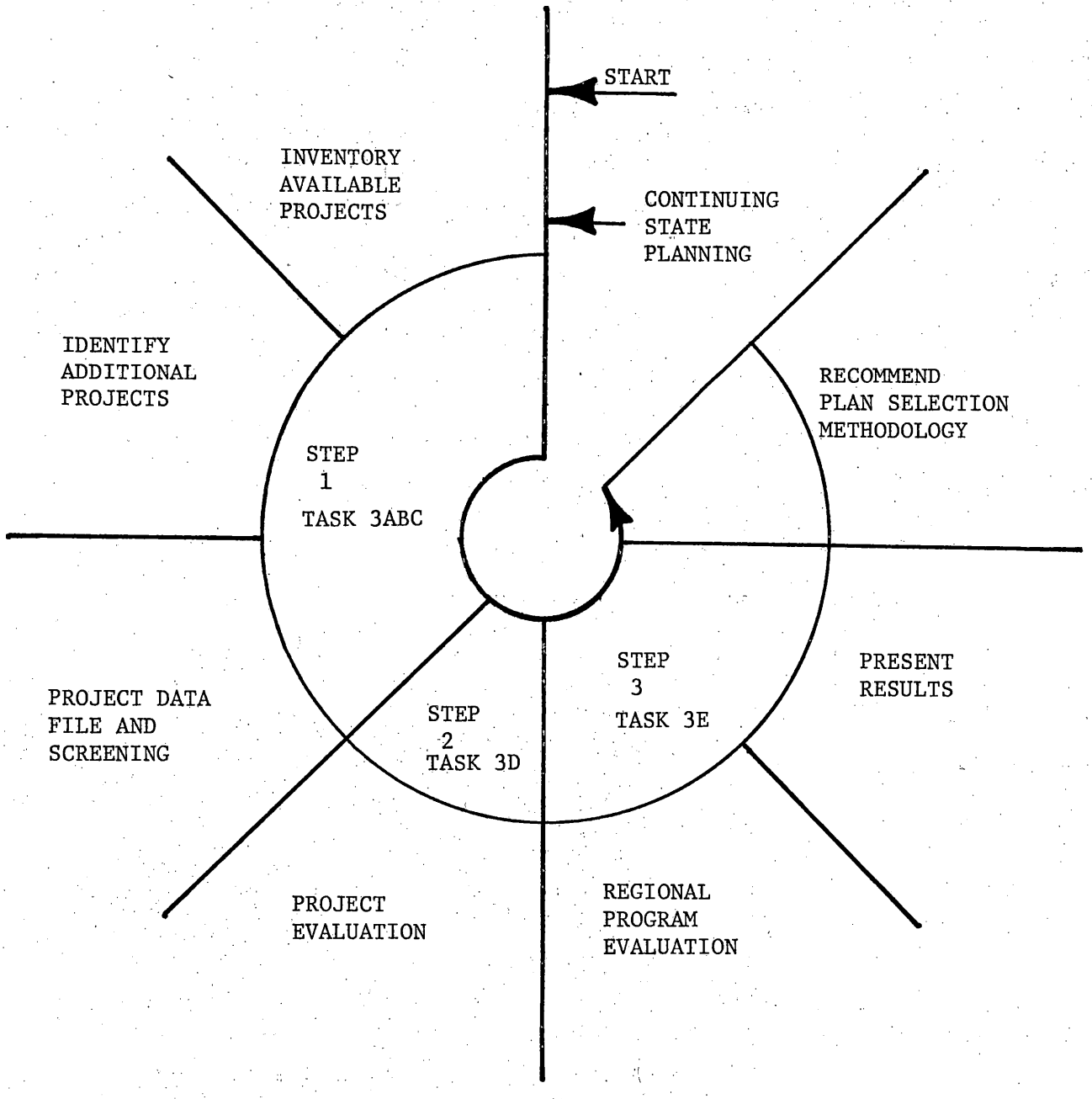

Figure 2

INITIAL PLAN SELECTION METHODOLOGY

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

NEW JERSEY

STATEWIDE WATER SUPPLY MASTER PLAN

SUBTASK 3A

INVENTORY OF ALTERNATIVES

SUBTASKS 3ABC

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EXHIBITS

A. Bibliography
B. Project List and Location Map
C. Project Descriptions

SUBTASK 3A - INVENTORY OF ALTERNATIVES

One of the requirements of the Master Plan is an inventory of all water supply projects which have been proposed during the previous few decades. This inventory provides an historical record of all proposed projects serving as a basis for the selection of preferred projects in Subtask 3D.

Previous water supply planning studies have been collected and reviewed to identify surface and ground water development and management alternatives. Projected water supply needs and planning issues from Task 2 are summarized for consideration in Task 3. Subregions are also proposed for use in later evaluations.

3A-1 PROJECT LIST

The Scope of Work requires the basis for the project list to be the alternative projects listed in Exhibit 5 of the State Water Supply Master Plan RFP, reproduced here as Table 3A-1.

A bibliography of references used to compile the project list appears as Exhibit A. References range in scope from extensive feasibility reports, through general water supply plans, to brief listings with little or no supporting data. Completeness and reliability of available data is highly variable. References particularly useful in preparing the project list were the Corps of Engineers NEWS Report Series (202), the TAMS 1955 report for the New Jersey Legislature (757), the State's survey of potential reservoir sites (810), and the 1974 report on alternative water supply projects for Newark (1206.01).

The available project list and general location map appear in Exhibit B. A key to the project list explains abbreviations employed. Project locations are indicated using the State's Land Oriented Reference Data System (L.O.R.D.S.) maps.

TABLE 3A-1

EXHIBIT 5. MAJOR WATER SUPPLY PROBLEMS, ISSUES AND ALTERNATIVE PROJECTS

Water Supply Study Regions		Major Problems or Issues	Alternative Projects
Region 6:	Delaware Basin tributaries north of Trenton and Wallkill Basin (Warren and portions of Sussex, Morris, Hunterdon & Mercer Counties)	. Further export of the regions surface supplies to the Northeast . Coordinated management and development of water quality & water supply facilities . The extent of available ground water reserves . Lack of backup for the Trenton Water System	. Delaware River development projects - direct diversion with storage in the Delaware Basin at Flat Brook, Honey Run & Musconetcong - direct diversion with storage in the Raritan & Passaic Basins - high flow skimming with storage in the Raritan & Passaic Basins - combinations of the above . Wallkill development for in-basin use or diversion to Passaic Basin . Localized development of ground water
Region 5:	Burlington, Camden & Gloucester Counties	. Protection of Camden wellfields . Prudent management of groundwater . Protection of Pine Barrens water resources	. Localized development of ground water . Conjunctive use/management of water resources
Region 4:	Salem and Cumberland Counties	. Groundwater contamination . Protection of Pine Barrens water resources . Prudent management of groundwater . Saltwater intrusion	. Localized development of ground water . Conjunctive use/management of water resources
Region 3:	Cape May and Atlantic Counties	. Protection of the Pine Barrens water resources . Saltwater intrusion	. Localized development of ground water . Conjunctive use/management of water resources
Region 2:	Ocean and Monmouth Counties	. Saltwater intrusion . Overuse of the Englistown formation . Isolated water service areas . Protection of Pine Barrens water resources	. Localized development of ground water . Conjunctive use/management of water resources . Upper and Lower Manasquan Reservoirs
Region 1:	Raritan, Passaic and Hackensack Basins (Middlesex, Somerset, Union, Essex, Hudson, Bergen & Passaic Counties, & portions of Monmouth, Mercer, Hunterdon, Morris, and Sussex Counties)	. Transfer of Raritan basin water to urban Northeast . Weakness in available water system backup during disaster events . Positive and negative effects of suburbanization . Overdrafting safe yields by several major systems . Establishment of design drought and minimum stream flow requirements	. Confluence Reservoir, Pump Station, and Force Main . Raritan-Passaic Pipeline . Two Bridges Pump Storage to Wanaque Reservoir . Wanaque-Oradell Pipeline . Raise D & R Canal to 100 MGD capacity . Six Mile Run Reservoir . Washington Valley Reservoir . Evaluate options available to encourage base load use at D & R Canal . Raise dams and dikes at Round Valley . Raritan-Raritan Pipeline . Delaware-Raritan Pipeline . Hudson River Development Proj. -pipeline to Little Falls for continuous skimming -high flow skimming with storage in NY State and inchannel flow to Little Falls -high flow skimming with storage in the Passaic Basin via pipeline to Little Falls . New York City Diversion from - Staten Island - Manhattan (G.W. Bridge) . Longwood Valley Reservoir . South River Tidal Dam . Two Bridges Reservoir . Little Falls-Oradell Pipeline . Crab Island Reservoir

3A-2 WATER SUPPLY NEEDS

Water use projections by county and New Jersey water supply planning region are presented in the Subtask 2A* report for 1975 and ten year intervals from 1980 to 2020. Projections cover self-supplied and purveyor supplied water and are summarized in Table 3A-2. Over the 45 year planning period, total self-supplied use is projected to decline 6.5 mgd and total purveyor supplied use is expected to increase 204.8 mgd. For the purposes of this analysis, it has been assumed that self-supplied users will continue to satisfy their needs using existing sources. All projections refer to yearly average million gallons per day.

TABLE 3A-2

SUMMARY OF WATER USE PROJECTIONS (MGD)[a]

	1975			2000			2020		
	Res	Ind	Tot	Res	Ind	Tot	Res	Ind	Tot
Self-supplied	25.7	787.6	813.3	22.0	785.2	807.2	9.0	797.8	806.8
Purveyor supplied	461.0	277.2	738.2	552.4	325.5	877.9	597.5	345.4	943.0
Total	486.7	1064.8	1551.5	574.4	1110.7	1685.1	606.5	1143.2	1749.8

[a]From Subtask 2A Report.* Excludes distribution losses and deficits.

Water supply needs for evaluating alternative projects are developed using revised 2A projections plus an allowance for "unaccounted for" water and considering existing surpluses and deficits. Unaccounted for water includes distribution losses, municipal water use, and inaccuracies in metering.

Unaccounted for water within each region was calculated to range from 20 to 35 percent by comparing actual volume supplied by purveyors in 1976 as reported in the questionnaires with the estimated 1975 demand for purveyor supplied water. Discussions with major purveyors indicate that these amounts of unaccounted for water may be slightly higher than normal and introduce a

*As revised by NJDEP

conservative element to forecasts of need for alternative projects. Regional loss factors are applied to the demand estimates from Subtask 2A to yield the water supply needs reported in Table 3A-3. As shown in this table, the increased need for purveyor supplied water in the year 2020 is estimated at 292 million gallons per day, exclusive of existing deficits. This is a 28 percent increase over the retail volume of 1,050 million gallons per day supplied in 1975 by all purveyors (from questionnaires). The existing deficit is an existing water supply need which, when added to 292 mgd, gives an estimated increased need for purveyor supplied water in 2020 of 347 mgd (High projection).

Some of the estimated statewide potential surplus of 466 mgd (Note 4 in Table 3A-3), might be applied to meet increased needs and deficits. An analysis was undertaken to determine a projection of needs assuming potential surplus is applied within each county but not outside a county. The Subtask 1.E.3 report and all purveyor questionnaires were reviewed to determine surpluses and deficits, which then were allocated to each region and county. The LOW projection in Table 3A-3 represents the results of this analysis. Assuming only in-county transfers of surpluses, the increased need for the State in 2020 is estimated at 103 mgd.

The actual increase in water supply need in 2020 will range between 103 mgd and 347 mgd depending on several variables. For example, unlimited transfer of water within a county may not be possible. Much of the state-wide potential surplus of 466 mgd results because average ground water pumped in 1976 is less than well capacities or diversion allowances. Some of this potential surplus is not a true surplus but represents water which must be reserved to meet peak demands from ground water storage. Actual surplus can only be determined on a case by case basis.

TABLE 3A-3

PROJECTED WATER SUPPLY NEEDS (MGD)[1]

REGION	High Projection Increased Need Assuming No Use of Potential Surpluses[2] 1980	2000	2020	Low Projection Increased Need Assuming Use Of In-County Potential Surpluses[4] 1980	2000	2020
1	62.5[3]	150.8[3]	202.6[3]	26.2	52.7	82.2
2	12.5	37.6	50.0	-	-	9.7
3	4.6	17.0	22.2	-	-	-
4	0.0	5.0	8.6	-	-	-
5	5.1	25.8	36.3	-	-	-
6	3.9	17.8	26.9	0.1	5.3	11.0
STATE	88.6	254.0	346.6	26.3	58.0	102.9

[1]Based on Subtask 2A (as revised by NJDEP) increased demands plus percentage for distribution losses: Regions 2, 6 - 35%; 1, 4 - 30%; 3 - 25%; 5 - 20%.

[2]Increased need over 1976 purveyor supplied water of 1050 mgd, determined from questionnaires.

[3]Includes Region 1 existing deficit of 55 mgd, determined from questionnaire data.

[4]Purveyor water supply capability or safe yield in excess of 1976 delivery. Total surpluses: Region 1 - 184 mgd; Region 2 - 40 mgd; Region 3 - 48 mgd; Region 4 - 37 mgd; Region 5 -114 mgd; Region 6 - 43 mgd; State - 466 mgd.

These water supply needs are significantly lower than those projected by the Corps of Engineers for the Northeastern United States Water Supply (NEWS) Study. For the ten county northeastern New Jersey area, from 1970 to 2020, NEWS reports increased needs of 970 mgd. NEWS considers that 220 mgd of this need could be met by local supplies including the additional 80 mgd provided by the Round Valley outlet works.[1]

Based on Table 3A-3, the Master Plan projection for a similar area (Region 1) and time frame is 202.6 mgd increased need. This is about twenty-one percent of the NEWS projection.

This difference in water demand results primarily from the differences in the projection of population for 2020. NEWS projects 7.9 million, an increase of 2.8 million. The Master Plan (Task 2A) projects 6.4 million for an increase of 1.3 million, or 46 percent of the NEWS projected increase.

Other reasons for the different projections relate to self-supplied users and industrial recirculation. The NEWS projection is based on the conversion of all self-supplied users to purveyor supplies and industrial recirculation to reduce industrial water demand by fifty percent. Task 2A assumes much self-supplied use will continue and projects self-supplied use in Region 1 to increase from 565 mgd to 621 mgd in 2020, although a slight decrease is projected statewide. Task 2A also assumes higher rates of industrial recirculation than does NEWS.

The Tri-State Regional Planning Commission projections of water supply needs are in close agreement with Master Plan projections. Tri-State

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[1] Summary Report, July, 1977, pages 41-42.

indicates a year 2030 demand of 1100 mgd for the eight county area, with capability for reduction to 960 mgd using water conservation. Master Plan Task 6, Water Conservation, reports on the alternatives capable of achieving reductions up to 229 mgd in Region 1. Tri-State also mentioned that planned developments for 360 mgd mean that New Jersey would be able to meet water supply needs for fifty years without resorting to the Hudson River.

2 "Evaluation of the Hudson River Water Supply Project, Interim Technical Report, June, 1978", Tri-State Regional Planning Commission, p.61,62.

3A-3 ISSUES AFFECTING NEEDS*

Issues reviewed and ranked in the Subtask 2B, 2C report include major regional developments which introduce uncertainties in projections, quality and quantity of supply, and institutional constraints. In this section, those issues identified with highest or high priority for each region are assessed for impact on projections of need.

Region 1 - Purveyors in Region 1 supplied 760 mgd in 1976 (Figure 1), with potential surpluses of 184 mgd and deficits of 55 mgd. Increased need for 2020 is projected to range from a high of 202.6 mgd (27%) to a low of 82.2 mgd (11%). Priority issues for Region 1 involve ground water quality, water supply, institutional constraints and surface water quality.

Deterioration of ground water quality from landfill leachates, industrial spills and salt water intrusion is a serious concern throughout Region 1, where the source for about 25 percent of water supplied by purveyors is ground water. While the magnitude of this problem is uncertain, the State is currently investigating several cases of pollution which may result in the ultimate curtailment of existing supplies totalling between 10 to 20 mgd.

The water supply issue involves existing purveyor deficits of 55 mgd. These are included as needs to be satisfied immediately.

The institutional issue is fragmentation of the water supply network. Region 1 potential surplus of 184 mgd cannot be applied to reduce the existing deficit of 55 mgd and is only partly available to meet increased needs. An examination of the questionnaires shows that if unlimited in-county transfers could be arranged, a total of 116 mgd would be available to meet increased needs. While the resulting low projection of needs of 82.2 mgd may not be realistically achieved, projected needs could be significantly reduced by integrated operation of purveyors systems.

*Further discussion of issues impacting needs is provided in Subtask 3D, Section 3D-2.3

Priority surface water quality issues involve industrial and sewage treatment plant discharges, lack of protection for purveyor intakes, flood plain development, and erosion and sedimentation. No instances have been identified where these issues threaten to curtail surface water withdrawals by major purveyors in Region 1. Remedial measures addressing these issues include basin management with discharge permit limitation, additional water treatment, land use policy and soil erosion control.

Issues in Region 1 indicate that the high projection of 202.6 mgd increased need is more realistic than the low projection.

Region 2 - Purveyors supplied an average of 79 mgd, with a potential surplus of 40 mgd in 1976. Increased need for 2020 is projected to range from a high of 50.0 mgd (63%) to a low of 9.7 mgd (12%). Priority issues for Region 2 are ground water quality, surface water quality, seasonal population variations, and alternative growth projections.

Ground water quality is threatened by salt water intrusion, storm-water runoff, malfunctioning septic tanks and leachate from landfills. While ground water is the source for nearly 70 percent of purveyor supplied water, the State has determined that pumpage in the Englishtown and Kirkwood aquifers cannot be safely increased because their water tables are now at levels which could allow salt water intrusion. Leachate from a landfill threatens the Cohansey aquifer upon which Toms River Water Company depends (6 mgd). Prudent ground water management is essential to maintain existing volumes of ground water pumpage. Increased needs may only be met by new alternative projects, such as surface water reservoirs, conjunctive use of surface and ground water, or transfers.*

Surface water quality issues are water craft discharges and new housing developments. The former, however, does not affect purveyor water supply.

*Availability of surpluses is discussed in Subtask 3D, Section 3D-2.3.2

Planning for additional surface water supply must consider the impact of new housing developments and rapid growth on potential water supply watersheds.

Region 2 population more than doubles during the summer, when precipitation and stream flows are below average. Most of the potential surplus of 40 mgd is committed to meet seasonal demands, and cannot therefore be considered a true surplus, available at all times. Alternative projects must be conceived to meet increased needs for this extended peak period.

Growth projections by the Ocean County Planning Board are significantly higher than the New Jersey Department of Labor and Industry projections used in Task 2A, and would account for appreciable increased needs.

Issues in Region 2 indicate that the high projection of 50.0 mgd increased need is more realistic than the low projection. Increased needs could be significantly higher if existing groundwater supplies are lost due to deteriorating quality or if the rate of growth exceeds that projected by the State.

Region 3 - Purveyors supplied an average of 28 mgd with a potential surplus of 48 mgd in 1976. Increased need for 2020 is projected to range from a high of 22.2 mgd (79%) to a low of 0 mgd. Priority issues for Region 3 are groundwater quality, seasonal population variation, Pine Barrens preservation legislation, surface water quality and Atlantic City development.

Groundwater quality issues are similar to those in Region 2. Groundwater is the source for over 85 percent of purveyor supplied water in Region 3. As in Region 2 prudent groundwater management is essential.

Seasonal population variations were characterized by summer population increases of 68 percent in Atlantic County in 1965 and 816 percent in Cape May County in 1973. Therefore, most of the potential surplus is committed to meet seasonal demands, and, as in Region 2, is not a true surplus.

Pending Pine Barrens preservation, legislation would limit future development in this region, although potential impacts have not been quantified. Surface water quality issues are similar to those in Region 2.

Atlantic City development is expected to accelerate as a result of the legalization of casino gambling. The Subtask 2B, 2C report indicates that induced growth from casino gambling for 1990 is projected by others to be about 196,400 new residents, representing a potential increase in water demand of 13.4 mgd. The Subtask 2A report indicates a year 2020 projected increase over 1975 demand of 7 mgd for Atlantic County.

Issues in Region 3 indicate that the high projection of 22.2 mgd increased needs is more realistic than the low projection. Increased needs could be significantly higher if existing groundwater supplies are lost due to deteriorating quality or if development of Atlantic City exceeds projections given in Subtask 2A.

Region 4 - Purveyors supplied an average of 20 mgd, with a potential surplus of 37 mgd in 1976. Increased need for 2020 is projected to range from a high of 8.6 mgd (43%) to a low of 0 mgd. Priority issues for Region 3 involve groundwater quality.

Groundwater quality issues are saltwater intrusion, leachate from landfills, and malfunctioning septic tanks. No immediate threats to purveyors' supplies have been identified. Groundwater management is needed to protect existing supplies and determine allowable pumping to meet increased needs.

Although most of the potential surplus of 37 mgd is reserved to meet peak demands, Vineland has a safe yield exceeding peak demands by 7 mgd. Issues in Region 4 indicate that increased needs for 2020 will be slightly less than the high projection of 8.6 mgd.

Region 5 - Purveyors supplied an average of 106 mgd, with a potential surplus of 114 mgd in 1976. Increased need for 2020 is projected to range from a high of 36.3 mgd (34%) to a low of 0 mgd. Priority issues for Region 5 are groundwater quality and surface water quality.

Groundwater quality issues are leachate from landfills, saltwater intrusion and malfunctioning septic tanks. City of Camden Water Department (CWD) wells are threatened by contamination from landfill leachate, and several have been shut down. CWD plans for modifying withdrawal practices and providing additional treatment are supported by a $3,000,000 grant from the Federal Government. However, because use of groundwater in Region 5 to meet increased needs is questionable, consideration should be given to alternative sources of water supply.

Surface water quality issues are municipal & industrial effluents, oil spills and agricultural runoff. These issues are of particular concern where groundwater supplies are infiltrated from the Delaware River and in development of new surface water supplies.

Although some of the potential surplus of 114 mgd may be applied to meet increased needs, threatened loss of CWD supplies indicates that increased needs for 2020 will be 36.3 mgd or higher.

Region 6 - Purveyors supplied an average of 57 mgd, with a potential surplus of 43 mgd in 1976. Increased need for 2020 is projected to range from 26.9 mgd (47%) to 11.0 mgd (19%). Priority issues for Region 6 involve groundwater quality and quantity.

The City of Trenton Water Department treated an average of 32 mgd in 1976 with a peak of 41 mgd, giving a peak factor of 1.28. Their treatment capability is 65 mgd which would be adequate for about 50 mgd average flow

with this peak factor. Therefore, Trenton currently has an average surplus of 18 mgd. Other purveyors in Region 6 are predominantly small, local groundwater systems, with potential surpluses reserved to meet peak demands.

Groundwater quality issues are malfunctioning septic tanks, leachate from landfills, and sludge disposal. The latter two are high priority issues for Mercer County. The groundwater quantity issue is protection of groundwater from overdrafting. Prudent groundwater management may reduce loss of groundwater supplies to deteriorating quality, but increased needs may have to be met by developing local surface water supplies in the Delaware Basin.

The projections used for Sussex County are substantially less than those of the Sussex County Department of Planning, Conservation and Economic Development, which represent an increased need higher by about 6 mgd for 2000.

Issues in Region 6 indicate that by utilizing surpluses at Trenton, the increased needs for 2020 might be less than the high projection of 26.9 mgd. However, interconnections capable of transferring water from Trenton to northern rural areas are impractical. If local population projections for Sussex County are realized, then the higher projection of 26.9 mgd is the most realistic increased need for Region 6 for evaluating alternatives.

The Warren County Planning Board is favoring a policy of total reliance on ground water, now and in the future. Garden State Water Company, however, projects a need for their Phillipsburg Division to tap surface supplies in the future (probably the Delaware River) to accommodate growth.

Seasonal Demands - It is to be recognized that the demand figures utilized in these analyses are average annual figures. Peaks will be generated, depending upon time of year and area of the State,

with largest demand fluctuation occurring during the summer months along the Atlantic Coast (Regions 2 and 3). As reported in Task 2A, the ratio of seasonal and temporary (July and August) to year round populations for the coastal areas is as follows:

		Peaking Ratio
Atlantic County	-	1.68
Cape May County	-	9.16
Monmouth County	-	2.42
Ocean County	-	2.39

In general, peaking conditions are local concerns requiring, perhaps, additional storage, contractual commitments with adjacent purveyors, stand-by wells, or excess (surplus) supply capacity of surface and groundwater resources. In subsequent Task 3 outputs, seasonal peaks are considered as actual needs to be satisfied, and proposed project development programs recognize this factor. As discussed above for each region, apparent existing surplus supplies must be considered as committed in areas where seasonal demands are significant.

Summary - For each region the high projection is considered the more realistic after evaluating the sensitivity of needs to issues. Potential benefits from transfers of water and use of surpluses do not outweigh potential problems with source quality and alternate growth projections. While needs within each region may vary as discussed above, the high projection is the most likely result and should be used for later analyses. Therefore, total statewide increased need for 2020 will be taken as 346.6 mgd.

3A-4 SUBREGIONS

Hydrologic and hydrogeologic features are the basis for subdividing the State into subregions for use in project evaluations. Figure 1 shows the six water supply planning regions.

Region 1 is subdivided into two hydrologic subregions based on major river basins. The Raritan subregion includes the Raritan, Rahway and Elizabeth basins. The Passaic subregion includes the Passaic, Hackensack, Hudson and Newark basins. Region 6 is wholly within the Delaware basin and does not warrant subdivision. Regions 2, 3, 4 and 5 rely primarily on groundwater supplies and do not contain significant hydrologic features to support subdivisions.

Hydrogeologic subregions have been developed elsewhere and a detailed discussion appears in the Subtask 7C report. Seven zones have been identified based on geologic conditions. Zone 1, covering the north and northwest part of the State, is characterized by Precambrian deposits. Zones 2 and 3 in north-central New Jersey and the Triassic Lowlands, Zones 4, 5, 6 and 7 in central and southern New Jersey are in the Atlantic Coastal Plain.

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STATEWIDE WATER SUPPLY MASTER PLAN

SUBTASK 3B

ADDITIONAL ALTERNATIVES

SUBTASK 3B - ADDITIONAL ALTERNATIVES

Additional alternatives have been identified from purveyor questionnaires, interviews and results of additional meetings with the major purveyors to discuss needs and projects (1977-1978). Task 4 (Interconnections), Task 6 (Conservation and Reuse), and Task 7 (Groundwater Management), also identify additional alternatives. Evaluation of alternatives in Subtasks 3D and 3E will consider new and modified projects as they become apparent in the evaluation process. Table 3B-1 lists those projects which have been cited by representatives of the major purveyor systems in New Jersey as preferred alternatives for additional supply. Projects listed are those mentioned in the questionnaires or interview (Spring 1977), or put forward at meetings to discuss needs. Some purveyors expressed no preferences, either because of adequate supply or the need only to implement local improvements to their own facilities. The additional projects identified by purveyors which do not appear in the list of 125 Projects are:

- Recharge to augment groundwater supply
- Delaware River diversion to Dunkers Pond (variation of project #46)
- Delaware River Intake (Camden)
- Interstate transfer from Pennsylvania (Camden)
- Interconnecting D&R Canal with Raritan River and/or Round Valley
- Hudson River diversion at Stony Point
- Round Valley Outlet Pipeline to S. Branch Rockaway Creek
- Lake Hopatcong emergency supply or use of maintenance drawdown

Project descriptions for these additional projects are included in Exhibit C. Several purveyors identified local ground and surface water projects or arrangements for wholesale purchase in order to meet increased needs. Although too numerous to list here, local projects and wholesale purchases are considered in general as alternatives to available projects.

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TABLE 3B-1

PROJECTS IDENTIFIED BY MAJOR PURVEYORS

REGION 1:

Black Brook Valley Groundwater Development
Confluence Pump Station and Force Main
Delaware River Diversion to Dunkers Pond
Delaware River Diversion to Upper Passaic River
Delaware and Raritan Canal Improvements
Delaware and Raritan Canal/Raritan River Interconnection
Hudson River Diversion at Stony Brook
Hudson River Diversion to Ramapo River
Lake Hopatcong - Use of Maintenance Drawdown
Longwood Valley Reservoir
Monksville Reservoir
Raritan River Diversion to Upper Passaic River
Round Valley Outlet to South Branch Rockaway Creek
Round Valley to Passaic River
Six Mile Run Reservoir
Two Bridges - Ramapo Diversion
Wanaque - Oradell Pipeline

REGION 2:

Manasquan Reservoirs (Upper and Lower)
Raritan Aquifer Development

REGION 3:

Great Egg Basin Surface Water Development
Groundwater Recharge

REGION 4:

Local Supply Development

TABLE 3B-1 (Continued)

REGION 5:

Delaware River Diversion
Groundwater Recharge
Supply Transfer from Pennsylvania

REGION 6:

Delaware River Diversion
Groundwater Development

Additional projects involving major interconnections may be identified by the Task 4 report recommendations for interconnection testing and analysis of interconnection capabilities. Additional projects to meet emergency water supply needs identified in Task 5 may be considered in alternative evaluations. Projects identified by Tasks 4 and 5 may be among the most critical to meet short term needs.

Other additional projects involve direct or indirect reuse of treated wastewaters, well injection to control saltwater intrusion and spray irrigation to recharge groundwater. Task 6 identifies and evaluates more than 20 projects for direct and indirect reuse of treated wastewater, which will be considered under Task 3D.

Task 7 identifies the location and severity of saltwater intrusion and areas of groundwater supply threatened by contamination or excessive pumping, and evaluates additional groundwater projects. Eleven potential additional projects are discussed below.

Development of existing water resources not presently used for supply purposes also presents viable alternatives for meeting future needs. Lakes such as Lake Hopatcong, Greenwood Lake and many other large and small facilities offer potential for augmenting present supplies, though generally on a local basis. In addition, site specific considerations such as use of abandoned quarries, clay pits, iron mines, etc., for reservoir development or aquifer recharge are to be factored into subsequent detailed analyses of project development.

Additional Water-Supply Projects

Ground Water

1) Investigate and Study Salty Ground Water Bodies in Deep Aquifers

This would be a continuous project the purpose of which would be to more precisely define the extent, both vertical and horizontal, of the salt-water interface in the five major hydrogeologic units of the Coastal Plain (Magothy-Raritan Formations and Potomac Group, Englishtown Formation, Mt. Laurel and Wenonah Formation, Kirkwood Formation, and Cohansey Sand) both on and off shore. This would require the drilling of many deep test holes for installation of monitoring wells to detect any long-term changes in chloride content. It is anticipated that it would take several years to install the wells and the monitoring wells would have to be maintained regularly so that annual expenditures would be required.

2) Investigate and Study the Ground Water Availability of the Deeper Fresh Water Aquifers

Although the ground water availability of the major hydrogeologic units in the Coastal Plain is fairly well known in their outcrop areas, this data is lacking in the eastern and southern part of the state where some of these units occur at significant depths below land surface. In order to further define the ground water availability in the Magothy-Raritan Formations and Potomac Group, the Englishtown Formation, the Mt. Laurel Sand and Wenonah Formation, and the Kirkwood Formation, test holes to bedrock would have to be drilled in southern Ocean and southern Burlington Counties, Atlantic,

Cumberland, and northern Cape May Counties to determine the lithology and extent of these units. Controlled pumping tests would be needed to determine aquifer coefficients and the interrelationship of the various units. This project may in part tie in with and overlap project one above.

3) Investigate the Feasibility of Installing Storm Water Recharge Basins

In certain areas of the state, urbanization has resulted in paving over permeable aquifer outcrop areas resulting in reduced recharge to these units and contributing to declines in the water table and in piezometric heads. Specifically, in Camden County in the Magothy-Raritan-Potomac outcrop area and in the glacial deposits of the Chatham Valley in Morris and Essex Counties, recharge has been reduced to the ground water reservoir and water levels have declined significantly. A project to determine the feasibility of installing storm water recharge basins in these areas to preserve and/or increase the quantity of the resource should be undertaken. Special emphasis should be placed on the quality of the recharged water and its effect on ground water.

A number of existing technical reports indicate that storm water, due to its often high pollutant loads, is generally unsuitable for aquifer recharge. For storm water recharge basins to function as so intended rather than as retention/detention basins seeping water into nearby streams through water table aquifers, effective storm water management programs, currently being developed, would need to be in place, and would need to ensure that the quality of the storm water would be at or near that of a raw water supply source (i.e. before treatment).

4) Mapping of Principal Unconsolidated Deposits in the Northwestern part of the State

The water supply potential in the northwest part of the state (all of Sussex and Warren Counties and parts of Passaic, Morris, Hunterdon, Somerset, and Bergen Counties) is somewhat limited due to the low permeability of the underlying bedrock. However, sand and gravel deposits, where of sufficient thickness, yield large quantities of water and are the most significant units in terms of future ground water supplies. The occurrence of these deposits should be mapped in detail throughout this part of the state, and ground-water availability should be determined through seismic work and test drilling and pumping.

5) Investigate Availability of Ground Water on Barrier Beaches

Water supplies on the beaches are somewhat unique in that they are obtained in areas completely surrounded by salt water. Ground water is the only potable water source. Pumping tests on existing wells along with drilling and testing of exploratory wells should be undertaken to determine as precisely as possible the ground water availability in this area. This project should be coordinated with project number one because the position of the salt water interface will in large part determine ground water availability on the barrier beaches.

6) Establish Water Quality Monitoring Programs

In order to insure development of ground water supplies for the future, water quality must be maintained, and monitoring programs must be established. Water samples collected from existing public supply wells and new wells

installed in key areas should be analyzed on a regular basis to provide a long term record of water quality trends in the five major hydrogeologic units of the Coastal Plain and throughout the Triassic Lowlands and the Highlands. It is anticipated that in addition to funding for the installation of the new wells, annual allocations will be required to perform standard and organic chemical analyses and interpret the results.

This project would allow the success of water quality management efforts to be monitored, and would also facilitate the earlier identification of and response to future water quality problems. At a minimum, monitoring programs established by and in cooperation with 208 programs should be continued, especially for public health parameters.

7) Establish Monitoring Programs to Determine the Effects of Septic Tank Density, Application of Lawn Fertilizer, and Agricultural Practices on Ground Water*

Areas in the state should be chosen representing a wide range in septic tank density in order to determine the impact of this waste disposal practice on ground water quality. Such a study, conducted in cooperation with the 208 water quality planning program, would be important for water quality planning purposes, particularly in siting systems or recommending specific agricultural practices in aquifer recharge areas. Land use patterns in the areas selected must have been stable for a long enough period to have allowed any influences on ground water to have occurred. Shallow wells should be installed a short distance below the water table so that water samples can be collected and analyzed to determine the effect on ground water quality from various septic

*Efforts should be coordinated with the Soil Conservation Service of the U.S. Department of Agriculture.

tank densities. The results of such a study will help the state determine the appropriate type of domestic waste disposal method needed to preserve the quality of the ground water resource. Several areas in different hydrogeologic environments would have to be studied. A similar investigation should be undertaken in an agricultural area to determine effects on ground water quality from the application of fertilizers and pesticides.

8) Investigate Feasibility of Using Artificial Recharge in Areas Underlain by Salt Water

This proposed project would consist of investigating the use of excess fresh surface water from streams in the Coastal Plain during high flow periods for injection of this water through wells into aquifers that contain salty or brackish water. Later, when needed, this fresh water could be pumped out and used locally. This technique is already being attempted on a small scale in Cape May County but could be expanded to other southern counties at selected locations along the coast which experience seasonal water shortages.

9) Investigate Feasibility of Using Artificial Recharge to Retard Salt-Water Intrusion

This proposed project would consist of investigating the use of excess fresh surface water from streams in the Coastal Plain during high flow periods and injection of this water through wells into aquifers threatened by salt-water intrusion. This project should be aimed primarily at the northern Middlesex County area and the northern Monmouth County area.

10) Definition of Key Aquifers Recharge Areas

In the Coastal Plain area, it was commonly believed that the aquifers were recharged from precipitation on their outcrop areas. Recent studies, especially modeling by the U.S. Geological Survey have shown that for some aquifers this form of recharge may constitute only a small part of the total recharge to the aquifer and that leakage from confining beds may be a more important source. Therefore, a project should be undertaken to determine more precisely the recharge areas for the five major hydrogeologic units in the Coastal Plain and for the major stratified drift deposits and important water bearing rock formations in the Triassic Lowlands and the Highlands area. Some of this work has already been accomplished by the COE and USGS for the Coastal Plain and has been recently initiated by the DRBC for the Delaware Basin portion of the Triassic Lowlands. This would involve water-level measurements in many existing wells. Additional monitoring wells would be installed in areas where water-level data are lacking. Controlled pumping tests would be required at many locations to define the influence of confining layers and the hydraulic interconnection between principal aquifers.

NEW JERSEY

STATEWIDE WATER SUPPLY MASTER PLAN

SUBTASK 3C

PROJECT DATA FILE

SUBTASK 3C - PROJECT DATA FILE

Existing data on each of the 125 available projects and additional projects identified under subtasks 3A and 3B was collected and organized. Data covers engineering, environmental, socio-economic and implementation considerations. During the inventory of 125 available projects it became apparent that many projects were unrealistic and unworthy of further evaluation. A project screening step considering environmental, technical and implementation constraints was employed to determine that 60 available projects are realistic and worthy of further evaluation.

3C-1 PROJECT DESCRIPTIONS - Existing data for each project is reported using the Alternative Project Description form. A blank form is included here as Figure 3C-1. Completed forms for all projects are appended. Reliable cost data are available for less than one-half of the projects. References useful in providing descriptive data on each project are identified by abbreviated title, author, and Master Plan Library Index Number. Project locations are referenced to the State's L.O.R.D.S. maps, for which a key is reproduced here as Figure 3C-2.

The availability and reliability of data are assessed as either "Fair" or "Good." "Fair" applies to those projects for which some data are available but are sparse, incomplete, out-of-date and/or unreliable. In particular, cost estimates for both construction and operation of the project either have not been prepared or are unreliable. "Good" applies to projects for which: 1) reasonable data are available to adequately evaluate the project; 2) minimal up-dating and/or verification of data is necessary; and 3) cost data are relatively current and reliable.

The purpose, storage capacity and safe yield of the project are presented. Yields are as reported in reference sources, recorded for either the 1931-1932 drought or the 1960-1965 drought.* Limitations on yield are

*Subsequent Task 3 analyses utilize results of HEC-5 computer modeling of alternative projects from which "reliable yields" are determined.

identified, where known, such as mimimum stream flow requirements, competing water supply projects, or competing uses for the water to be regulated.

A narrative description presents the project concept, beneficiaries, type and size of project elements, reservoir elevation and area inundated, and variations in concept, operation or size. Related or conflicting projects are identified. A figure is provided where it is readily available from a reference. Costs and reliability or limitations of cost information are reported.

Where references have identified technical, financial, environmental or institutional problems associated with the project, these are listed. The current status of the project is reported as proposed, potential or discarded. Proposed projects are fully conceived projects which have been formally proposed by the State or others in recent years and are now under consideration. Discarded projects are those that have been rejected by the State and are not to be considered in the future. Potential projects, which comprise the balance of projects identified, are projects in varying stages of conception which have not been conclusively proposed or discarded. The form also provides space for reporting screening results.

3C-2 PROJECT SCREENING - To eliminate projects which obviously fail to meet needs of the State, projects are screened by applying the three constraints listed below to determine if the project is realistic and worthy of further evaluation. Projects failing to meet each of these constraints are unrealistic and will not be considered further.

1. Environmental/Social

No major, irreversible adverse impacts, such as:

- o extensive relocations from developed sites
- o loss of unique or irreplaceable natural resources
- o disruption of ecosystem

2. Technical

Water supply project with potential for meeting projected water supply needs.

3. Implementation

No insurmountable obstacles to implementation, such as:

o prohibition by statute

o redundancy to an approved project

o extensive relocation required, e.g. transport or utility network.

Upper limits for project capital construction cost and cost-benefit in the forms of cost per million gallons supplied were considered as criteria for screening. However, the lack of reliable cost data, difficulties with setting upper limits, and the few projects affected warranted that no cost criteria be applied at this project screening stage.

For some projects, sufficient data are not available to support screening considering these three constraints. A project is considered realistic until information becomes available, or is developed, to reject that determination.

The effect of each of the above constraints varies with the issues and needs of the Region(s) in which a project is located. The screening process is conducted on a regional basis, with consideration given to inter-regional influences.

REGION 1 - Surface water sources offer primary potential for water supply in this region. Characterized by dense population, industrialization and rapidly expanding suburban areas, Region 1 has a high environmental sensitivity. Major screening issues include disruption of community cohesiveness (development) and effects on the existing ecosystem (flood plains, wetlands and open space). Because Region 1 is currently served by a complex water supply network, implementation, supply capacity and redundancy are also

major screening issues.

REGION 2 - This Region comprises the northern portion of the Atlantic coastal area of the State and contains significant amounts of open, public and recreational areas. Existing and potential conservation areas and proximity to the ocean make Region 2 particularly sensitive to environmental issues and institutional constraints. Central and southern Region 2 depend on ground water supplies. Protection of aquifiers is a major issue of concern in these areas. Water supply needs in Region 2 are highly variable in terms of both seasonal demand and location.

REGION 3 - This region comprises the southern portion of the Atlantic coastal area of the State and is characterized predominantly by open space and recreational areas. The primary potential for water supply in the region is ground water and utilization and protection of area aquifers are major issues. Although surface water supplies offer some potential for local agricultural and industrial use, alternative surface water projects are considered redundant to potential ground water supplies.

REGION 4 - Located along the lower Delaware River and Delaware Bay, Region 4 is a sparsely settled rural section of the State, influenced by the agricultural and chemical industries. Virtually all water supply is from ground water. The great potential for additional ground water supply within the region makes surface water alternative projects redundant except for minor, local uses.

REGION 5 - The eastern and southern portions of Region 5 are largely open space and conservation areas, while most of the population and industrial activity is concentrated along the Delaware River. Ground water is the primary source of water and screening issues involve protection and utilization of area aquifers. Institutional constraints are also of major importance.

SAMPLE FIGURE 3C-1

ALTERNATIVE PROJECT DESCRIPTION

No._____ Name _____ L.O.R.D.S. No._____

Region(s)_____ Basin(s)_____ County(ies)_____

Author_____ Title_____ Library No._____

Data Availability/Reliability_____

Purpose(s)_____ Storage(BG)_____ Yield (mgd) 30's drought 60's drought Other

Limitations on yield_____

Narrative description Figure: No ☐ Yes ☐

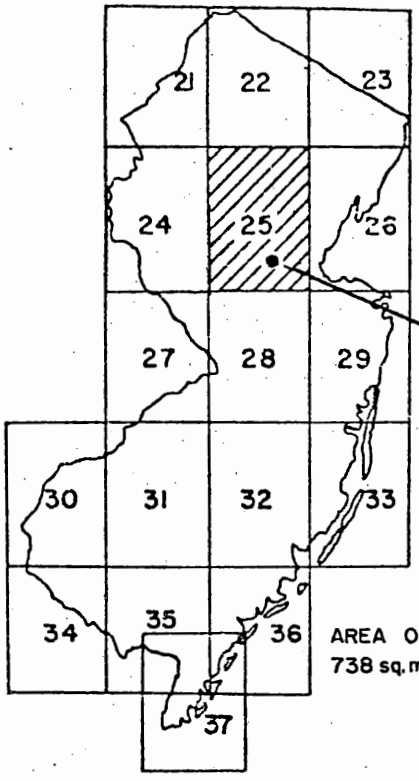
Cost ($ million) Capital_____ O & M _____ $/MG _____ Year _____ ENR _____ Source_____ Note_____

Identified_____

Problems _____

Project Status: Proposed ☐ Potential ☐ Discarded ☐ Realistic ☐ Unrealistic ☐

Prepared_____ Revised 1_____ Revised 2_____



AREA OF MAP # 25
738 sq. mi.

ATLAS SHEET 25

1	2	3	4	5
11	12	13	14	15
21	22	23	24	25
31	32	33	34	35
41	42	43	44	45

25–33

BLOCKS ON ANY SHEET
AREA OF BLOCK DESCRIPTION
25-33, 34 sq. mi.
6' LATITUDE
6' LONGITUDE

BLOCK 33

1	2	3
4	5	6
7	8	9

25–33–8

RECTANGLES IN ANY BLOCK
2' LATITUDE
2' LONGITUDE
ABOUT 3.8 sq. mi.

RECTANGLE 8

1	2	3
4	5	6
7	8	9

25–33–8–2

SQUARES IN ANY RECTANGLE
A LITTLE LESS THAN 1/2 sq. mi.

SQUARE 2

1	2	3
4	5	6
7	8	9

25-33–8–2–4

UNITS IN ANY SQUARE
30 ACRES

EACH UNIT COVERS AN AREA APPROXIMATELY 1/4 BY 3/16 MILES.

Diagram showing use of New Jersey Rectangular Coordinate System to Locate a Facility at 25-33-8 2 4

FIGURE 3C-2

KEY TO L.O.R.D.S. MAPS

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

REGION 6 - This region, located within the Delaware River Basin above Trenton, is generally rural in character, with concentrations of population and economic activity at Trenton, Phillipsburg and Hackettstown. About 13 percent of the land in Sussex and Warren Counties is owned by the State or Federal governments. Both surface and ground water are significant sources of potable water. Potential interregional water supply schemes using the Delaware River will affect Region 6. Development effects on flood plains, protection of the existing ecosystem and project redundancy are the major screening constraints for this region. Preservation of agriculture, recreation and open space are also important concerns.

3C-3 PROJECT SCREENING RESULTS - Each of the 125 alternative projects in the project inventory was analyzed for environmental, technical and institutional constraints as they apply to the Region(s) in which the project is located. Based on this analysis, two meetings and follow-up discussions with knowledgeable purveyors within the State, and meetings with State representatives and other interested parties, determinations have been made whether projects are realistic and worthy of further consideration for water supply planning in New Jersey.

Projects which fail to meet one or more major planning constraints are unrealistic and are eliminated from further evaluation. Realistic projects are: those which satisfy all major screening constraints; those for which insufficient data are available to cause their elimination from the evaluation process; or those, which on an individual basis may not merit further consideration, but which may offer significant potential for integration with other realistic projects.

The results of project screening are presented below.

REGION 1 - Forty percent of the alternative projects in or affecting Region 1 are deemed unrealistic, primarily because of redundancy or community development. Sixty percent (forty-four projects) remain for further evaluation. Realistic projects include local, regional, inter-regional and interstate projects. New sources for raw water include the Raritan, Passaic, Delaware and Hudson Rivers, with transmission by pipeline, aqueduct, in-stream, or through existing facilities.

REGION 2 - Six of the nine projects in or affecting Region 2 are considered realistic. Additional groundwater supply is available from realistic well field alternatives in southeast Burlington County. Surface water projects in the Manasquan and Toms River Basins have potential for significant additional supply.

REGION 3 - Burlington County well field alternatives are realistic projects for supply in Region 3. Four of six alternative projects in or affecting Region 3 are considered realistic, including one surface water project in the South River Basin.*

REGION 4 - All but one of the water supply projects listed in the project inventory for Region 4 are considered unrealistic. Surface water projects suggested for this region are unrealistic due to the greater potential for local groundwater development. Also, major projects are not justified in view of small needs.

REGION 5 - Local surface water reservoir projects suggested for Region 5 are considered unrealistic for the current planning period, eliminating fourteen of the eighteen water supply alternatives in the project inventory.

*Sub-Basin of the Great Egg Harbor River Basin

Groundwater projects, particularly those in the southeast portion of the region, are considered realistic. Projects including diversions from the Delaware River are considered realistic.

REGION 6 - Twenty-two of the thirty-eight alternative projects in or affecting Region 6 are considered realistic. Projects were eliminated for reasons of redundancy, development, or low water supply yields. Realistic projects include those for local supply and those conceived as part of larger regional or interregional projects. Other realistic projects involve Delaware River diversions, the Delaware and Raritan Canal and Wallkill River diversions.

Summary listings of realistic and unrealistic projects appear as Table 3C-1 and 3C-2. In Table 3C-2, reasons for a project being unrealistic are identified as "E" (not meeting environmental/social constraints), "T" (not meeting technical constraints), and/or "I" (not meeting institutional constraints). Specific comments concerning these determinations may also be found in the alternative project description forms appended. Table 3C-3 presents realistic projects by drainage basin.

TABLE 3C-1

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

REALISTIC WATER SUPPLY ALTERNATIVES

PROJECT NUMBER	PROJECT NAME
1	Raritan-Passaic Pipeline (North Route, Main Stem Development)
2	Raritan-Passaic Pipeline (South Route, Main Stem Development)
3	Confluence Reservoir, Pump Station and Force Main
4	Delaware River Diversion to Raritan River
5	Delaware River Flood Skimming to Raritan River
6	Delaware River Flood Skimming to Raritan(Round Valley Expansion)
7	Delaware and Raritan Canal Improvements
8	Six Mile Run Reservoir
10	Delaware-Raritan Canal Optimization
13	Upper Raritan Pipeline
14	Round Valley Reservoir Expansion
16	Hacklebarney Reservoir
17	Ravine Lake Reservoir
25	Bartley Reservoir
27	Two Bridges Reservoir (W/Myers Road; Passaic River FC Plan III)
28	Delaware River Diversion, Frenchtown - Two Bridges
29	Delaware River Diversion to Canoe Brook - Great Notch
30	Delaware River Diversion, Port Jervis- Pequannock
31	Delaware River Diversion, Tocks Island - Wanaque
32	Hudson River - Ramapo River Diversion (N.Y. Storage)
33	Hudson River - Ramapo River Diversion (Ramapo Storage)
34	Hudson River - Little Falls Continuous Skimming
35	Hudson River - Little Falls Diversion (N.Y. Storage)
36	Hudson River - Great Notch (N.J. Storage)
37	Delaware River Control - Transfer from Kensico
39	Wanaque - Oradell Pipeline
40	Two Bridges - Ramapo Diversion Project
41	Monksville Reservoir with Ramapo Pump Station
42	Great Notch Interconnection
43	Washington Valley Reservoir
44	Longwood Valley Reservoir
46	Dunkers Pond Reservoir with Wallkill River Diversion
48	Hardscrabble Reservoir
54	Greenwood Lake
55	Tocks Island Lake Project
56	Hackettstown Reservoir
57	Flat Brook Reservoir
58	Flatbrook -Raritan Continuous Diversion
60	Ross Corner Reservoir
65	Shades of Death Reservoir
66	Petersburg Reservoir
67	Honey Run Reservoir
72	Franklin Reservoir
73	Beaver Run Reservoir
74	Sussex North Reservoir
75	(See Project 46)
76	Upper and Lower Manasquan Reservoirs

TABLE 3C-1 (CONTINUED)

PROJECT NUMBER	PROJECT NAME
77	Hackensack River Optimization
78	New York City Diversion from Manhattan
79	New York City Diversion from Staten Island
80	South River (Middlesex Co.) Ground Water Pumped Storage Diversion
81	Weldon Brook Reservoir
86	Toms River Reservoir
103	South River (Atlantic Co.) Reservoir Project
113	Raritan-Raritan Pipeline
116	Frenchtown Pumped Storage Reservoir
131	Well Field in Wharton Tract (Southwest NJ Supply)
132	Well Field in Wharton Tract (Southeast NJ Supply)
135	Burlington County East Zone Well Fields
136	Alamatong Well Field and Recharge Basin

TABLE 3C-2

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

UNREALISTIC WATER SUPPLY ALTERNATIVES

PROJECT NUMBER	PROJECT NAME	CRITERIA FAILED
9	Delaware-Raritan Pipeline and Canal	E-I
11	Crab Island Dam and Reservoir	E-I
12	South River Tidal Dam/Recharge Pond (Middlesex Co.)	E-I-T
15	Flatbrook -Raritan High Flow Skimming	E-I-T
18	Bunnvale Reservoir	E
19	McCrea Mills Reservoir	E-I
20	Oldwick Reservoir	E
21	Big North Branch Reservoir	E-I
22	Chimney Rock Reservoir (East Branch)	E-I
23	Rocky Hill Reservoir (Bedens Brook)	E-I
24	Stony Brook Reservoir	T-I
26	Schooleys Mountain Reservoir	E-I
38	Oradell Pipeline	E-I
45	Whippany Reservoir (Troy Meadows)	T
47	Tourne Reservoir	T-I
49	Darlington Reservoir (Ramapo)	E-I
50	Harrisons Brook Reservoir	T-I
51	Corys Brook(Myers Road)Reservoir	E
52	Como Reservoir	E-I
53	Long Hill Reservoir (Great Swamp)	E-I
59	Sussex Mills Reservoir	I
61	Newton-West Reservoir	E-I-T
62	Kerrs Corner Reservoir	E-I-T
63	Paulina Reservoir	T-I
64	Huntsville Reservoir	T-I
68	Oxford Watershed	T
69	Wallpack Bend Reservoir	E-I
70	Pequest Reservoir	E-I-T
71	Greenwich Watershed	T
82	Pulaski Reservoir	T
83	Woodbourne Reservoir	T-I
84	Papakating Reservoir	T-I
85	Bennets Mills Reservoir	T-I
87	Crosswicks Reservoir	T-1
88	Deacons Reservoir	T-I
89	Rancocas Reservoir	T-I
90	Chews Reservoir	T-I
91	Pines Run Reservoir	T-I
92	Mantua Reservoir	T-I
93	Chestnut Branch Reservoir	T-I
94	Swedesboro Reservoir	T-I
95	Mullica Hill Reservoir	T-I
96	Major Run Reservoir	T-I
97	Alphano Reservoir	E-I-T
98	Nichomus Run Reservoir	T-I

TABLE 3C-2 (CONTINUED)

PROJECT NUMBER	PROJECT NAME	CRITERIA FAILED
99	Alloway Creek Reservoir	T-I
100	Stow Creek Reservoir	T-I
101	Cohansey Reservoir (Shiloh)	T-I
102	Carmel Reservoir	T-I
104	Penny Pot Reservoir	T-I
105	Merrill Creek Reservoir	T
106	Cool Run Reservoir	T-I
107	Indian Branch Reservoir	T-I
108	New Hampton Reservoir	E-I-T
109	North Branch Timber Creek Reservoir	T-I
110	Otter Brook Reservoir	T-I
111	Monangahela Reservoir	T-I
112	Dock Watch Hollow Reservoir	E-I
114	Rainey Road Reservoir	T-I
115	Vestry Road Reservoir	T-I
117	Glen Alpin Reservoir	T-I
118	Van Doran Mills Reservoir	T-I
119	Silver Lake Reservoir	T-I
133	South Jersey Ground Water	I
134	Sanford Plan	T-I

TABLE 3C-3
REALISTIC PROJECTS BY DRAINAGE BASIN

Primary River Basin	Project Number	Project Name	Sub-Basin or Tributary	Other Basins Involved in Project
Delaware	55	Tocks Island Lake Project	-	-
	56	Hackettstown Reservoir	Musconetcong	-
	57	Flat Brook Reservoir	Flat Brook	-
	58	Flat Brook - Raritan Continuous Diversion	Flat Brook	Raritan
	60	Ross Corner Reservoir	Paulins Kill	-
	65	Shades of Death Reservoir	Pequest	-
	66	Petersburg Reservoir	Pequest	-
	67	Honey Run Reservoir	Pequest	-
	81	Weldon Brook Reservoir	Musconetcong	-
	116	Frenchtown Pumped Storage Reservoir	-	-
	137	Delaware River Diversion to Dunker Pond Reservoir	Yards Creek	Wallkill
	138	Source-Source Interconnection Delaware and Raritan Canal	-	Raritan
	140	Delaware River Intake at Camden	-	-
Great Egg Harbor	103	South River (Atlantic County) Reservoir Project	South River	-
Hackensack	77	Hackensack River Optimization	-	-
Manasquan	76	Upper and Lower Manasquan Reservoirs	-	-
Mullica	131	Well Field in Wharton Tract (Southwest NJ Supply)	Batsto	-
	132	Well Field in Wharton Tract (Southeast NJ Supply)	Wading	-
	135	Burlington County East Zone Well Fields	Batsto, Wading	-
Passaic	27	Two Bridges Reservoir (W/Myers Road; Passaic River FC Plan III)	Pompton, Ramapo	-
	28	Delaware River Diversion, Frenchtown - Two Bridges	-	Raritan, Delaware
	29	Delaware River Diversion to Canoe Brook - Great Notch	Dead River	Raritan, Delaware
	30	Delaware River Diversion, Port Jervis - Pequannock	Pequannock	Wallkill, Delaware

TABLE 3C-3 (Continued)

Primary River Basin	Project Number	Project Name	Sub-Basin or Tributary	Other Basins Involved in Project
Passaic	31	Delaware River Diversion, Tocks Island - Wanaque	Wanaque	Delaware
	32	Hudson River - Ramapo River Diversion (N.Y. Storage)	Ramapo	Hudson
	33	Hudson River - Ramapo River Diversion - (Ramapo Storage)	Ramapo	Hudson
	34	Hudson River - Little Falls Continuous Skimming	-	Hudson
	35	Hudson River - Little Falls Diversion (N.Y. Storage)	-	Hudson
	36	Hudson River - Great Notch (N.J. Storage)	-	Hudson
	37	Delaware River Control - Transfer from Kensico	-	Hudson, Delaware
	39/40	Two Bridges - Ramapo Diversion Project/ Wanaque-Oradell Pipeline	Pompton, Ramapo	Hackensack
	41	Monksville Reservoir with Ramapo Pump Station	Wanaque, Ramapo	-
	42	Great Notch Interconnection	(Great Notch)	-
	43	Washington Valley Reservoir	Whippany	
	44	Longwood Valley Reservoir	Rockaway	
	46	Dunkers Pond Reservoir with Wallkill River Diversion	Pequannock	Wallkill
	48	Hardscrabble Reservoir	-	Raritan, Delaware
	54	Greenwood Lake	Wanaque	-
Raritan	1	Raritan-Passaic-Hackensack Pipeline (North Route, Main Stem Development)	-	Passaic
	2	Raritan-Passaic-Hackensack Pipeline (South Route, Main Stem Development)	-	Passaic
	3	Confluence Reservoir, Pump Station and Force Main	(Confluence)	-
	4	Delaware River Diversion to Raritan River	-	Delaware
	5	Delaware River Flood Skimming to Raritan River	-	Delaware
	6	Delaware River Flood Skimming to Raritan (Round Valley Expansion)	-	Delaware

TABLE 3C-3 (Continued)

Primary River Basin	Project Number	Project Name	Sub-Basin or Tributary	Other Basins Involved in Project
Raritan	7	Delaware and Raritan Canal Improvements	(D&R Canal)	Delaware
	8	Six Mile Run Reservoir	(D&R Canal)	Delaware
	10	Delaware-Raritan Canal Optimization	(D&R Canal)	Delaware
	13	Upper Raritan Pipeline	Lamington	-
	14	Round Valley Reservoir Expansion	Rockaway	-
	16	Hackelbarney Reservoir	Lamington	-
	17	Ravine Lake Reservoir	(North Br)	-
	25	Bartley Reservoir	(South Br)	-
	80	South River (Middlesex County) Ground Water Pumped Storage Diversion	South River	-
	113	Raritan-Raritan Pipeline	-	Passaic, Delaware
	136	Alamatong Well Field and Recharge Basin	Lamington	-
Toms River	86	Toms River Reservoir	Ridgeway	-
Wallkill	72	Franklin Reservoir	-	-
	73	Beaver Run Reservoir	-	-
	74	Sussex North Reservoir	-	-
	75	(See Project 46)	Pequannock	Passaic
(New York City)	(78)	New York City Diversion From Manhattan	Emergency Interconnection	
	(79)	New York City Diversion From Staten Island	Emergency Interconnection	
(Pennsylvania)	(139)	Interstate Transfer - PA to Camden	Interconnection	

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EXHIBIT B
PROJECT LIST AND LOCATION MAP

KEY TO TABLES 3A-2 and 3A-3

Column	Heading	Explanation
1	Project Number	Consecutive numbering scheme. Projects are located on Figure 3A-1 and are identified by the Project Number.
2	Project Name	Name as listed in Table 3A-1, as appropriate; alternative name in parenthesis.
3	Basin	Major basin generally listed first, with subbasin if appropriate. (Ex. Passaic, Rockaway)
4	Purpose	Identified purpose of project, as conceived, in decreasing order of priority. Abbreviations as follows: WS = Water Supply PS = Pumped Storage IC = Interconnection FA = Flow Augmentation HB = Hurricane Barrier HY = Hydroelectric R = Recreation FC = Flood Control GWR = Protection or Groundwater recharge
5	Yield (MGD)	Safe yield in million gallons per day as reported by reference; basis for value is variable.
6	Storage (BG)	Total storage in billion gallons.
7	Project Description	Brief statement of project type, facilities, purpose, related projects and other data.
8	Author/Sponsor	Original author or sponsor of project as conceived, or party responsible for most thorough project description or evaluation. Abbreviations as follows: NJ = State of New Jersey COE = Corps of Engineers NWK = Newark Water Department HWC = Hackensack Water Company CWC = Commonwealth Water Company JC = Jersey City Water Department EWC = Elizabethtown Water Company EDF = Environmental Defense Fund PVWC = Passaic Valley Water Commission NJDWSC = North Jersey District Water Supply Commission MCMUA = Morris County Municipal Utilities Authority
9	Reference	NJSWSMP Library Reference by index number. List of references included in 3A output. (Addendum I)

TABLE 3A-2
NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN
AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
1	Raritan-Passaic Pipeline - North Route	Raritan & Passaic	WS	70	-	NEWS R-1 Intake at Bound Brook, Treatment at Chimney Rock, reservoir, and 28 mile transmission to Newark	NJDWSC	202, 1207.03 1206.01
2	Raritan Passaic Pipeline - South Route	Raritan & Passaic	WS	70	-	NEWS R-1 Expand treatment at Bound Brook, transmission to meadowlands in Hudson County	EWC	202, 1201.01 1206.01
3	Confluence Reservoir	Raritan	WS,	50	1	NEWS R-2 Flood skimming and pumping to Round Valley. Option 1 treat at confluence, transmit to Bound Brook. Option 2 - release and treat at Bound Brook(EWC)	 COE NJ	202, 1206.01 757 202, 1206.01
4	Delaware River Diversion to Raritan River	Raritan & Delaware	WS	300	-	NEWS R-3 Tocks Island Reservoir, intake at Frenchtown, transmission to Hamden (Round Valley), flow in Raritan to Bound Brook for treatment and transmission to Newark of 70 mgd.	COE NWK	202, 1206.01

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
5	Delaware River Flood Skimming to Raritan A	Raritan & Delaware	WS	100	-	NEWS R-4 Divert during 6 months high flow, store at Round Valley otherwise same as R-3		1206.01, 202
6	Delaware River Flood Skimming to Raritan B	Raritan & Delaware	WS	150	30	NEWS R-5 Same as R-4 but Round Valley expanded from 55 BG to 75 BG storage		202
7	Delaware and Raritan Canal Improvements	Raritan & Delaware	WS	+25	-	NEWS R-6a Improvements to increase flow capacity from 75 mgd to 100 mgd (usable)	SNJ	202, 1006
8	Six Mile Run Reservoir	Raritan & Delaware	WS	38	6	NEWS R-6b Offstream reservoir to regulate Delaware water in D & R canal and meet peak demands	SNJ	202
9	Delaware-Raritan Pipeline and Canal	Raritan & Delaware	WS	400	-	NEWS R-6c Tocks Island Reservoir; intake at Trenton; pipe 16 miles to canal at Kingston; canal improvements.	COE NJ	202
10	Optimize Use D & R Canal	Raritan	WS	30-50		Options to encourage base load use	NJ	1015

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
11	Crab Island Dam	Raritan	WS	90	-	NEWS R-7 Tidal weir 5 miles above mouth, with facilities to release flood flows Poor quality for WS	COE	202
12	South River Tidal Dam	Raritan, South River	GW	15-25	0.6-0.8	NEWS R-8 Temporary GW protection measure pending R-7, N.J. Leg. authorized acquisition of land	SNJ	202,1007
13	Upper Raritan Pipeline	Raritan	WS	-	-	Option 1 - Transfers Round Valley water to Upper North Branch, Upper South Branch Raritan Rivers and the Lamington River. Option 2 - Provides for diversions to the Passaic River via the Upper Rockaway, Whippany and Passaic Rivers (see Project 28).	NJ	1008.01
14	Round Valley Reservoir Expansion	Raritan	WS	25	20	NEWS R-5 Expand storage from 55 to 75 BG using dikes	NJ	1006, 202, 1016

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
15	Flat Brook-Raritan	Raritan & Delaware	WS Flat Brook Round Valley	300	80 or 22 55 or 75	High Flow Skim Delaware Divert 300 mgd at Frenchtown to Round Valley Low Flow augmentation from Flat Brook	EDF	511
16	Hackelbarney Reservoir	Lamington River	WS	-	11	Stream Flow Augmentation for the Lamington River	NJ	810, 202, 757
17	Ravine Lake Res.	Big North Br.	WS	-	11	Stream Flow Augmentation for the North Branch Raritan River	NJ	810, 202, 1017
18	Bunnvale Res.	South Br.	WS	>50	-	Stream Flow Augmentation for the South Branch Raritan River	NJ	810, 1207.04
19	McCrea Mills Res.	North Br. Rockaway Cr.	WS	-	-	Abandoned alternative due to active quarrying in 1962.	NJ	810
20	Oldwick Res.	Lamington River	WS	-	4.8	Need to relocate cemeteries and roads. High land cost.	NJ	810
21	Big North Branch Res.	North Br.	WS	-	16	High land cost	NJ	810, 202, 757
22	Chimney Rock Res. (East Branch)	Millstone	WS PS	70	26	Failed public Referendum 1955 (TAMS CR-3)	NJ	810, 757
23	Rocky Hill Res. (Bedens Brook)	Millstone	WS	-	9	High cost for relocations	NJ	810, 202, 757
24	Stony Brook Res.	Millstone	WS	-	10	Serious public opposition 1957	NJ	810, 757
25	Bartley Res.	South Br.	WS	10	10.5	1/2 mile south of Budd Lake	NJ	1008.01, 202
26	Schooleys Mountain Res.	South Br.	WS	-	27	Possible terminal storage for Delaware River water	NJ	810, 202

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
27	Two Bridges and Myers Road Reservoirs (Lower Millington Res.)	Passaic Pompton	WS FC GW	100	26 10	NEWS P-1 Flood control and water supply from Pompton plus treatment	COE	202, 205.03, 231, 229.07
28	Delaware River Diversion to Two Bridges	Delaware Passaic Raritan	WS	400	-	NEWS P-2 Tocks Island Reservoir, intake at Frenchtown thru 4 pump stations, to Schooley Mtn., Bartley and Hardscrabble Reservoirs, to Two Bridges for storage, treatment and pipe to Great Notch Option without Two Bridges, storage at 3 reservoirs	SNJ	202, 1206.01
29	Delaware River Diversion to Canoe Brook	Delaware, Raritan, Passaic	WS	300	-	NEWS P-3 Tocks Island Reservoir, intake at Frenchtown, to Hamden and Round Valley, intake at Confluence to Dead River (Passaic), intake and treatment at Canoe Brook (CWC) or Great Notch	COE	202, 1206.01

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
30	Delaware River Diversion - Port Jervis to Pequannock	Delaware, Passaic, Pequannock	WS PS	150	-	NEWS P-4 Tocks Island Reservoir Intake at Port Jervis, 29 miles transmission of Oak Ridge Res.(Nwk) Pumped storage to new Dunkers Pond Reservoir Treat at Charlotteburg Half to Great Notch, half to local systems	NWK	202
31	Delaware River Diversion Tocks Island to Wanaque	Delaware, Passaic, Wanaque	WS	300	-	NEWS P-5 Tocks Island Reservoir, intake of Flatbrookville, 36 mile tunnel to Wanaque, treatment, tunnel filtered water to Great Notch	COE	202
32	Hudson-Ramapo Diversion Storage Hudson	Hudson, Ramapo, Wanaque	WS	250 500	34 102	NEWS P-6 Storage, intake, pump at West Park, N.Y.; 31 mile aqueduct to Ramapo R.; pump at Pompton Lakes to Wanaque Res.; treatment and transmit to Great Notch	COE	202, 205.03
33	Hudson-Ramapo Diversion-Storage Ramapo	Hudson, Ramapo, Wanaque	WS	250	24	NEWS P-6A Similar to P-6 except storage in 3 reservoirs near Ramapo headwaters. High flow skimming of Hudson	SNJ COE	229.07, 202, 1206.01

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
34	Hudson to Little Falls - continuous skimming	-	WS	-	-	Intake, treatment and pumping at West Park, transmission to Little Falls	COE	202
35	Hudson to Little Falls - Storage in New York	-	WS	150-350	-	NEWS HU-6 High flow skimming from Hudson, Storage, treatment and pumping at West Park. Transmit to Little Falls	COE	202, 1206.01 1008.04
36	Hudson to Great Notch - Storage in New Jersey	-	WS	150-350	-	NEWS HU-6A Same as above with storage in N.J. at Great Notch or elsewhere	COE	202
37	Delaware River Control - transfer from Kensico	Delaware, Hudson, Passaic	WS FA	300	65 (TILP)	NEWS D-2 N.J. yields 300 mgd to Delaware R. to meet N.Y. release requirement. N.Y. compensates with 300 mgd from Kensico to Great Notch	COE	202
38	Oradell Pipeline	Passaic Hackensack	WS	40	-	Alternative Schemes W.S. to Oradell Res.	NJ HWC	1011
39	Wanaque-Oradell Pipeline	Wanaque-Hackensack	WS IC	40	-	See Two Bridges-Ramapo Project	HWC NJDWSC	1011, 1202.03

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
40	Two Bridges Ramapo Project	Pompton, Ramapo, Wanaque	WS	79	-	Intake at confluence of Passaic and Pompton R.; pump to Wanaque Res., PVWC, and Oradell. Several related alternatives in 1011.	SNJ HWC	1207.01, 1202.03 1011
41	Monksville Res.	Wanaque	WS FC,R	25	7	Green Acres site upstream of Wanaque Res. In conjunction with pumping from Ramapo will increase Res. yield from 94 to 119 mgd.	NJDWSC	1207.02, 1008.04, 1011
42	Great Notch Interconnection	Passaic	WS	-		Identified terminus for several interbasin transfer alternatives. Existing	COE NBFU	202, 1338
43	Washington Valley Res.	Whippany	WS	7	1.2	Site being acquired by MCMUA. Optional pumped diversion.	MCMUA	202, 1205.03
44	Longwood Valley Reservoir	Rockaway	WS HY	10.3	5.2	Operation with existing Split Rock & Boonton Res. Public opposition	JC	1203.02, 202 1203.04
45	Whippany Res. (Troy Meadows)	Whippany	FC	-	18.6	Dry-detention reservoir near Rt. 280 for flood control - Green Acres	COE NJ	810, 231, 1017

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Basin: Passaic

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
46	Dunkers Pond Res.	Pequannock	WS PS	20	11	To be filled from Wallkill diversion, which alone would yield 8-12 mgd - See 1-19-75	Nwk	1206.01
47	The Tourne Res.	Rockaway	WS PS		3.3	Pumped storage, off-stream site, public opposition	MCMUA	1205.03, 810, 202
48	Hardscrabble Res.	Passaic	WS PS	5	2	NEWS P-2 Plans storage of Delaware River water here	NJ	810, 202, 757
49	Ramapo Res. (Darlington)	Ramapo	FC, WS	-	9.2	Alt: dry for flood control; wet for water supply. Much development	NJ	810, 202, 757
50	Harrisons Brook Res.	Passaic	WS, PS	14	4	Alt. to Great Swamp. Now is a developed site.	NJ	810
51	Corys Brook Res. (Myers Road Res.)	Passaic	FC, WS			Alt. to Great Swamp. Limited storage for water supply.	COE	810
52	Como Res.	Rockaway	WS, PS	-	-	Pumped storage onstream, downstream of Split Rock.	MCMUA	810, 202
53	Long Hill Res. (Great Swamp)	Passaic	WS	>600	182	Jet Port Ban by N.J. Legislature.	-	1014, 202, 757
54	Greenwood Lake	Wanaque	WS	-	6.9	Recreational lake. May be used for emergency supply.	NJ COE	810, 202

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Number (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
55	Tocks Island Lake	Delaware	WS FC HY R	300	275	Major impoundment on Delaware from 7 miles north of Delaware Water Gap to Port Jervis, NY	COE	230, 202
56	Hackettstown Res.	Musconetcong	WS R, FA	40	10	Authorized by DRBC	COE NJ	1013, 1209.01 502.03
57	Flatbrook Res.	Flat Brook	FC	-	84	Alternative to Tocks Island, which would also flood this site; WS with Round Valley. Supplemental to Projects 67 and 116.	NJ	230.04, 757, 1008.11
58	Flatbrook - Raritan	Raritan	FA, WS	300	44 80	Flat Brook FA for continuous WS at Frenchtown of 300 mgd	EDF	511, 757
59	Sussex Mills	Paulins Kill	WS PS	-	3.4	Potential Site	NJ	1008.9(a)
60	Ross Corner	Paulins Kill	WS PS	20	9.2	Potential Site. Replacement for Newton/Wallkill Diversion.	NJ	1008.10
61	Newton-West	Paulins Kill	WS PS	-	5.4	Potential Site	NJ	1008.10
62	Kerrs Corner	Paulins Kill	WS PS	-	5.7	Potential Site	NJ	1008.10
63	Paulina	Paulins Kill	WS		17.9	On-stream site	COE	810, 202

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
64	Huntsville	Pequest	WS PS	-	2.0	Potential Site	NJ	1209.01 1008.9(a)
65	Shades of Death	Pequest	WS PS	-	5.5	Potential Site	NJ	1209.01 1008.9(a)
66	Petersburg	Pequest	WS PS	-	8.0	Potential Site	NJ	1209.01 1008.9(a)
67	Honey Run	Pequest	WS PS	-	30.5	Potential Site Diversion from Delaware River. Supplemental to Projects 57 & 116.	NJ	1209.01 1008.9(a)
68	Oxford Watershed	Pequest	FC	-	-	PL 566 Watershed authorized for construction may be same as 6-19-70	NJ	1209.01
69	Wallpack Bend	Delaware	WS,R FC,HY	300	120	26 mile long main stem reservoir from Bushkill,Pa. to Port Jervis, N.Y.	COE TAMS	230.04, 757
70	Pequest	Pequest	WS	-	13.3	On stream site. May be same as 6-19-68	COE	810, 202
71	Greenwich Watershed	Pohatcong	FC	-	-	PL 566 Watershed authorized for planning	NJ	1209.01

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
72	Franklin	Wallkill	WS PS	-	7.6	Offstream W/WO Nos. 73, 74 and 75B.	NJ	1209.01 1008.9
73	Beaver Run	Wallkill	WS PS	-	5.5	Offstream W/WO Nos. 72, 74 and 75B.	NJ	1209.01 1008.9
74	Sussex North	Wallkill	WS PS	-	14.4	Offstream W/WO Nos. 72, 73 and 75B.	NJ	1209.01 1008.9
75	Wallkill River Diversion	Wallkill	WS	3-12	-	Diversion to and storage at Dunker Pond/Pequannock System for Newark. See 1-16-46	Nwk	1206.01
76	Upper and Lower Manasquan Reservoirs	Atlantic, Manasquan	WS PS	35	5	Pumped storage from lower pool to upper reservoir.	NJ	810, 229.07
77	Hackensack River Optimization	Hackensack	WS	15	-	-	HWC COE	757, 810, 201
78	NYC Diversion from Manhattan (GW Bridge)	Hudson	WS	-	-	Emergency	NJ	-
79	NYC Diversion from Staten Island	Hudson	WS	-	-	Emergency	NJ	-

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
80	South River GW Pumped Storage	Raritan, South River	WS GWR	15-20	-	PS Reservoir at Duhernal Lake	NJ	1007
81	Weldon Brook Res.	Delaware Musconetcong	WS	3.5	3	Near Longwood Valley Res.	MCMUA	1205.03
82	Pulaski Reservoir	Delaware Musconetcong	WS	-	0.7	Near Hackettstown	MCMUA	1205.03
83	Woodbourne	Papakating, Wallkill	WS	-	6.4	No data except NJ Site Acquisition Rpt. 1966	NJ	1017
84	Papakating	Papakating, Wallkill	WS FA	-	12.0	No data except NJ Site Acquisition Rpt. 1966	NJ	1017

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
85	Bennets Mills	Metedeconk	WS	-	2.4	Potential Reservoir Site	NJ	1017
86	Toms River	Toms River	WS	100	8.1	" " "	NJ	1017
87	Crosswicks	Crosswicks	WS	-	5.1	" " "	NJ	1017
88	Deacons	Assiscunk	GWR Irr.	-	9.4	" " "	NJ	1017
89	Rancocas	Rancocas	WS Irr.	50	8.2	" " "	NJ	1017
90	Chews	Big Timber	GWR	-	5.2	" " "	NJ	1017
91	Pines Run	Big Timber	GWR	6	2.1	" " "	NJ	1017
92	Mantua	Mantua	GWR Irr.	18	3.4	" " "	NJ	1017
93	Chestnut	Mantua	GWR Irr.	9	1.8	" " "	NJ	1017
94	Swedesboro	Raccoon	GWR Irr.	3-35	2.6	" " "	NJ	1017
95	Mullica Hill	Raccoon	GWR Irr.	8-40	4.1	" " "	NJ	1017
96	Major Run	Salem	GWR Irr.	3-30	1.4	" " "	NJ	1017
97	Alphano	Pequest	WS SFA	-	7.7	" " "	NJ	1017

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
98	Nichomus Run	Salem	GWR Irr.	5-30	1.8	Potential Reservoir Site	NJ	1017
99	Alloway Creek	Alloway	GWR Irr.	2-10	3.4	" " "	NJ	1017
100	Stow Creek	Stow	GWR WS	10	7.8	" " "	NJ	1017
101	Cohansey	Cohansey	GWR Irr.	4-40	6	" " "	NJ	1017
102	Carmel	Maurice	WS	10	2.2	" " "	NJ	1017
103	South River	Great Egg	WS	92,4	8.6	" " "	NJ	1012
104	Penny Pot	Great Egg	WS	-	8.0	" " "	NJ	1017
105	Merrill Creek	Delaware	WS	42-113	17.11	" " "	DRB Electric Util. Group, Aug. 1976	
106	Cool Run	Alloway Creek	GWR IRR	3-10	3.0	" " "	NJ	1017
107	Indian Branch	Maurice	WS	55	12.5	" " "	NJ	-
108	New Hampton	Musconet-cong	WS, R,FC	-	14.3	(NEWS D-3)	COE	202

AVAILABLE SURFACE WATER SUPPLY PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Pur-pose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
109	North Branch Big Timber Creek	Big Timber Creek	WS	20	5.2	Potential Reservoir Site	NJ	-
110	Otter Brook	Big Timber Creek	WS	5	1.3	" " "	NJ	-
111	Monongahela Brook	Mantua Creek	WS	4	1.16	" " "	NJ	-
112	Dock Watch Hollow Res.	Raritan	WS PS	-	15.8	" " "	TAMS	757
113	Raritan-Raritan Pipeline	Delaware Raritan	WS	-	-	Part of Project 28, Round Valley bypass	NJ	202
114	Rainey Road	Oldmans Creek	WS	2	0.7	" " "	NJ	-
115	Vestry Road	Oldmans Creek	WS	2	1.3	" " "	NJ	-
116	Frenchtown	Delaware	WS PS	-	-	On Delaware Pipeline Supplemental to projects 57 and 67.	NJ	-
117	Glen Alpin	Passaic	WS PS,FA	2.3	0.8	Potential Reservoir Site	MCMUA	1205.04
118	Van Doran Mills	Passaic	WS	3.7	0.55	Potential Reservoir Site	MCMUA	1205.04
119	Silver Lake	Passaic	WS FA	5.1	3.3	Potential Reservoir Site	MCMUA	1205.04

TABLE 3A-3
NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN
AVAILABLE GROUND WATER PROJECTS

Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
131	Well Field in Wharton Tract (Southwest NJ Supply)	Coastal Plain	WS	100	NA	Installation of 120 wells in 4 stages along the lower reaches of the Mullica and Batsto Rivers.	NJ TAMS	757
132	Well Field in Wharton Tract (Southeast NJ supply)	Coastal Plain	WS	22	NA	Installation of 28 wells in stages along the lower reaches of the East and West Branches of Wading River.	NJ TAMS	757
133	South Jersey Ground Water	Coastal Plain	WS	200 to 400	NA	NEWS SJ-1 and SJ-2 Installation of 200 wells in the Fort Dix Military Reservation and adjacent Lebanon State Forest area. Additional well field in Wharton Tract could increase project yield 200 to 400 mgd.	COE	202
134	Sanford Plan	Coastal Plain	WS	5	NA	Artificial recharge of the Pennsauken Formation by construction of two dams, one on the Millstone River and the other on Big Bear Brook along with troughs excavated behind each dam to increase the yield of the Formation.	J. Homer Sanford	Special Report 35 - Water Resources of the Upper Millstone River Basin, New Jersey 1972

AVAILABLE GROUND WATER PROJECTS

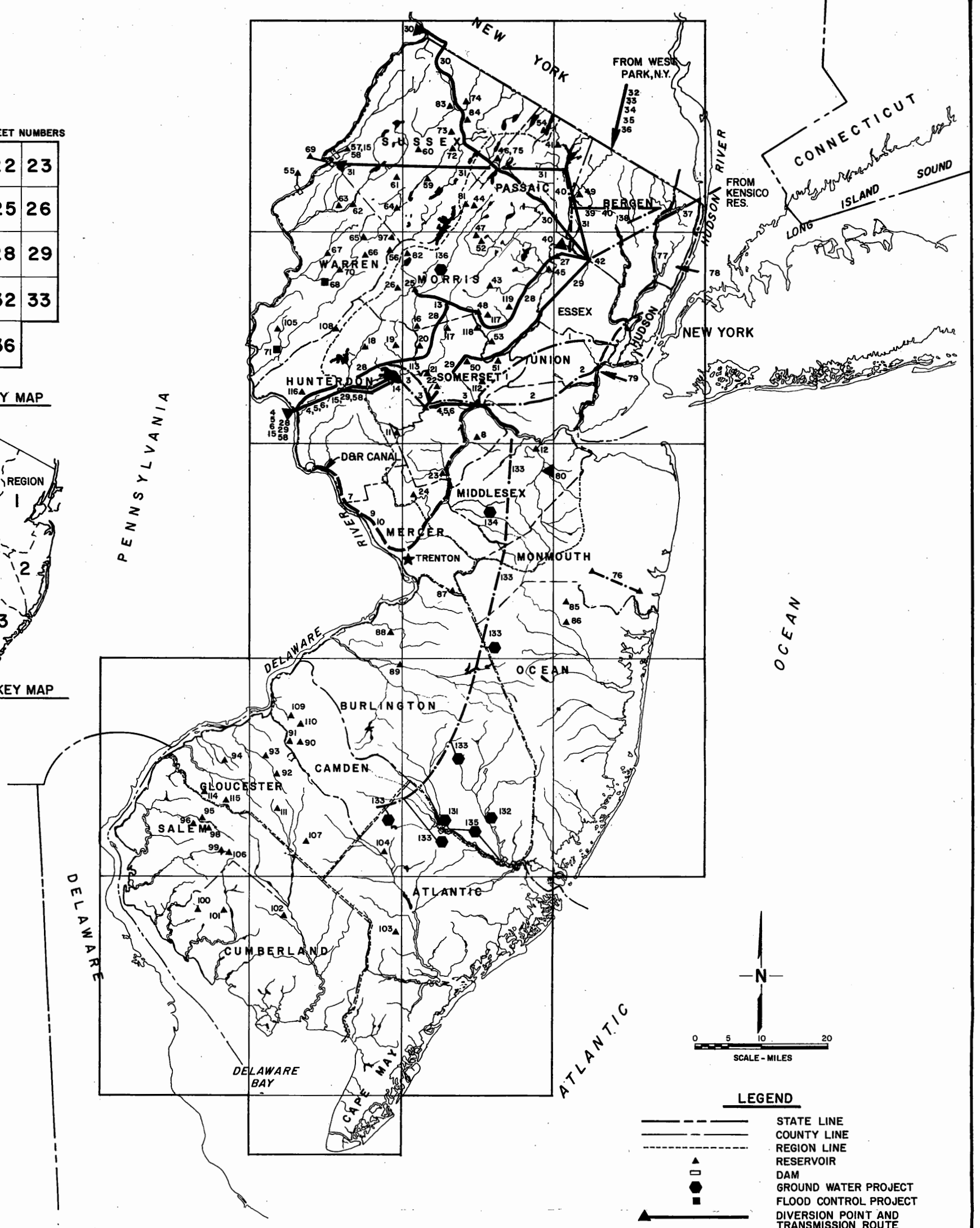
Project Number	Project Name (Alternate Name)	Basin(s)	Purpose	Yield mgd	Storage BG	Project Description	Author/ Sponsor	Reference
135	Burlington County East Zone-Well Fields	Coastal Plain	WS	113	NA	Two recharge dams and impounding reservoirs on the Batsto and Wading Rivers. Installation of 58 wells along the banks of the two rivers. Transmission of water to coastal areas of Burlington and Atlantic and to central and western Burlington and Camden area. Staged development through the year 2000.	Land Engineering and Surveying Co., Inc.	1211.01
136	Alamatong Well Field and Recharge Basin	Raritan	WS GWR	-	NA	Wells on Black River; construction of low dam to create a retention basin of high stream flow storage.	Morris County MUA	1205.03

ATLAS SHEET NUMBERS

	21	22	23
	24	25	26
	27	28	29
30	31	32	33
34	35	36	
	37		

L.O.R.D.S. KEY MAP

REGION KEY MAP



LEGEND

- STATE LINE
- COUNTY LINE
- REGION LINE
- RESERVOIR
- DAM
- GROUND WATER PROJECT
- FLOOD CONTROL PROJECT
- DIVERSION POINT AND TRANSMISSION ROUTE
- PIPELINE OR TRANSMISSION IMPROVEMENTS

EXHIBIT B

WATER SUPPLY ALTERNATIVES
PROJECT LOCATIONS

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

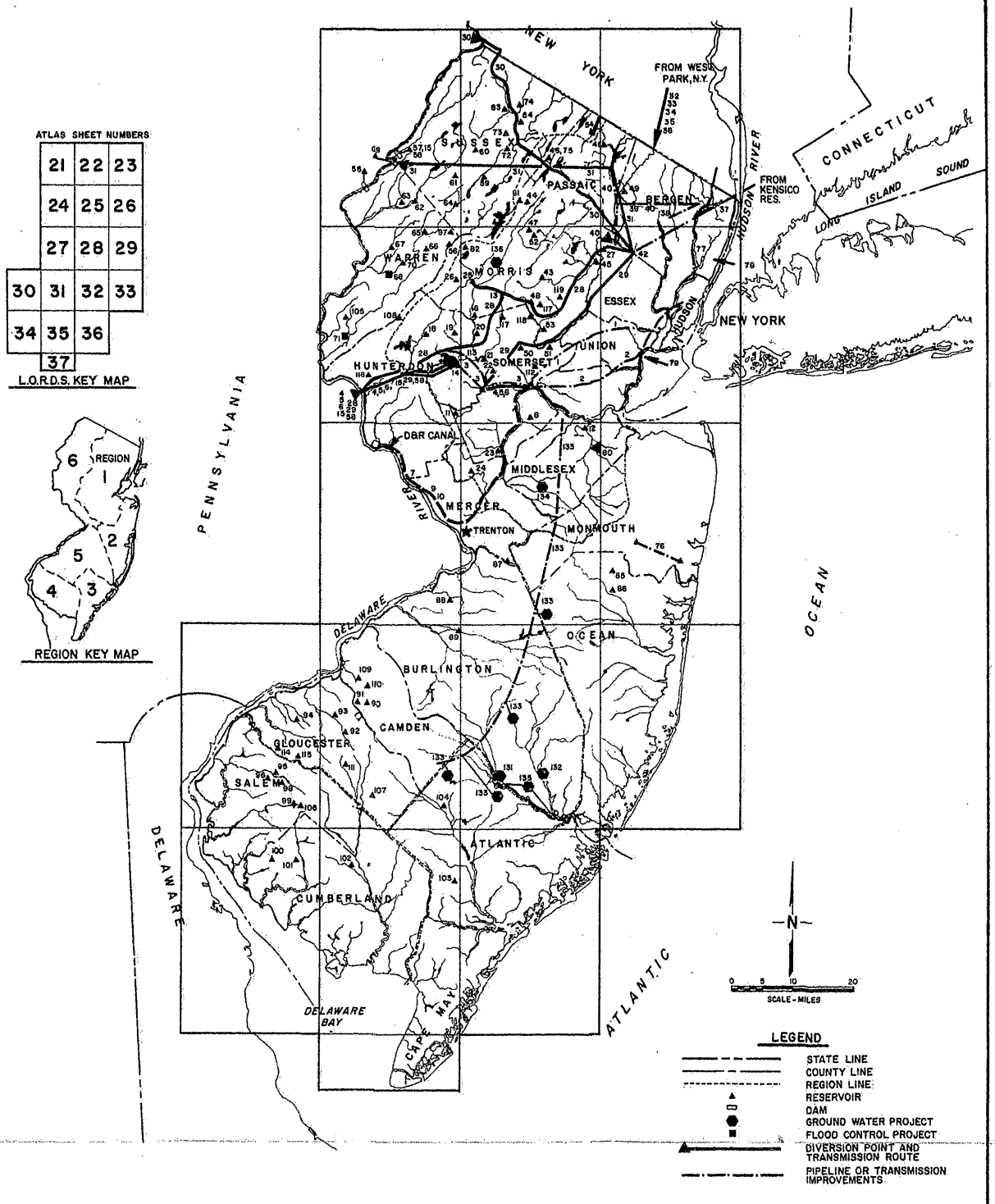


EXHIBIT B

WATER SUPPLY ALTERNATIVES
PROJECT LOCATIONS

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

EXHIBIT C
PROJECT DESCRIPTIONS

ALTERNATIVE PROJECT DESCRIPTION

No. 1 Name Raritan-Passaic Pipeline (North Route, Main Stem Development) L.O.R.D.S. No. Atlas Sheet 25

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Somerset, Union, Essex, Hunterdon

Author	Title	Library No.
NJDWSC	News Report Nov. 1971	202 (R-1)
NJDWSC	Gilbert Assoc. Rpt. 1968	1207.03
NJDWSC	Hazen & Sawyer Rpt. 1974	1206.01

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			70	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Project proposed by NJDWSC as alternate to 1961 Round Valley Report by Capen and Purcell (1207.04). Intake and Pumping Station on the Raritan River above Bound Brook, raw-water main to vicinity of Chimney Rock, water treatment plant, balancing Reservoir, and a 28-mile transmission main to a connection with the NJDWSC Wanaque Reservoir Line in Newark. NJDWSC planned 70 mgd yield in 1980 and 90 mgd yield for 1988. Based on 160 mgd at Bound Brook, 70 mgd to EWC, 90 mgd to NJDWSC. Estimated Confluence Reservoir to add 50 mgd for 210 mgd. Assumes Round Valley-Spruce Run provide 160 mgd for water supply over the 90 mgd passing flow of Bound Brook.

Project might serve Hackensack Water Company.

To Wanaque Reservoir Line in Newark:

Capital	$63-72
O & M	$6.7-7.5
$/MG	$200-250/MG
Year	12/68
Source	1207.03

Cost ($ million): Capital $20.1, O & M $ 3.6, $/MG $141/MG; Year 1971, ENR 1400, Source 202

Note To Bound Brook:

Identified Problems: Reduced water quality due to in-stream transmission. Possible environmental and institutional issues.

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐

Two Bridges - Ramapo (Project 40) preferred

Prepared 2/8/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 2 Name Raritan-Passaic Pipeline (South Route, Main Stem Development) L.O.R.D.S. No. Atlas Sheet 25

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Hunterdon, Somerset, Union, Hudson

Author	Title	Library No.
EWC	News Report Nov. 1971	202 (R-1)
EWC	Killam Report 1970	1201.01
EWC	Hazen and Sawyer Rpt. 1974	1206.01

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			70	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Expansion of Elizabethtown Water Company's treatment plant at Bound Brook and construction of transmission main to Newark and meadowlands in Hudson County. Assumes Raritan with Round Valley-Spruce Run provides 250 mgd at Bound Brook, of which 90 mgd is passing flow required by N.J. legislature. Possible supply for Hackensack Water Company.

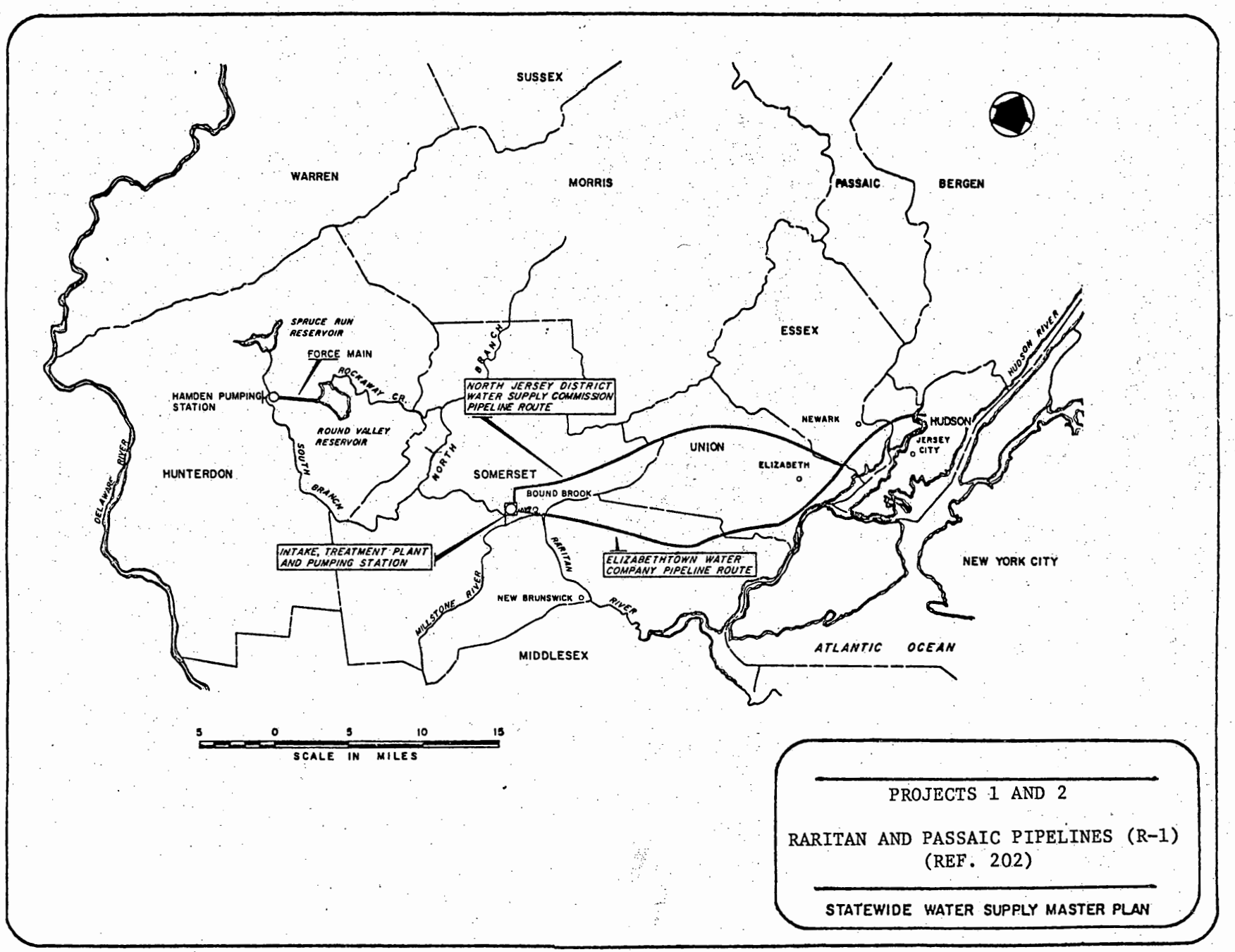
Cost ($ million) Capital ____ O & M ____ $/MG $416 Year 1974 ENR ____ Source 1206.1 Note See Project No. 1 for similar costs.

Identified Problems Reduced water quality due to in-stream transmission; Possible environmental and institutional issues

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐

Two Bridges-Ramapo (Project 40) preferred

Prepared 2/8/78 Revised 1 ____ Revised 2 ____



PROJECTS 1 AND 2

RARITAN AND PASSAIC PIPELINES (R-1)
(REF. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 3 Name Confluence Reservoir, Pump Station and Force Main L.O.R.D.S. No. Atlas Sheets 24,25

Region(s) 1 Basin(s) Raritan County(ies) Somerset, Morris, Union

Author NJ COE Title News Report, Nov. 1971 Rpt. on Alt. Wtr. Sup. Proj. Cty. of Newark, NJ (H&S-CB As.) Library No. 202 (News R-2) 1206.01

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	1			50	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Includes a 1.0 billion gallon reservoir at the confluence of the north and south branches of the Raritan River, a pumping station at the reservoir, and a force main to Round Valley. Gravity fill from Raritan. A filter plant below the reservoir and a filtered water main to Bound Brook included in project cost estimates because of the possibility of increasing pollution of the Raritan River. Land acquisitions under green acres program. Bond issue 1976 allocated $1.4 million for design. One of seven sites whose acquisition was authorized by 1969 bond issue for $27 million. About $1.95 million spent with $1.0 million to be spent (as of 12/76, 522 acres purchased, 87 acres to be acquired).

The State has suggested an alternative which would eliminate the Treatment Plant at the Reservoir as well as the Confluence - Bound Brook Force main. Water would be transferred in-stream (Raritan River) and treated at Bound Brook. Cost savings would be about $35 million.

To Newark:

Capital	$133.0
$/MG	$825/MG
Year	1974 (ENR 2100)
Source	1206.01

Cost ($ million)

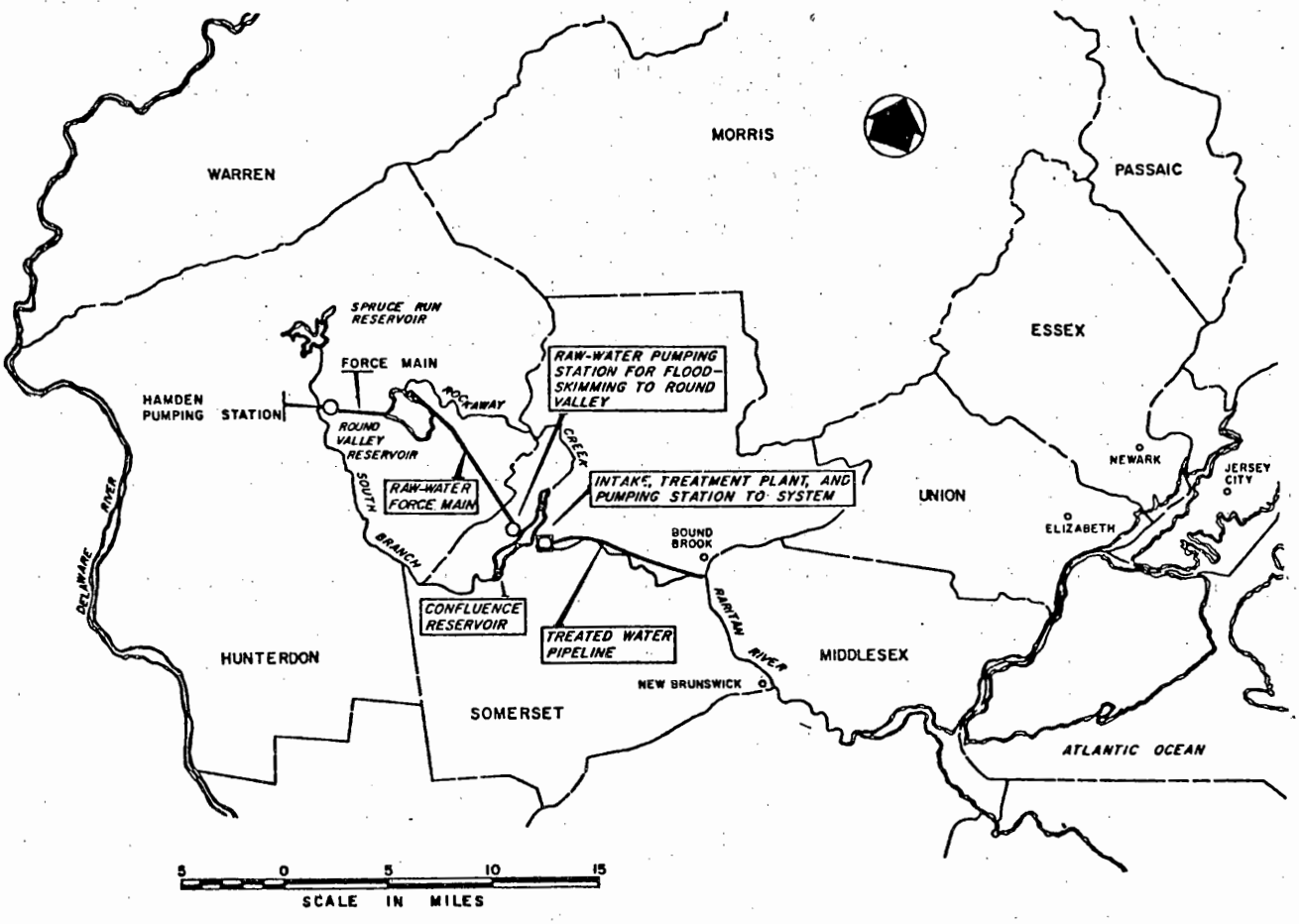
Capital	$95.0 M	Year	1975
O & M	$13.0 M	ENR	
$/MG	$819/MG	Source	229.07

Note Cost of WTP and FM to Bound Brook included.

Identified Problems

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 1/25/78 Revised 1 Revised 2



PROJECT 3

CONFLUENCE RESERVOIR (R-2)
(REF. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 4 Name Delaware River Diversion to Raritan River L.O.R.D.S. No. Atlas Sheets 24, 25

Region(s) 1,6 Basin(s) Raritan County(ies) Hunterdon, Somerset

Author COE Newark Title News Study Nov. 1971 Alt. WS for Newark HS/CB 1974 Library No. 202 (News R-3) 1206.01

Data Availability/Reliability Good

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			300	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Tocks Island Reservoir, intake at Frenchtown with 360 mgd pumping and transmission to Hamden Intake Pond. Storage in Round Valley. In-stream transmission to Confluence pump station. Pipeline to Bound Brook.

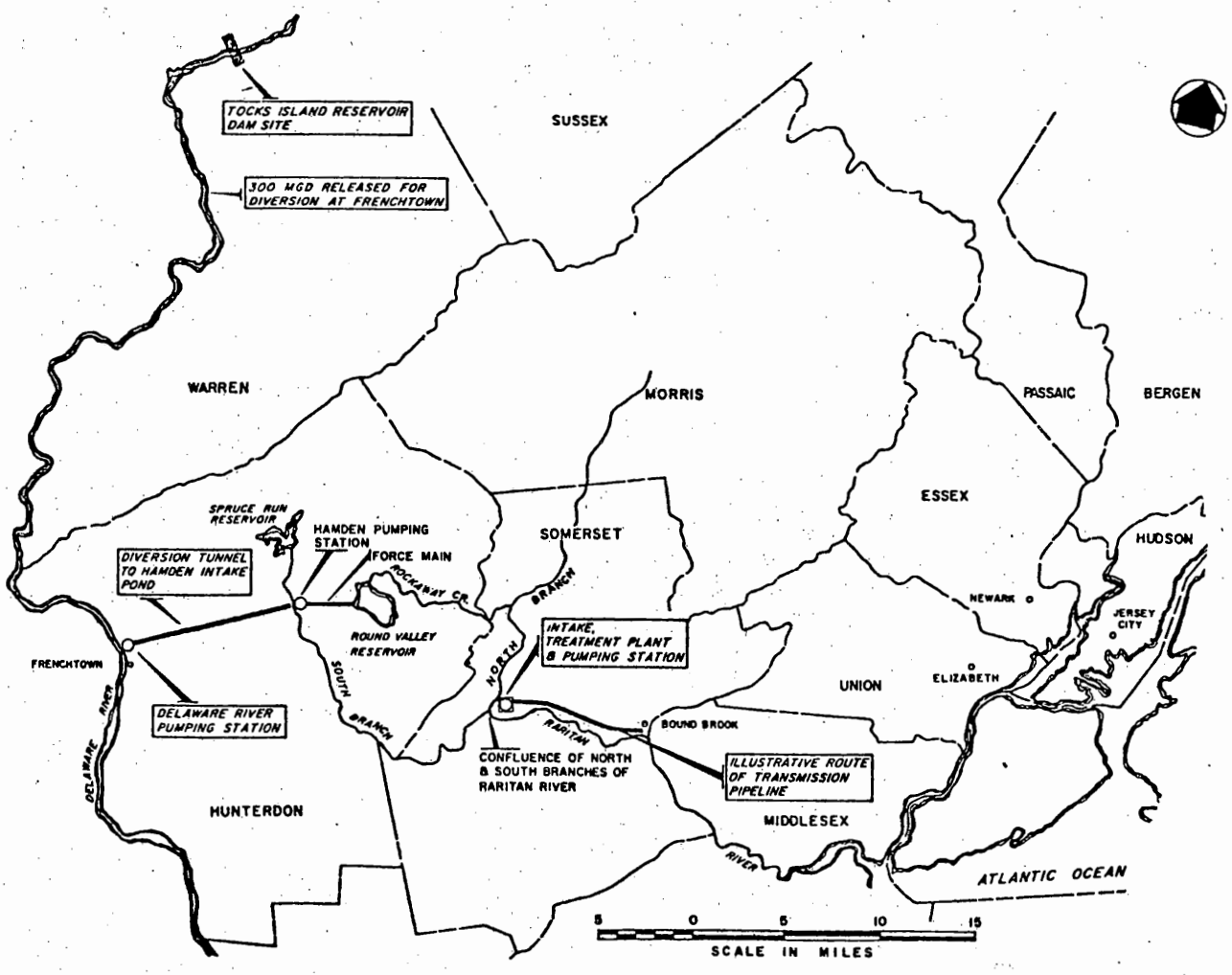
Alternative by Newark 1974 has in-stream transport to Bound Brook and transport to Newark of 70 mgd.

Cost ($ million) Capital $395 O & M $/MG $421/MG Year 1974 ENR 2100 Source 1206.01 Note To Newark

Identified Problems Water quality impacts of in-stream transport. Reliance on Tocks Island. Need for pump station and force main when in-stream transport is available to Bound Brook.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 1/31/78 Revised 1 Revised 2



PROJECT 4

DELAWARE RIVER DIVERSION TO RARITAN RIVER (R-3) (REF. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 5 Name Delaware River Flood Skimming to Raritan L.O.R.D.S. No. Atlas Sheets 24,25

Region(s) 1,6 Basin(s) Delaware/Raritan County(ies) Hunterdon, Somerset

Author Title News Report, Nov. 1971 Library No. 202 (News R-4)
Rpt. on Alt. Wtr. Sup. Proj. 1206.1
Cty. of Newark, 1974

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			100.0	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Diversion of Delaware River water at Frenchtown during six months of high runoff and stored in Round Valley. Facilities would include an intake and 360 mgd pumping station at Frenchtown, an aqueduct to Hamden, and a second aqueduct from Hamden to Round Valley. Arrangements would be included for returning compensation water (40 mgd) to the Delaware River during the dry season. The 40 mgd compensating withdrawal to the Delaware River is a tenuous part of the project since, as currently conceived, the project would require pumping in both directions. Construction of tunnels in place of the aqueducts could alleviate this problem.

To Newark (70 mgd):

Capital	$192
$/MG	$863/MG
Year	1974
ENR	2100
Source	1206.01

Cost ($ million)

Capital	$115	Year	1971	Note To Bound Brook:
O & M	$10.4	ENR	1400	
$/MG	$285/MG	Source	202	

Identified Problems Confluence Reservoir (R-2) and this project both rely on same storage at Round Valley.

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 1/24/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 6 Name Delaware River Flood Skimming to Raritan, Round Valley Expansion L.O.R.D.S. No. Atlas Sheets 24,25

Region(s) 1,6 Basin(s) Delaware/Raritan County(ies) Hunterdon, Somerset

Author _____ Title News Report, Nov. 1971 Library No. 202 (R-5)

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			150.0	

Limitations on yield _____

Narrative description Figure: No ☐ Yes ☒

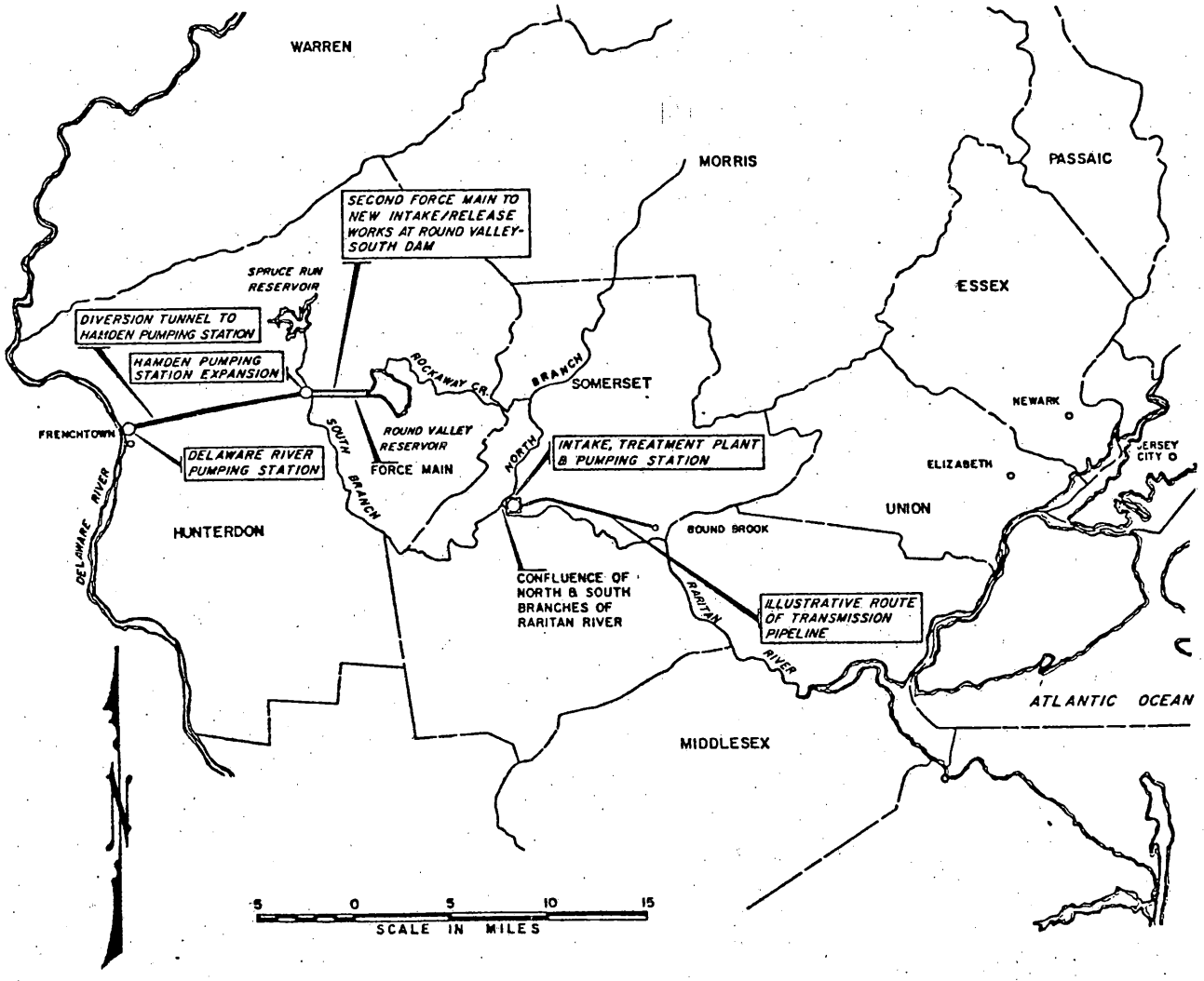
See Project No. 5. Additional 50.0 mgd yield realized with Round Valley Reservoir enlarged from 55 BG to 75 BG.

Cost ($ million)					
	Capital		Year		Note See Project No. 5
	O & M		ENR		
	$/MG		Source		

Identified Problems See Project 5.

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 1/24/78 Revised 1 _____ Revised 2 _____



PROJECTS 5 AND 6

DELAWARE RIVER FLOOD SKIMMING TO RARITAN (R-4, R-5) (REF. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 7 Name Delaware and Raritan Canal Improvements L.O.R.D.S. No. Atlas Sheets 25, 27, 28

Region(s) 1,6 Basin(s) Raritan, Delaware County(ies) Somerset, Mercer

Author NJ COE Title Water Res. Circular 21 News 1971 Library No. 1006 202

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-				+25

Limitations on yield 1954 Supreme Court decree limits to 100 mgd diversion out of Delaware Basin.

Narrative description Figure: No ☒ Yes ☐

Related to Project No. 10. Corps NEWS 1971 (202) considered improvements for capacity of 120 mgd to yield average 100 mgd. Current hydraulic capacity for intake is 90 mgd. Seepage losses reduce this to 75 mgd. Flow has been allocated on a maximum daily demand charge basis to:

Elizabethtown Water Co.	22.5
New Brunswick	10.5
Middlesex Water Co.	10.0
Small Water Companies	10.5
Industries	Balance

As a result of irregular use and no storage, an average of 47 mgd is used. See Project No. 8 for storage option.

A 1976 Bond issue allocated $3.3 million for D & R Canal rehabilitation.

Cost ($ million)					
Capital	50	Year	1975	Note	With Project No. 8
O & M	8	ENR			
$/MG	316	Source	229.07		

Identified Problems

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 2/16/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 8 Name Six Mile Run Reservoir L.O.R.D.S. No. 25-43-400

Region(s) 1 Basin(s) Raritan/Delaware County(ies) Middlesex

Author NJ Title NEWS November 1971 Report Library No. NEWS R-6b 202

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	5.9			38	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Offstream reservoir Spillwaycrest 83 feet MSL to regulate Delaware water in Delaware and Raritan Canal; and to meet peak demands. Reservoir would be filled by pumping from canal. Location within 5 miles of New Brunswick, NJ. If necessary, water diverted from the Delaware River at Frenchtown could be pumped from the Raritan River into the D & R Canal. Yield of 38 mgd assumes 10 mgd from drainage area of 16 sq. mi. and 28 mgd from increase in Canal use from 47 to 75 mgd. See Project No. 7 for improvements of 25 mgd from 75 to 100 mgd.

This is one of seven sites whose acquisition was authorized by 1969 bond issue for $27 million. Nearly $9.2 million spent with $2.5 million to be spent (as of 12/76: 2553 acres purchased; 316 acres to be acquired). The need for Six Mile Run Reservoir is contingent on the variable demand practices presently in existence along the D & R Canal necessitating storage for peak demands.

Cost ($ million)					
Capital	50.0	Year	1975	Note	(includes Project 7, Ref. 229.07)
O & M	8.0	ENR			
$/MG	316	Source			

Identified High land costs.

Problems Required only if demand remains variable.

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 1/23/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 9 Name Delaware-Raritan Pipeline and Canal L.O.R.D.S. No. Atlas Sheets 25, 27, 28

Region(s) 1,6 Basin(s) Delaware, Raritan County(ies) Mercer, Hunterdon, Somerset

Author NJ Title News Study, Nov. 1971 Library No. 202 (R-6)

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			400	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Canal improved to deliver additional 53 mgd which added to 47 mgd now used gives 100 mgd. Also considered use of the canal to transfer 300 mgd, to be available from Tocks Island Reservoir, for total of 400 mgd. Such flows would require major improvements to the canal: project involves replacement of upper portion of canal with a new intake and pumping station on the Delaware River at Trenton and a 16-mile pipeline to Kingston, below Lake Carnegie; with improvements to the remaining sections of the canal. The upper portion of the canal presents the most difficulties in terms of improvements.

For better project to develop 100 mgd, see project nos. 7,8. Canal widening would encroach on Millstone River Flood plain.

Cost ($ million)					Note
	Capital	40	Year	1971	Capital - (minimum for 400 mgd project)
	O & M		ENR	1400	
	$/MG	35-40	Source	202	$/MG - (transmission costs)

Identified Problems: Capacity limited by construction under bridges and through culverts; many highway and other crossings; irregular canal bottom; banks frequently in poor condition; surface water contamination; dry weather seepage losses; disruption of Flood plain.

Project Status: Proposed ☐ Realistic ☐ Potential ☒ Unrealistic ☒ Discarded ☐

Does not meet environmental screening criterion.

Prepared 2/1/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 10 Name Delaware-Raritan Canal Optimization L.O.R.D.S. No.
Atlas Sheets 25, 27, 28

Region(s) 1,6 Basin(s) Raritan, Delaware County(ies) Somerset, Hunterdon, Mercer

Author NJ Title NJDEP-Rutgers Univ. Agrmnt. Prof. Granstrom conducting study 1977-1978 Library No. 1015

Data Availability/Reliability Good

Purpose(s) WS, FC Storage(BG) - Yield (mgd) 30's drought 60's drought Other 30-50

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

The canal serves 22 contractual customers and municipalities. This project involves the development of options to encourage base load usage of the canal by its customers; control of Canal flooding; physical improvements (see project no. 7);improvement in hydraulic capacity to 100 mgd potential; reorganization and optimization of maintenance and operational programs; development of recreational usage, industry, irrigation and water supply over entire 60-mile length. Storage may be required.

(Refer to Rutgers study for more detail)

Cost ($ million) Capital Year Note Not Available
O & M ENR
$/MG Source

Identified Problems Flooding/Water Quality; Structural integrity/hydraulic capacity of canal components; leakage; efficient water use by industry.

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/16/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 11 Name Crab Island Dam and Reservoir L.O.R.D.S. No. 24-45-400

Region(s) 1 Basin(s) Raritan County(ies) Middlesex

Author COE Title News Report, Nov. 1971 Library No. NEWS (R-7) 202

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS GWP,R,HB	NA			90.0	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Project includes a tidal weir across the Raritan River five miles above the mouth, with facilities for releasing flood flows. The dam would exclude salt water from 10 miles of the present estuary and recapture some of the 90 mgd passing flow from Bound Brook and provide approximately 20 mgd from the storage capacity of Crab Island Reservoir. Quantity available for diversion would be dependent on institutional actions concerning residual flow to estuary. Also provides hurricane barrier, recreation and groundwater protection.

Cost ($ million) Capital 87.0 Year Note
O & M ENR
$/MG Source

Identified Problems Poor quality water for water supply - would require high degree of treatment; fresh water lake created by barrier would be subject to warm temperatures, algae growth & accumulations of undertreated wastes; legal issue of releases to estuary.

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Does not meet environmental screening criterion.

Prepared 1/30/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 12 Name South River Tidal Dam and Recharge Pond L.O.R.D.S. No. 28-04-300

Region(s) 1 Basin(s) Raritan, South River County(ies) Middlesex

Author COE, NJ Div. of Wtr. Policy & Study Title NEWS Study, Nov. 1971, Wtr. Res. of the Sayreville Area. Mdlsx. Co. WR Cr. 20 (1969) NJ DCED Library No. 202 (NEWS R-8), 1007

Data Availability/Reliability Good

Purpose(s) GW Storage(BG) .6-.7 Yield (mgd) 30's drought 60's drought Other 15-25

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Location on the South River near the South River Generating Station (at contact of Old Bridge Sand and South Amboy Fire Clay). Normal pool elevation of 7.5 ft. Prevents salt-water intrusion to the existing groundwater diversion of 30 mgd from the Old Bridge Sand in the Sayerville area; also maintain fresh water levels near South River, Sayerville, and other communities dependent upon wells for municipal and industrial supplies.

Drainage area - 95 sq. mi.

Will possibly stabilize salt-water intrustion into the Farrington sand. Recharge to and yield from Old Bridge Sand could be increased by stripping the bed of the lake formed behind the dam. NJ Legislature has authorized acquisition of land and water rights.

(Would be inundated by the Crab Island Project)

Bond issue 1958 allocated $1.25 million for site of which $0.5 million has been spent. Also, one of seven sites whose acquisition was authorized by bond issue - 1969 for $27 million. Further spending for South River has been deferred by State.

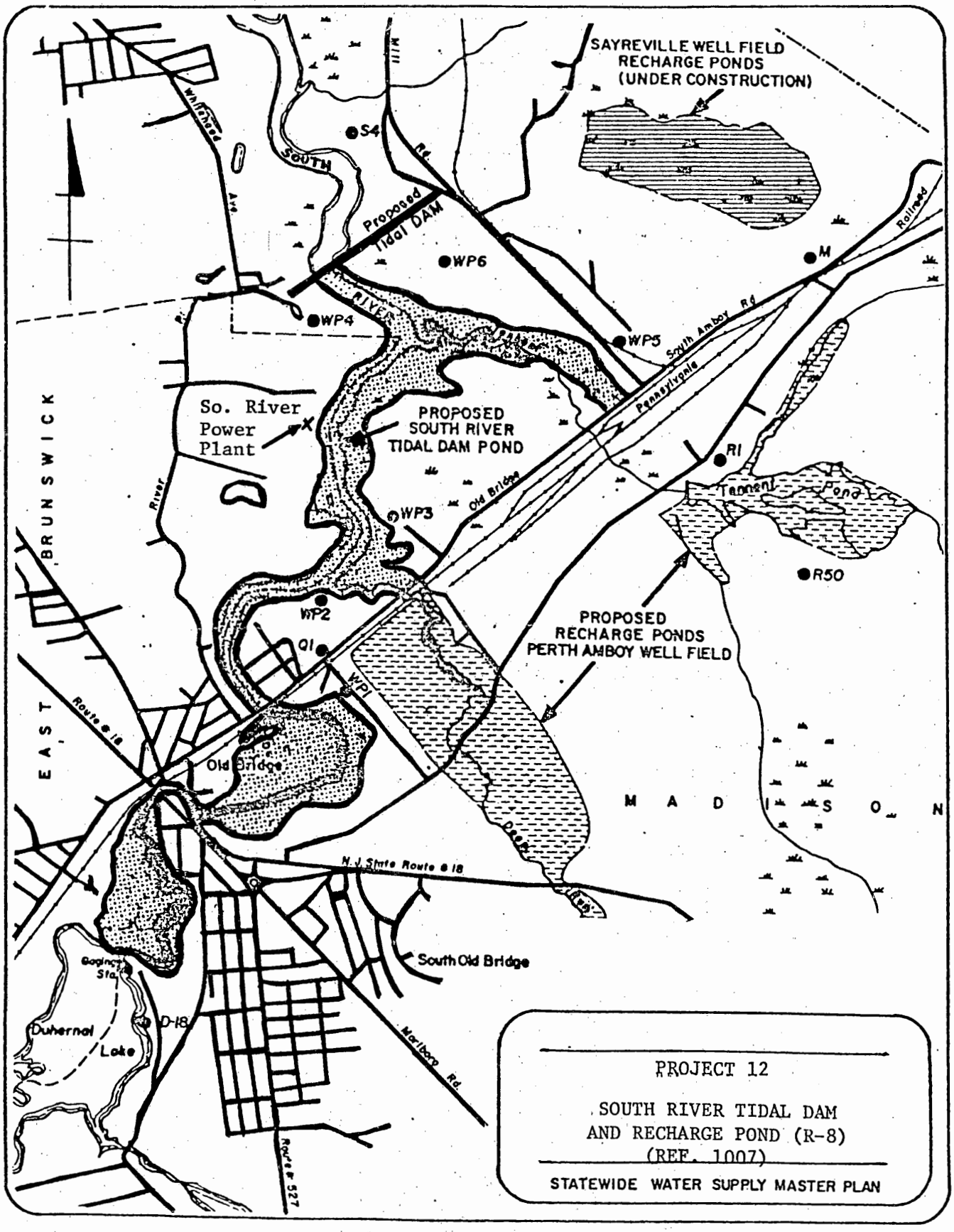
Recharge is effective for approximately 1000 feet; would require dikes and continuous pumping.

Cost ($ million) Capital 12.1 O & M $/MG Year 1971 ENR (1400) Source 202,1007 Note $12 million includes cost of land inundated within City of Perth Amboy well field.

Identified Problems Displacement of about 90 residential properties & subsurface problems; one major industry and dislocation of utilities (ref. 1007). Maintenance of recharge pond to allow for high infiltration rates.

Project Status: Proposed ☐ Potential ☐ Discarded ☒ Realistic ☐ Unrealistic ☒

Prepared 2/1/78 Revised 1 Revised 2



PROJECT 12

SOUTH RIVER TIDAL DAM
AND RECHARGE POND (R-8)
(REF. 1007)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 13 Name Upper Raritan Pipelines L.O.R.D.S. No. _____
Atlas Sheets 24,25

Region(s) 1 Basin(s) Raritan County(ies) Hunterdon, Morris, Somerset

Author NJ Title Raritan RB Nat. Flow-Res. Suppl. Sys. Library No. 1008.1

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) - Yield (mgd) 30's drought 60's drought Other Unknown

Limitations on yield _____

Narrative description Figure: No ☒ Yes ☐

This potential facility could transfer waters stored in Round Valley Reservoir to the Headwaters of the North Branch of the Raritan River and the South Branch of the Raritan River. (part of Project 28):

- to the South Branch at potential Bartley Reservoir site on the main stream of the South Branch in Mt. Olive Township, Morris Co. about 5 miles downstream of the Budd Lake Dam.
- to the Lamington River near the NJ Route 24 Bridge
- to the Peapack Brook
- to the Upper North Branch near the NJ Route 24 Bridge

Increases wet year storage capacity of project 28 system (Delaware Diversion to Two Bridges). Pump stations at Far Hills, Ralston and Bartley. Ralston and Bartley pump stations could provide entry to Passaic River Basin via Upper Rockaway River, Whippany River and Upper Passaic Basin.

Cost ($ million) Capital _____ O & M _____ $/MG _____ Year _____ ENR _____ Source _____ Note None Available

Identified Problems Yields and pipe carrying capacity and discharge rates to streams have not been determined. Costs not developed.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 1/31/78 Revised 1 _____ Revised 2 _____

ALTERNATIVE PROJECT DESCRIPTION

No. 14 Name ROUND VALLEY RESERVOIR EXPANSION L.O.R.D.S. No. 24-34-300

Region(s) 1 Basin(s) Raritan County(ies) Hunterdon

Author NJ Title News Report Nov. 1971 Library No. 202 (News R-5)
Water Resources Circ. 21 1006
EIS (R.V.-Confluence Force Main) 1016

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	+20			+27	

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒
See Project No. 5

Enlargement of Round Valley Reservoir from 55 BG to 75 BG by modification to two dams and a dike, raising water flow line elevation 25 feet to elevation 410 msl. This expansion is considered as part of other alternative water supply projects:

See : Confluence Reservoir - Proj. 3
Delaware River Diversions - Proj. 6 and 15

Existing Round Valley Reservoir is designed to release up to 400 mgd ('60s drought) at the North Dam to the South Branch Rockaway Creek and/or the proposed force main to Confluence (Proj. 3); the former is limited by small stream bed. Annual average flows involve 90 mgd passing flow at Bound Brook, and 160 mgd for sale. With Proj. 3, 210 mgd is available for sale and with Project 14, 237 mgd (1960's drought). Peak demand would require 405 mgd (60 + 150% x 237) release flow without consideration of 1930's drought yield nor storage of Delaware River waters at Round Valley. Round Valley and Spruce Run release facilities can provide 400 and 150 mgd, respectively, at minimum storage conditions.

1969 Bond issue authorized $15 million for construction of North Dam outlet pipe. Millions spent: $0.1 design; $0.3 acquisition, $9.3 construction. Millions to be spent: $0.03 acquisition, $2.0 construction.

Cost ($ million) Capital 7.0 Year 1973 Note
O & M ENR
$/MG Source 511

Identified Problems

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 2/9/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 15 Name Flat Brook - Raritan High Flow Skimming L.O.R.D.S. No. Atlas Sheets 21,24

Region(s) 1, 6 Basin(s) Delaware, Flat Brook, Raritan County(ies) Sussex

Author Env. Def. Fund Title Alt. to Tocks Is. Res.; M. Disko Assoc., Oct. 1973 Library No. 511 (EDF Alt. #2)

Data Availability/Reliability Good

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS FA, PS	22.0			300	

Limitations on yield *Capacity and outlet works at Round Valley

Narrative description Figure: No ☐ Yes ☒

EDF preferred alternative to TILP. Construction of a 22.0 BG reservoir at Flat Brook; a 400 mgd pumping station at the confluence of the Delaware and Flat Brook Rivers; a 400 mgd pumping station at Frenchtown; a 14-mile, 400 mgd pipeline from Frenchtown to Round Valley Reservoir; enlargement of Round Valley Reservoir from 55 BG to 75 BG; and construction of more adequate Round Valley Reservoir outlet facilities.

1. maintains 3000 cfs at Trenton
2. no special oyster requirements in effect
3. NYC obligation satisfied

(If no diversions in April, May and June, a 32.0 BG reservoir is required at Flat Brook)

See also project no. 14. Release flow is 405 mgd from Project No. 13 and 450 mgd (150% x 300) for Project No. 15, totalizing as 855 mgd. Round Valley can release 530 to 400 mgd and Spruce Run 275 to 150 mgd from maximum to minimum storage conditions.

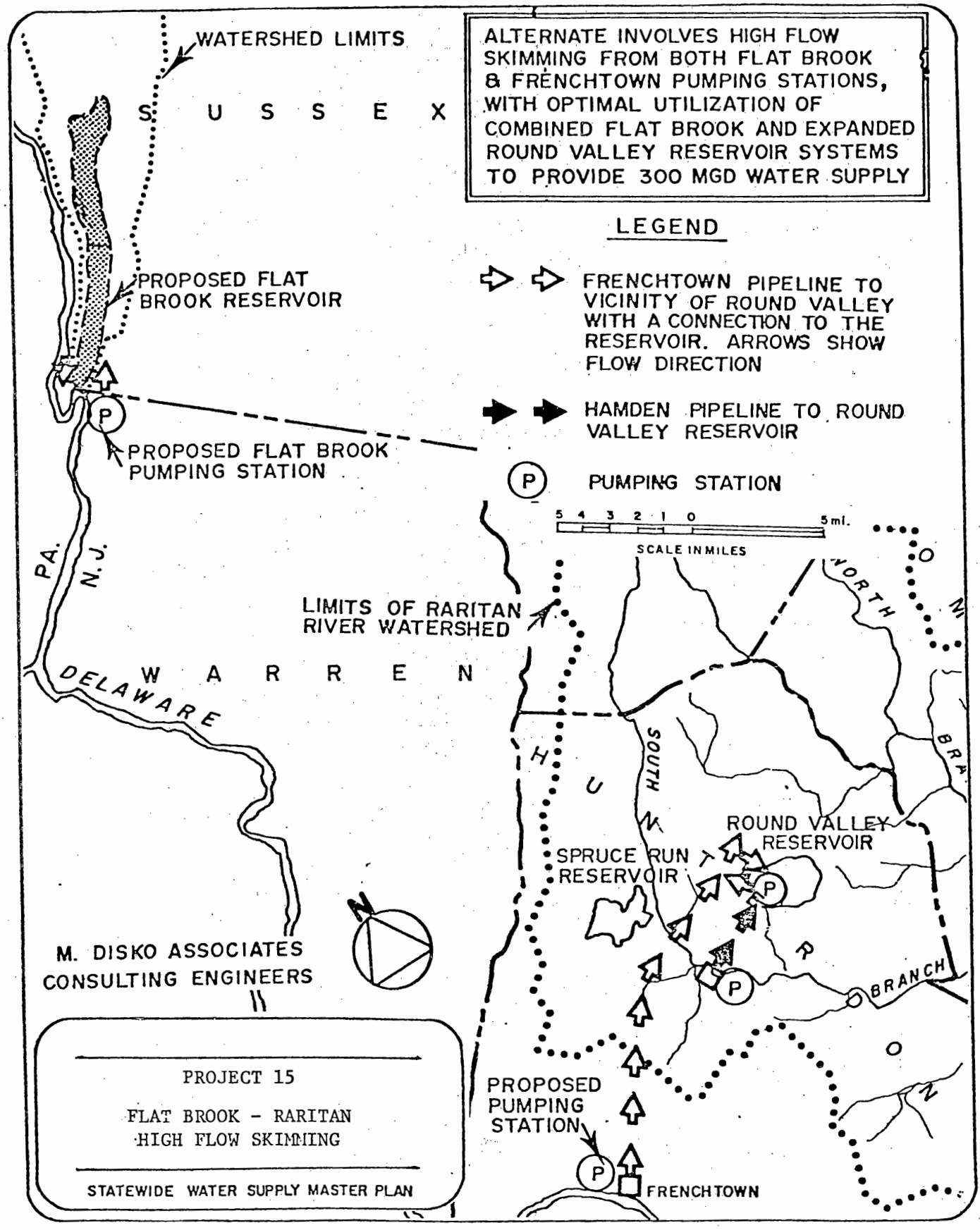
Problems. Insufficient release flow capacity at Round Valley and Spruce Run at certain storage elevations.

Cost ($ million) Capital 92.0 Year 7/1970 Note * 3-1/8 - 10% discount rate
O & M 6.3-9.5* ENR
$/MG Source 511

Identified Problems NYC ability to meet legal requirement of 1750 cfs at Montague.
Environmental impacts at Flat Brook
Insufficient capacity at Round Valley

Project Status: Proposed ☒ Realistic ☐
Potential ☐ Unrealistic ☒
Discarded ☐

Prepared 2/9/78 Revised 1 Revised 2


WATERSHED LIMITS
S U S S E X
ALTERNATE INVOLVES HIGH FLOW SKIMMING FROM BOTH FLAT BROOK & FRENCHTOWN PUMPING STATIONS, WITH OPTIMAL UTILIZATION OF COMBINED FLAT BROOK AND EXPANDED ROUND VALLEY RESERVOIR SYSTEMS TO PROVIDE 300 MGD WATER SUPPLY
LEGEND
PROPOSED FLAT BROOK RESERVOIR
FRENCHTOWN PIPELINE TO VICINITY OF ROUND VALLEY WITH A CONNECTION TO THE RESERVOIR. ARROWS SHOW FLOW DIRECTION
HAMDEN PIPELINE TO ROUND VALLEY RESERVOIR
PROPOSED FLAT BROOK PUMPING STATION
PUMPING STATION
5 4 3 2 1 0 5 mi.
SCALE IN MILES
PA.
N.J.
LIMITS OF RARITAN RIVER WATERSHED
W A R R E N
DELAWARE
NORTH
SOUTH
BRANCH
ROUND VALLEY RESERVOIR
SPRUCE RUN RESERVOIR
M. DISKO ASSOCIATES
CONSULTING ENGINEERS
PROJECT 15
FLAT BROOK - RARITAN
HIGH FLOW SKIMMING
STATEWIDE WATER SUPPLY MASTER PLAN
PROPOSED PUMPING STATION
FRENCHTOWN

ALTERNATIVE PROJECT DESCRIPTION

No. 16 Name Hacklebarney Reservoir L.O.R.D.S. No. 25-21-200

Region(s) 1 Basin(s) Raritan, Lamington County(ies) Morris

Author NJ Title TAMS Report 1955 Library No. 757
Reservoir Sites NJ, 1966 810
NEWS Study, 1971 202

Data Availability/Reliability Good

Purpose(s) WS Storage(BG) 11 Yield (mgd) 30's drought 60's drought Other

Limitations on yield Possible conflict with Confluence Pump Station

Narrative description Figure: No ☒ Yes ☐

Originally conceived as the 2.9 BG Pottersville Reservoir on the Lamington River with flow line elevation of 400 feet MSL. Original plan was to operate in tandem with Oldwick site (now "lost"). This and loss of McCrea Mills site were compensated by new concept of 11.0 BG Hacklebarney Reservoir at Pottersville site. Drainage area is 33 square miles. Much of site has been acquired under Green Acres and is currently Hacklebarney State Park. Could also be developed for local supply only and stream flow augmentation along the Lamington River. Hydrological analysis for the Raritan River Basin diversions at Bound Brook might indicate a reduction in the pump rates for the Hamden and Raritan Confluence pumping stations to Round Valley Reservoir and flow releases therefrom.

Pottersville Reservoir provides 2.2 BG usable storage with concrete dam 1,200 feet long and 150 feet high (existing).

Cost ($ million) Capital Year Note None available
O & M ENR
$/MG Source

Identified Problems State Park inundated.

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/9/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 17 Name Ravine Lake Reservoir L.O.R.D.S. No. 25-22-100

Region(s) 1 Basin(s) Raritan, North Branch County(ies) Somerset, Morris

Author NJ; —; — Title Site Acquis. Rpt. 1966; Reservoir Sites NJ, 1966; NEWS Report 1971 Library No. 1017; 810; 202

Data Availability/Reliability Fair

Purpose(s) WS, WS Storage(BG) 11, 8 (Usable) Yield (mgd) 30's drought 60's drought Other

Limitations on yield Possible conflict with Confluence Pump Station

Narrative description Figure: No ☒ Yes ☐

Dam on North Branch of Raritan above Far Hills and South of Morris County would inundate existing Ravine Lake. Drainage area is 27 square miles. Storage of 8 BG provided by spillway crest at 318.5 feet MSL. Site privately held by ten or fewer owners and is not conducive to real estate development (steep slopes). While considered small for a regional project, it might be operated as a terminal storage reservoir for a Delaware River diversion.

Could be developed for local supply and stream flow augmentation for the North Branch Raritan River. Hydrological analysis for the Raritan River Basin diversions at Bound Brook might indicate a reduction in the pump rates for the Hamden and Raritan Confluence pumping stations to Round Valley Reservoir and flow releases therefrom.

Cost ($ million) Capital 8.8 O & M — $/MG — Year 1971 ENR 1400 Source 202 Note 1966 site costs at $1.75 million

Identified —

Problems —

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/8/78 Revised 1 — Revised 2 —

ALTERNATIVE PROJECT DESCRIPTION

No. 18 Name Bunnvale Reservoir L.O.R.D.S. No. 24-24-400

Region(s) 1 Basin(s) Raritan, South Branch County(ies) Hunterdon

Author NJ Title Round Valley Rpt. 1961; NJ Reservoir Sites 1966 Library No. 1207.04; 810

Data Availability/Reliability Fair

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS					>50

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Proposed by NJ 1930 as a high level supply with dam at Bunnvale about 3 miles north of High Bridge. Three communities would have been innundated. Referendum of 1930 for $7 million passed. Revised proposal in 1931 rebutled Chimney Rock proposal by NJDWSC. Money never available due to depression. Site never reconsidered seriously.

Could be developed for local supply and stream flow augmentation for the South Branch Raritan River. Hydrological analysis for the Raritan River Basin diversions at Bound Brook might indicate a reduction in the pump rates for the Hamden and Raritan Confluence pumping stations to Round Valley Reservoir and flow releases therefrom. The "developed" status has been questioned.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None available

Identified Problems Site has been developed.

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☐ Unrealistic ☒ Developed. Does not meet environmental screening criterion.

Prepared 2/9/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 19 Name McCrea Mills Reservoir L.O.R.D.S. No. 24-25-400

Region(s) 1 Basin(s) Raritan, North Branch Rockaway County(ies) Hunterdon

Author NJ Title Res. Site Capacity 1966 Library No. 810

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Dam on North Branch of Rockaway Creek at McCrea Mills, about 4 miles northeast of Round Valley. Considered by NJ as possible alternative to Big North Branch Reservoir (project 21). No longer under serious consideration.

Cost ($ million) Capital Year Note None available
O & M ENR
$/MG Source

Identified Problems Abandoned from consideration in 1962 due to working rock quarry at dam site.

Project Status: Proposed ☐ Realistic ☐ Developed. Does not meet environmental screening criterion.
Potential ☐ Unrealistic ☒
Discarded ☒

Prepared 2/9/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 20 Name Oldwick Reservoir L.O.R.D.S. No. 25-21-500

Region(s) 1 Basin(s) Raritan, Lamington County(ies) Somerset, Hunterdon

Author NJ Title Reservoir Site Capacity Library No. 810

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) 4.8 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

On stream reservoir on Lamington River east of Oldwick. Proposed for operation with Hacklebarney Res. (Proj.16) for Raritan development. No longer under serious consideration.

Could be developed for local supply and stream flow augmentation for the lower Lamington River. Hydrological analysis for the Raritan River Basin diversions at Bound Brook might indicate a reduction in the pump rates for the Hamden and Raritan Confluence pumping stations to Round Valley Reservoir and flow releases therefrom.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note 1966 site cost $1.4 million (760 acres)

Identified Problems Innundation of cemetaries, roads, developed area. High real estate costs.

Project Status: Proposed ☐ Potential ☐ Discarded ☒ Realistic ☐ Unrealistic ☒ Developed. Does not meet environmental screening criterion.

Prepared 2/9/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 21 Name Big North Branch Reservoir L.O.R.D.S. No. 25-31-300

Region(s) 1 Basin(s) Raritan, North Branch County(ies) Somerset, Hunterdon

Author NJ Title TAMS Report 1955 Library No. 757
Res. Site Capacity 1966 810
NEWS Study 1971 202

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) 16 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Dam immediately south of confluence of the Lamington River and the North Branch Raritan River, east of Burnt Mill. Proposed in 1955 to regulate flow at Bound Brook for 130 mgd. One of four reservoir sites evaluated. Considered pumping to Chimney Rock Reservoir as attractive. Not selected for below listed problems. NEWS discarded as unsuitable, replaced by Confluence Reservoir. Need for BNB Res. supplanted by Round Valley - Spruce Run Project. BNB is no longer under serious consideration.

Storage	Elevation
10 BG	105 feet
16 BG	112 feet
30 BG	120 feet

Also could be developed for local supply and stream flow augmentation for the Upper South Branch Raritan River. Hydrological analysis for the Raritan River Basin diversions at Bound Brook might indicate a reduction in the pump rates for the Hamden and Raritan Confluence pumping stations to Round Valley Reservoir and flow releases therefrom.

Cost ($ million) Capital 6 Year 1955 Note
O & M ENR
$/MG Source 757

Identified Problems Valuable agricultural acreage; high real estate costs; interstate highways 78 and 287 and State Route 22. Loss of 30% Bedminister Twp. area.

Project Status: Proposed ☐ Realistic ☐
Potential ☐ Unrealistic ☒
Discarded ☒

Developed. Does not meet environmental or implementation criteria.

Prepared 2/9/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 22 Name Chimney Rock Reservoir (East Branch Reservoir) L.O.R.D.S. No. 25-32-400

Region(s) 1 Basin(s) Raritan (Millstone) County(ies) Somerset

Author NJ Title Res. Site Cap. is running out in NJ-D.J.Kroeck, NJ Div. WS&P Jan. 1966/TAMS Rpt. 1955 Library No. 810/757 (TAMS CR-3)

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd) 30's drought	60's drought	Other
WS, PS	26.0	70.0		

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Site situated between the First and Second Watchung Mountains north of the Borough of Bound Brook (Washington Valley). Sources of water include the North and South Branches of the Raritan River and the Millstone River.

Flow line elev.:	290.0	feet	East Branch: 57% of flooded area
Flooded area:	1690	acres	of entire C.R. site; 64% of storage
Total area:	1900	acres	capacity; 59% of total area.

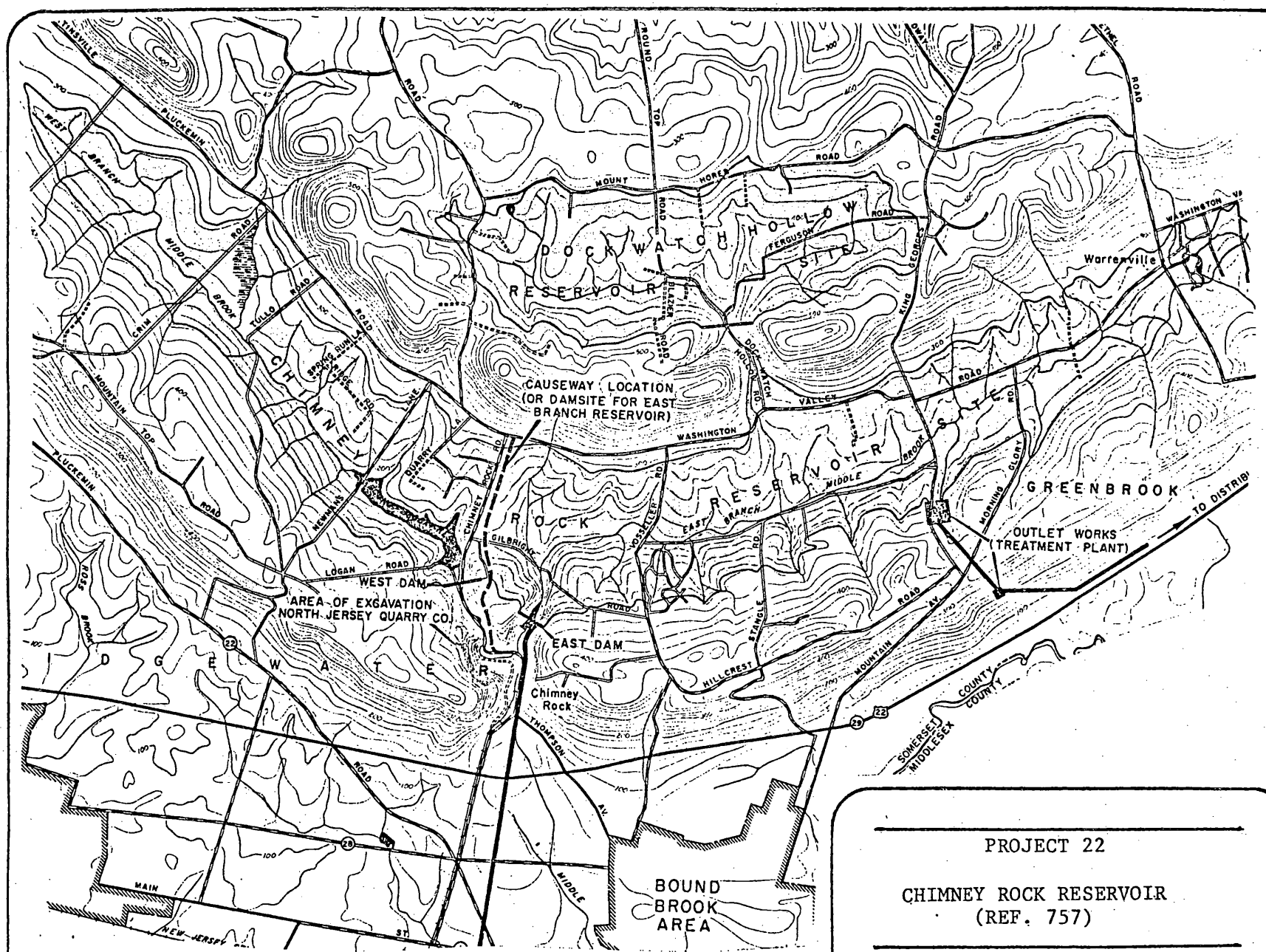
110 mgd pumping station at Bound Brook.
Useable storage 22.1 BG.
Adding pumping and force main capacity could increase dependable yield to 140 mgd.

Cost ($ million)					
Capital	32.97	Year	1955	Note	Capital (incl. Spruce Run. Res.)
O & M	2.09	ENR			
$/MG	$82/MG	Source	TAMS		

Identified Developed site; part of defeated Bond Referendum 1955.
Problems

Project Status: Proposed ☐ Potential ☐ Discarded ☒ Realistic ☐ Unrealistic ☒ Does not meet environmental implementation criteria.

Prepared 2/9/78 Revised 1 Revised 2



PROJECT 22

CHIMNEY ROCK RESERVOIR
(REF. 757)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 23 Name Rocky Hill Reservoir (Bedens Brook) L.O.R.D.S. No. 28-02-400

Region(s) 1 Basin(s) Raritan (Millstone) County(ies) Somerset

Author	Title	Library No.
NJ	Res. Site Capacity 1966	810
	TAMS 1955	757
	NEWS Report 1971	202

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	9				

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Site "lost" in early 1960 when a preliminary detailed study indicated that the relocation of people, houses, and the interference with the New Jersey Neuro Psychiatric Institute at Skillman would be too costly. Located on Bedens Brook about 0.3 miles upstream from the confluence with the Millstone River, some 3 miles north of Princeton.

Drainage area - 50 sq. mi.
Spillway crest elev. - 80 ft. above msl
Reservoir Water Area - 2,180 acres
Dam - 2,600 ft. in length and max. height of 53 ft. (earth)

Cost ($ million)				
Capital	4.0	Year	1955	Note
O & M		ENR		
$/MG		Source	757	

Identified Problems: High cost of relocation, irregular configuration with shallow fingers have potential water quality problems.

Project Status: Proposed ☐ Potential ☐ Discarded ☒ Realistic ☐ Unrealistic ☒ Does not meet environmental or implementation criteria.

Prepared 2/9/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 24 Name Stony Brook Reservoir L.O.R.D.S. No. 28-11-200

Region(s) 1 Basin(s) Raritan, Millstone County(ies) Mercer
Stony Brook

Author NJ Title Res. Site Capacity 1966 Library No. 810
TAMS 1955 757

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) 10 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Site 2 miles west of center of Princeton. The earth dam would be 1,900 ft. long at the crest with a maximum height of about 80 ft. above the stream bed, with a flow line at elev. 152. Flooded area of 1,520 acres. Drainage area above dam: 38 sq. mi. TAMS considered this, with Spruce Run, Rocky Hill and North Branch Reservoirs for regulating flow at Bound Brook. Need for Stony Brook supplemented by Round Valley and Spruce Run Reservoirs. Serious public opposition in 1957 to Stony Brook site as part of regional system. Might be considered for local supply or stream flow augmentation for the Lower Millstone River. However, D&R Canal with Six Mile Run Reservoir (Proj. 8) storage offers better local supply potential.

Cost ($ million) Capital 4.64 Year 1955 Note
O & M ENR
$/MG Source 757

Identified Problems

Project Status: Proposed ☐ Realistic ☐
Potential ☐ Unrealistic ☒
Discarded ☒

Prepared 2/9/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 25 Name Bartley Reservoir L.O.R.D.S. No. 25-11-200

Region(s) 1 Basin(s) Raritan, South Branch County(ies) Morris

Author NJ Title Raritan RB Nat. Flow 1974; NEWS Report 1971 Library No. 1008.01, 202

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	10.5			10	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Located in Mount Olive Township on the South Branch Raritan River above Bartley, about 5 miles downstream of the Budd Lake Dam. NEWS P-2 (Project 28) contemplated Bartley as one of three terminal storage reservoirs for Delaware River Water being delivered to Two Bridges and Great Notch. Also considered (1008.01) as terminus for Upper Raritan Pipeline (Project 13) discharging Round Valley water to the South Branch Raritan River.

Area:	Water	450 acres
	Land	490 acres
Drainage Area		13 sq. mi.
Spillway		900 feet MSL

Cost ($ million): Capital ____ Year ____ Note None available. 1966 site costs $2.7 million per NJ.
O & M ____ ENR ____
$/MG ____ Source ____

Identified Problems: Remote location, high pumping expense.

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/9/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 26 Name Schooleys Mountain Reservoir (Stony Brook) L.O.R.D.S. No. 24-15-100

Region(s) 1 Basin(s) Raritan South Branch, Stony Brook County(ies) Morris

Author NJ Title NEWS Report 1971 Res. Site Acquisition Library No. 202 810

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) 27 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Located in Mount Olive Township on Stony Brook immediately west of confluence with Raritan South Branch, east of Schooley's Mountain (elev. 1208). NEWS P-2 (Project 28) contemplated Schooley's Mountain as one of three terminal storage reservoirs for Delaware River water.

Spillway	1,000 feet MSL
Drainage area	4 square miles
Area - water	1,095 acres
land	55 acres

Cost ($ million) Capital 20 O & M $/MG Year 1971 ENR 1400 Source 202 Note

Identified Problems Redundant to TILP (Project No. 55) and Round Valley which could be used equally well for seasonal storage; site residentially developed.

Project Status: Proposed ☐ Potential ☐ Discarded ☒ Realistic ☐ Unrealistic ☒ Developed site. Does not meet environmental criterion.

Prepared 2/2/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 27 Name Two Bridges Reservoir (w/Myers Road) (Passaic River Flood Control Plan III) L.O.R.D.S. No. 26-01-400

Region(s) 1 Basin(s) Passaic, Pompton County(ies) Essex, Morris

Author	Title	Library No.
Corps	Passaic Flood Plan, 1968	231
	NEWS Reports 1971, 1973	202.205.03
	NEWS Report 1977	229.07

Data Availability/Reliability Good

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS	26			100	

Limitations on yield Competing diversions from Ramapo (NJDWSC) and Pompton (PVWC)

Narrative description Figure: No ☐ Yes ☒

Proposed by Corps (231, 1968) as part of preferred "Alternative Plan III Multiple Purpose" (see figure), which included:

(1) Flood Control using dry detention at Two Bridges, Whippany, and Myers Road sites along with levees and channel improvements on the Upper Passaic, Whippany, Ramapo, Pompton and Passaic Rivers.

(2) Water Supply of 90 mgd surface water and 8 mgd groundwater at Two Bridges.

(3) Flow Augmentation of 38 mgd to Upper Passaic from Myers Road.

(4) Recreation benefits for 7.8 million people annually.

Total costs in 1968 were $415 million capital and $4.2 million O & M. Water supply costs estimated at $32.6 million capital and $1.3 million O & M with $36/MG.

NEWS P-1 (202, 1971) included Two Bridges and Myers Road for 100 mgd but excluded levees and dry detention in Whippany and along Passaic. NEWS P-2 (202, 1971) includes Two Bridges for developing Delaware supply. Corps (205.03, 1973) preferred System D including P-1.

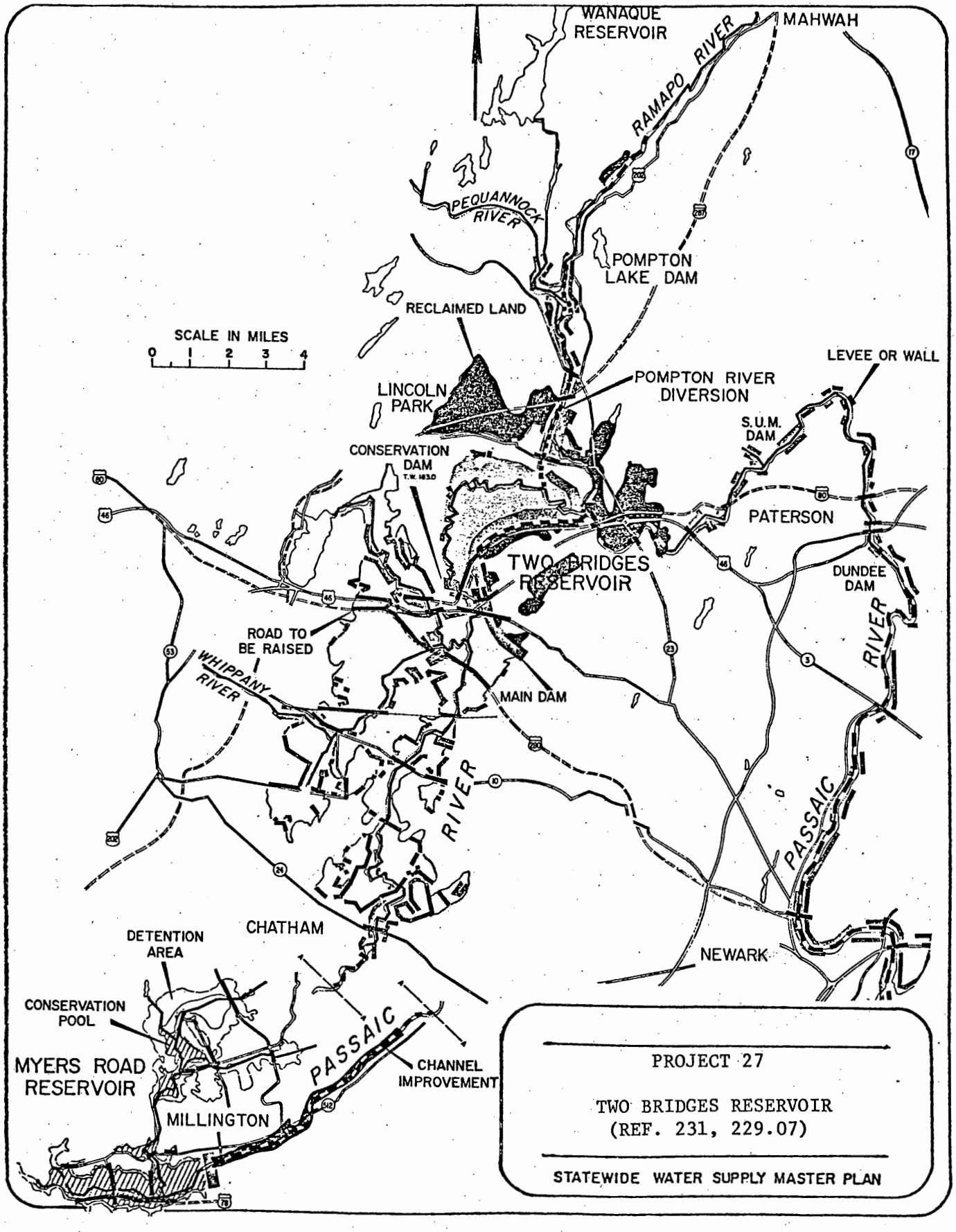
Corps (229.07, 1977) proposed four alternatives for NY Metro Area, two of which included Two Bridges project for 100 mgd. Costs reported below. Potential also for storage of Hudson River water at Two Bridges.

Cost ($ million)					Note
	Capital	130	Year	1975	Two Bridges Reservoir for water supply only.
	O & M	18	ENR		
	$/MG	493	Source	229.07	

Identified Problems: Water quality with shallow reservoir. Substantial development. Reservoirs displace major flood plain area - would require extensive dike system; coordinated operation of reservoir with pumping station MUST be evaluated.

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 3/2/78 Revised 1 Revised 2


WANAQUE RESERVOIR
MAHWAH
RAMAPO RIVER
PEQUANNOCK RIVER
POMPTON LAKE DAM
RECLAIMED LAND
SCALE IN MILES
0 1 2 3 4
LEVEE OR WALL
POMPTON RIVER DIVERSION
LINCOLN PARK
S.U.M. DAM
CONSERVATION DAM
T.W. 183.0
PATERSON
TWO BRIDGES RESERVOIR
DUNDEE DAM
ROAD TO BE RAISED
WHIPPANY RIVER
MAIN DAM
RIVER
PASSAIC
CHATHAM
DETENTION AREA
NEWARK
CONSERVATION POOL
MYERS ROAD RESERVOIR
PASSAIC
CHANNEL IMPROVEMENT
MILLINGTON
PROJECT 27
TWO BRIDGES RESERVOIR
(REF. 231, 229.07)
STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 28 Name Delaware River Diversion
Frenchtown - Two Bridges
L.O.R.D.S. No.
Atlas Sheets 24, 25, 26

Region(s) 1, 6 Basin(s) Delaware, Raritan
Passaic
County(ies) Warren, Morris
Passaic

Author COE
NJ (Kroeck)
Title News Report Nov. 1971
Personal Communications
Library No. 202 (News P-2)

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			400	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Proposed project includes an intake on the Delaware River at Frenchtown, 70 miles of pipeline, five pumping stations and three terminal reservoirs. Water pumped to the Passaic Basin would flow through the proposed 2.0 BG Hardscrabble Reservoir (Proj. 48) to be built on the headwaters of the Passaic River near Bernardsville. Additional pumped storage capacity would be provided in the headwaters of the Raritan River South Branch, at Schooleys Mountain Reservoir (Proj. 26) or at the Bartley site (Proj. 25) just below Budd Lake. A seven mile spur would connect these reservoirs to the main pipeline. Raw water would be drawn at selected points along the pipeline, or from the reservoirs, filtered and delivered to Great Notch.

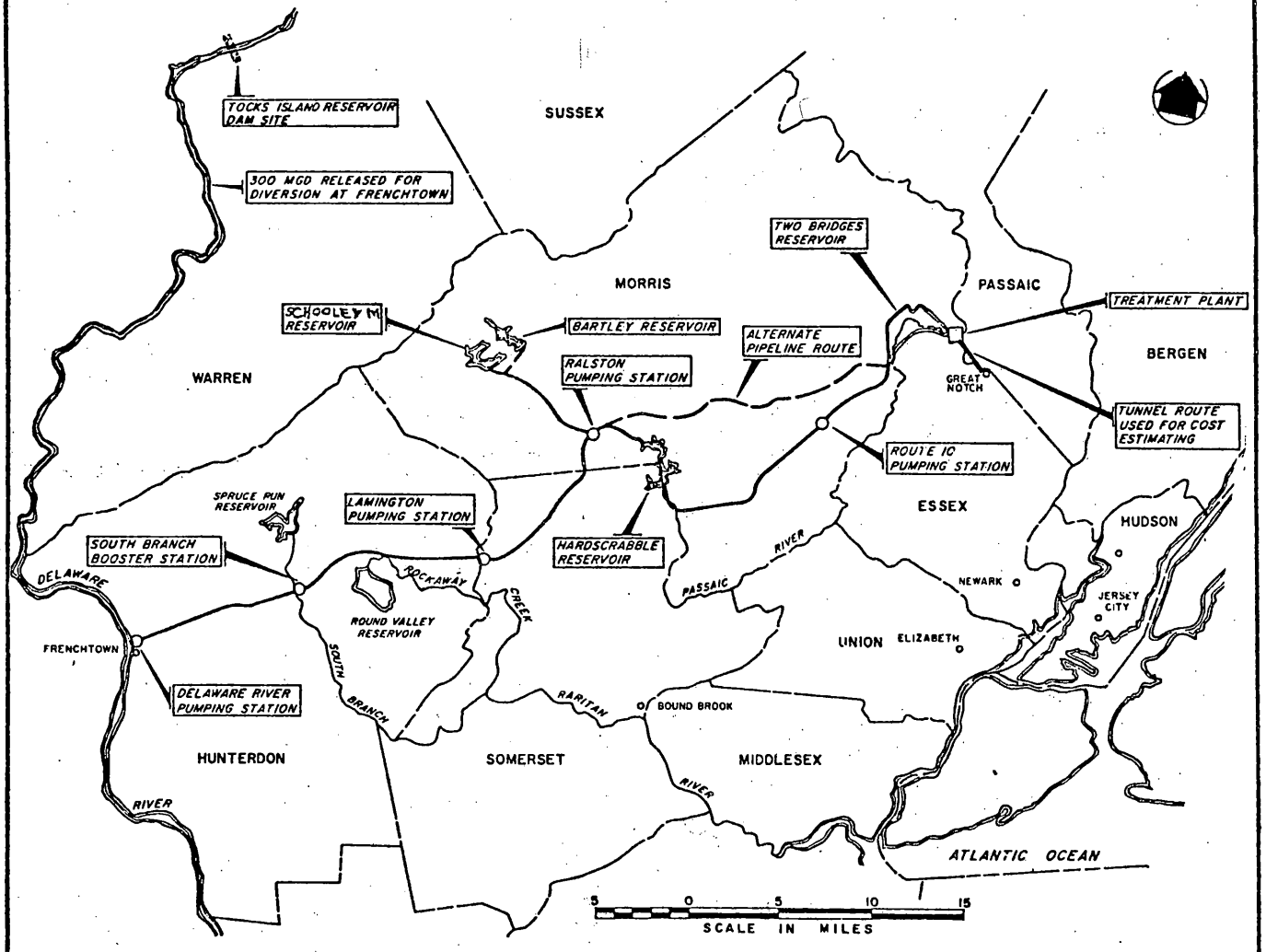
(Costs of building and operating treatment facilities are included in project estimates.) As conceived by New Jersey, numerous other options exist, including Raritan-Passaic pipeline to Dead River.

Cost ($ million)					Note
	Capital	438	Year	1971	Capital and O & M based on Delivery to Secaucus
	O & M	38	ENR	1400	
	$/MG	254	Source	202	$/MG is to Great Notch

Identified Problems High capital expense of surface pipelines; necessity of proposed reservoirs may be in question;

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/2/78 Revised 1 Revised 2



Project 28
Delaware River Diversion
Frenchtown-Two Bridges
(News P-2) ref. 202

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 29 Name Delaware River Diversion to Canoe Brook - Great Notch L.O.R.D.S. No. Atlas Sheets 24, 25, 26

Region(s) 6, 1 Basin(s) Delaware, Raritan, Passaic County(ies) Hunterdon, Somerset, Morris, Union, Essex

Author COE Title News Report 1971 Newark - Alt. WS Projects 1974 Library No. 202 (News P-3) 1206.01

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			300	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Tocks Island release waters would be diverted from the Delaware River at Frenchtown and pumped via tunnel to the Hamden Intake Pool, then flow instream in the South Branch Raritan River to the confluence with the North Branch Raritan River. From there, water would be pumped via tunnel and pipeline to the Dead River and Upper Passaic River, for about 20 miles to a pump station near Chatham, and into the existing Canoe Brook Reservoirs (2.8 BG capacity). The water is then treated and pumped via tunnel to Great Notch.

The project provides flexibility for delivering water to southern Morris Co. and Essex Co. west of the Watchung Mountains

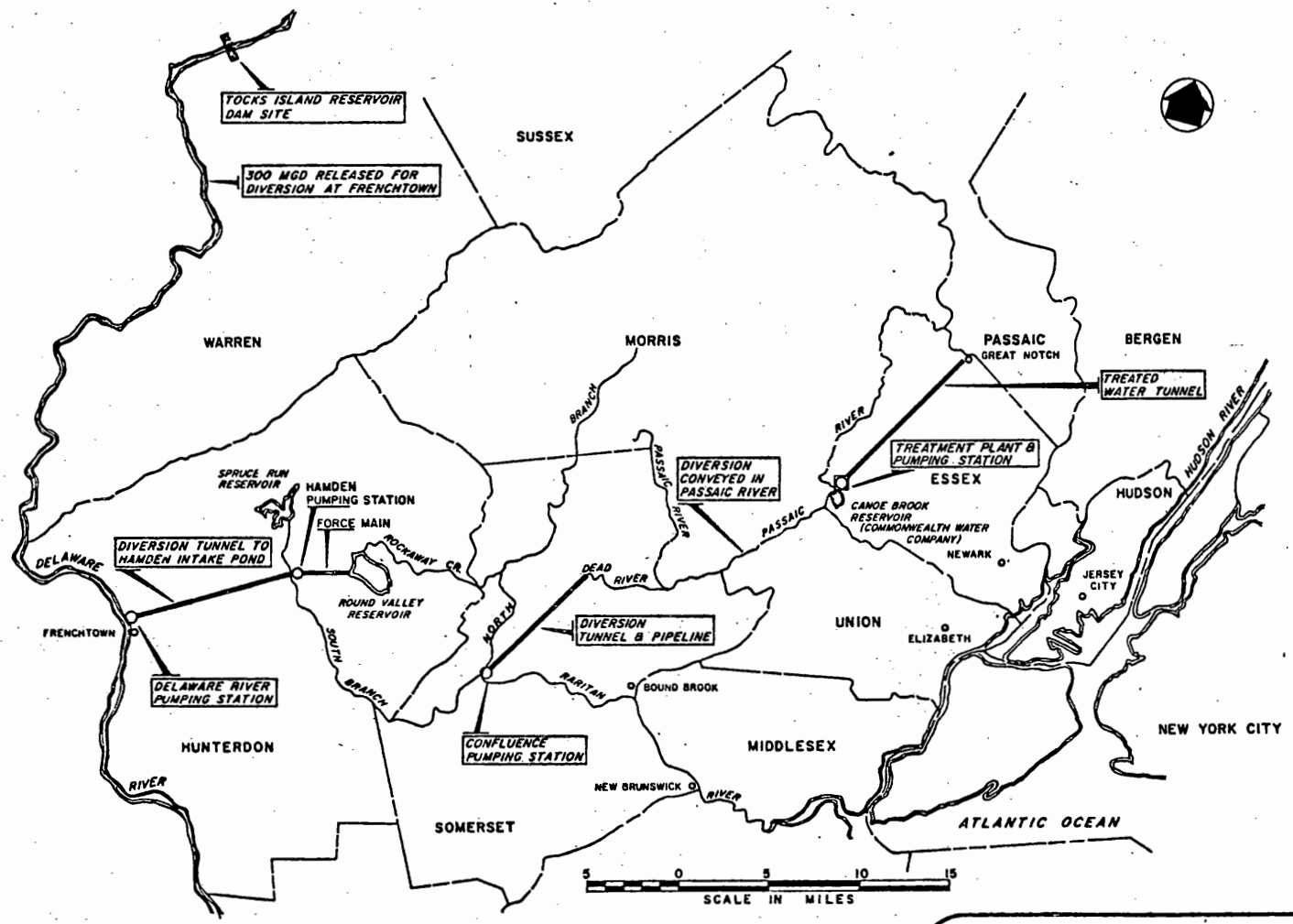
Ref. 202 costs: (1971, ENR 1400):
Capital (to Secaucus) - $276 million
O & M (to Secaucus) - $22 million
$/MG (to Canoe Brook) - $174
(to Great Notch) - $199

Cost ($ million) Capital 322 O & M $/MG 385 Year 1974 ENR Source 1206-01 Note

Identified Problems TILP

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/8/78 Revised 1 Revised 2



Project 29
Delaware River Diversion
to Canoe Brook-Great Notch
(ref. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 30 Name Delaware River Diversion - Port Jervis to Pequannock L.O.R.D.S. No. Atlas Sheets 21 & 22

Region(s) 1 Basin(s) Delaware River, Pequannock River County(ies) Sussex, Morris, Passaic

Author Newark W. D. Title News Report Nov. 1971 Library No. 202 (Proj. P-4)

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, PS	11			150	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

This project would augment the Pequannock River system from the Delaware River. Facilities would include an intake and pumping station at Port Jervis, above Tocks Island (Proj. 55); ten miles of tunnel under the Shawangunk Mountains; and nineteen miles of pipeline to the Newark owned Oak Ridge Reservoir, following a route along Clove Brook and Wallkill Reservoir, including another tunnel section under Hamburg Mountains. The 4.0 BG Oak Ridge Reservoir would be augmented by the 11.0 BG Dunkers Pond Reservoir (Proj. 46) about one mile north of Oak Ridge, to be filled through a force main by lifting Oak Ridge water 350 feet. 10 mgd would be added to the capacity of the Newark-Pequannock system. Water would be released from Oak Ridge Reservoir, as needed, be treated at Charlottesburg, and carried by pipeline to Great Notch. Local systems may also tap off of this pipeline. (cost estimates assume half of Delaware River water delivered to Great Notch.)

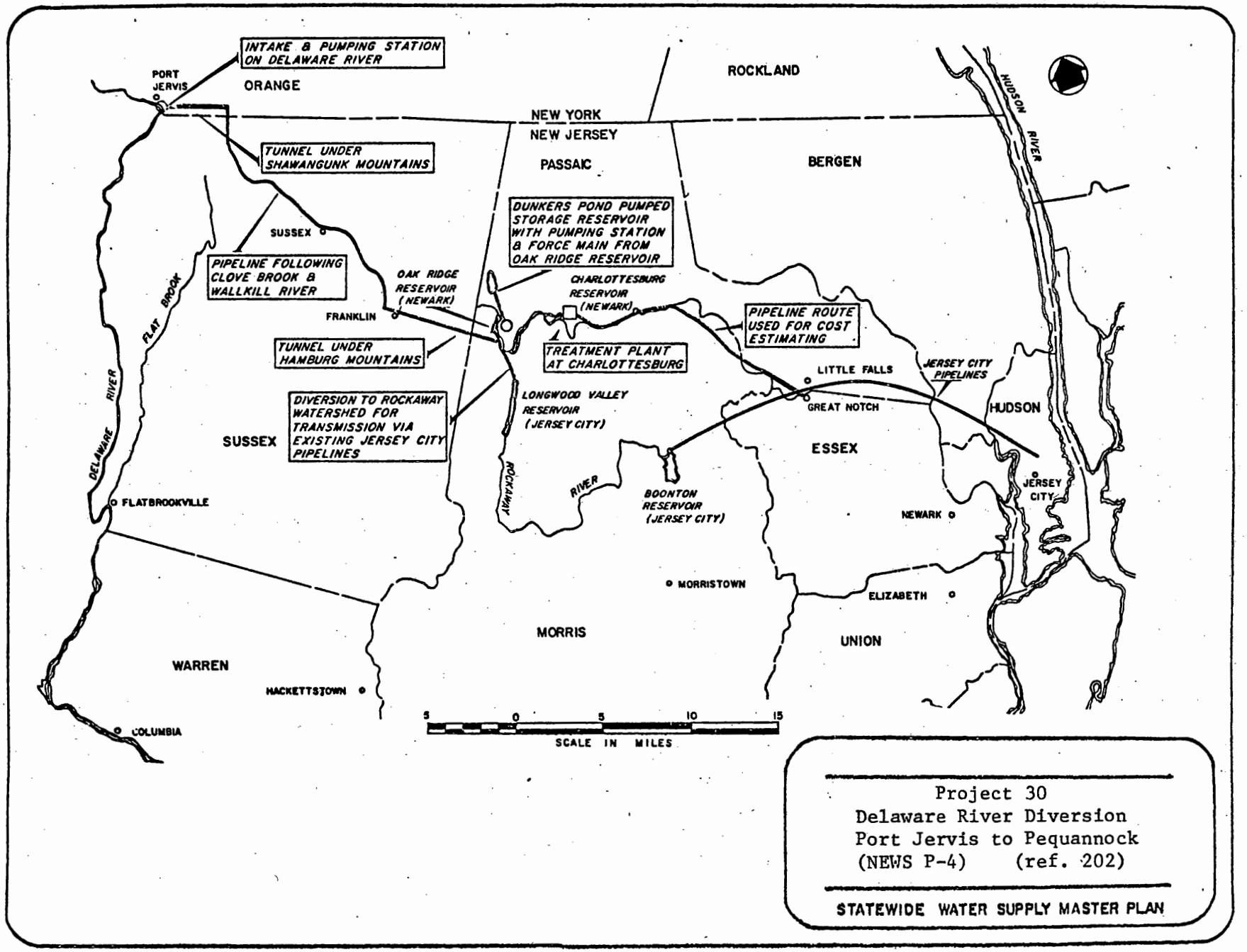
This project could also be used to augment the supply in the Jersey City system (diversion to Longwood Valley Reservoir [Proj. 44] in the Rockaway River watershed) or the supply of the NJDWSC at Pompton Lakes.

Cost ($ million)				
Capital	199.2	Year	1971	Note: Capital and O&M: delivery to Secaucus; $/MG to Great Notch, to Charlottesburg
O & M	15.9	ENR	1400	
$/MG	290, 260	Source	202	

Identified Problems: Development of TILP;

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/13/78 Revised 1 Revised 2



Project 30
Delaware River Diversion
Port Jervis to Pequannock
(NEWS P-4) (ref. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 31 Name Delaware River Diversion Tocks Island to Wanaque L.O.R.D.S. No. Atlas Sheets 21,22,23,36

Region(s) 1,6 Basin(s) Delaware, Passaic, Wanaque County(ies) Sussex, Passaic

Author COE Title News Report Nov. 1971 Library No. 202 (P-5)

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			300.0	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

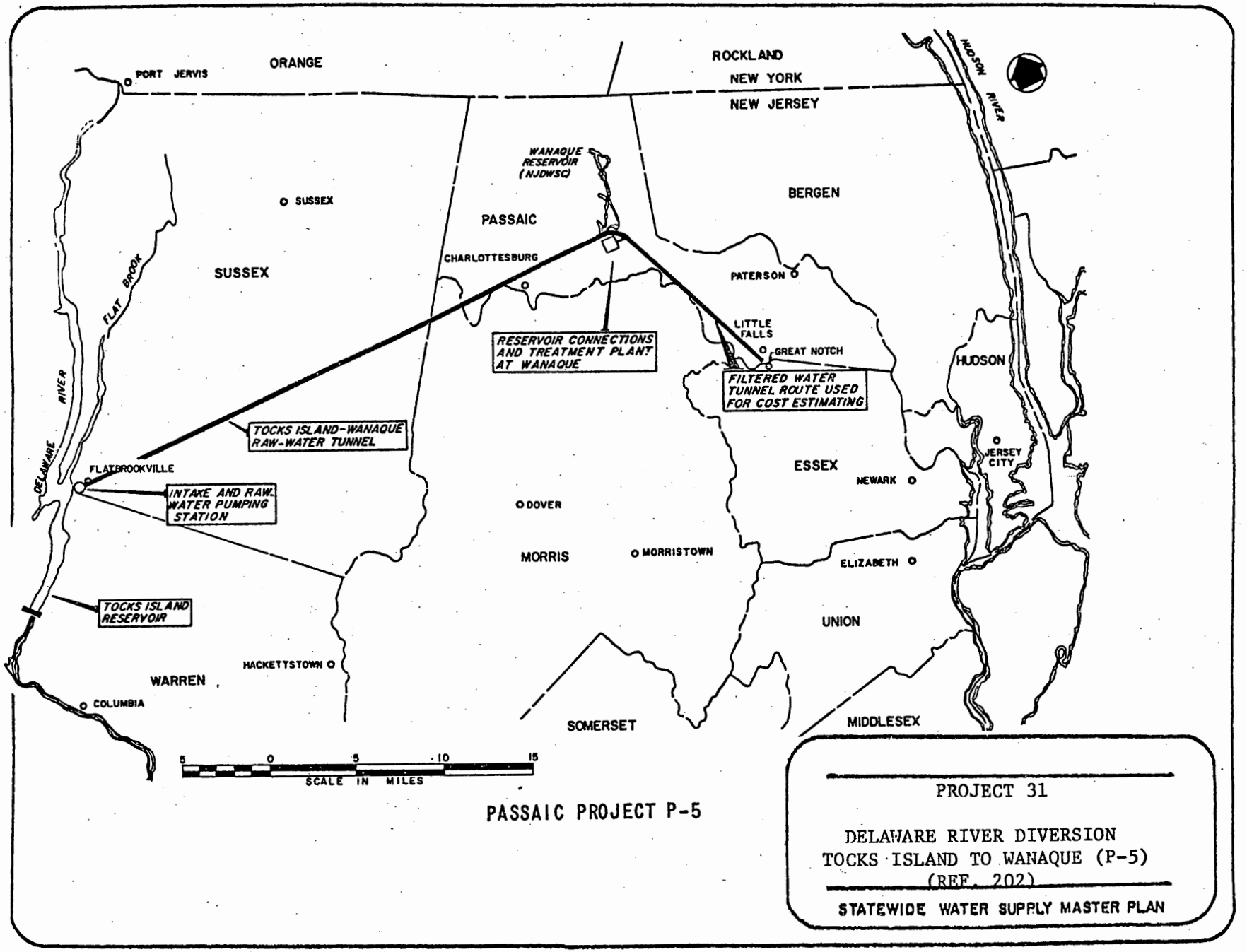
Facilities consist of an intake and pumping station on Tocks Island Reservoir at Flatbrookville, NJ, a 36-mile long, 10-foot diameter tunnel to Wanaque Reservoir, a treatment plant at Wanaque, and a filtered-water transmission tunnel from Wanaque to Great Notch. System capacity of 360 mgd between Tocks Island and Wanaque (for maximum monthly demands) and 450 mgd from Wanaque to Great Notch (for peak day demands). Project would require that NJDWSC convert its present gravity flow transmission system to a pumped flow system. However, even with this conversion it is questionable that transmission system could handle the 300 mgd.

Cost ($ million)					
	Capital	344.3	Year	1971	Note To Great Notch
	O & M	22.6	ENR	1400	
	$/MG	$175/MG	Source	202	

Identified Problems Contingent on Tocks Island. Capacity of transmission system; cost of conversion to a pumped transmission system.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/13/78 Revised 1 Revised 2



PASSAIC PROJECT P-5

PROJECT 31

DELAWARE RIVER DIVERSION
TOCKS ISLAND TO WANAQUE (P-5)
(REF. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 32 Name Hudson River - Ramapo Diversion - Storage in New York L.O.R.D.S. No. Atlas Sheet 23

Region(s) 1 Basin(s) Hudson, Ramapo County(ies) Passaic

Author COE Title News Report 1971, News Report 1973 Library No. 202 (NEWS P-6), 205.03

Data Availability/Reliability Good

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS	34, 102			250, 500	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Two phase project (250 mgd, 500 mgd yield) involving diversion of Hudson River water to the Ramapo River to supplement the Wanaque Reservoir supply of NJDWSC (also includes local supplies to Orange and Rockland Counties, N. Y.) Project includes an intake and pumping station at West Park, N. Y., a 31-mile aqueduct to the headwaters of the Ramapo River atHarriman, N. Y., a pumping station at Pompton Lakes, N. J. and a force main to Wanaque Reservoir. Present filter plant facilities at the Wanaque Reservoir would be expanded. Estimated average diversion of Hudson River for water supply in normal years is 80 mgd, and less in drought years. Storage releases to the Hudson River for salt-front control (drought years only). Storage reservoirs proposed for location on Upper Hudson River.

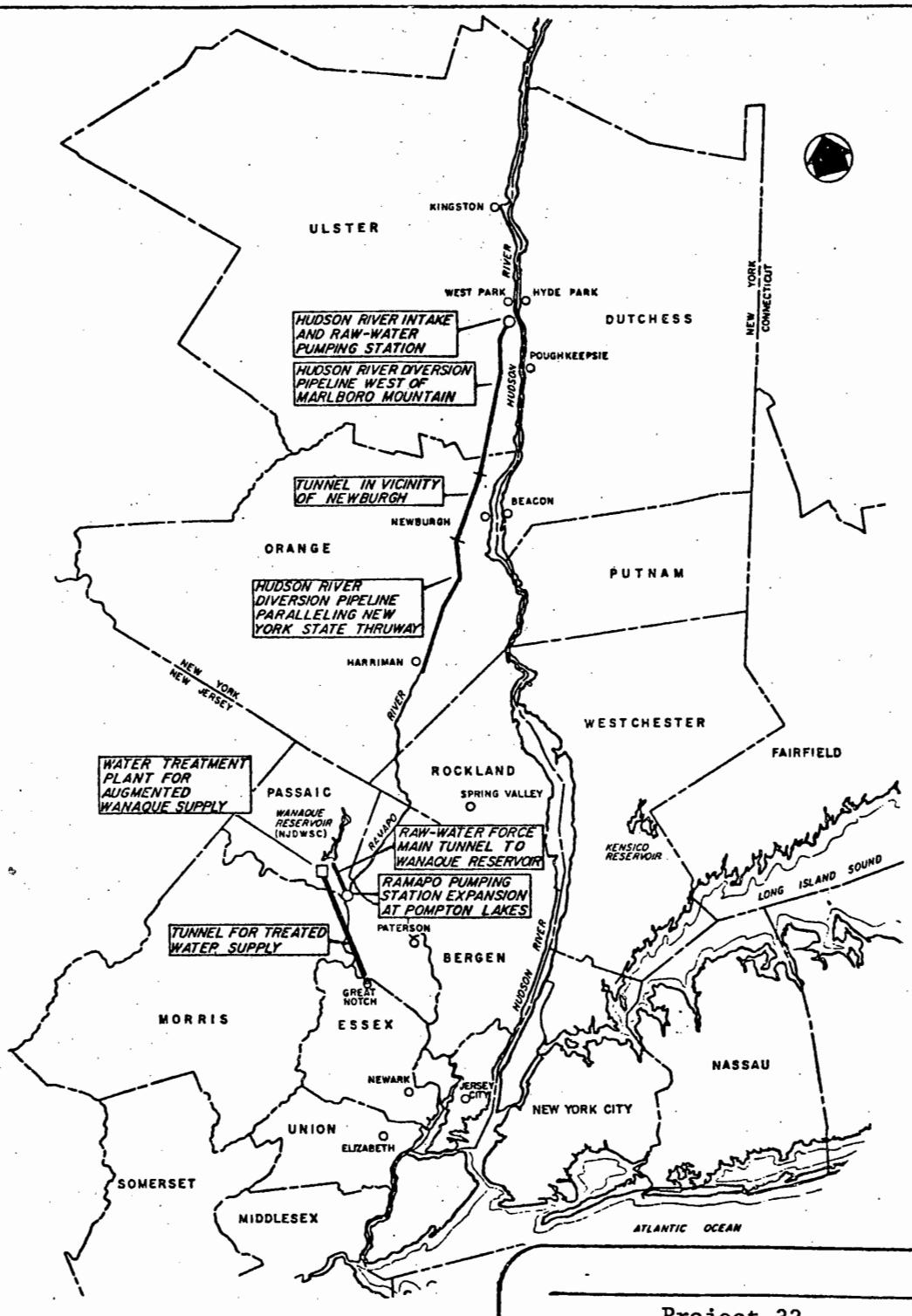
Phase I costs - Delivery to Great Notch (ref. 202, ENR 1400)
Capital - $292 million
O & M - $ 23 million
$/MG - $251

Cost ($ million)					Note
	Capital	473	Year	1971	Delivery to Great Notch; PHASE II facilities
	O & M	40	ENR	1400	
	$/MG	219	Source	202	

Identified Problems: Environmental impact on Ramapo River involves implementation of NEWS Project HU-1, Hyde Park diversion to Kensico Reservoir (N. Y. project)

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 1/24/78 Revised 1 Revised 2



Project 32
Hudson River - Ramapo Diversion
Storage in N. Y.
(ref. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 33 Name Hudson-Ramapo Diversion, Storage Ramapo L.O.R.D.S. No. _____
Atlas Sheets 22,24,26

Region(s) 1 Basin(s) Hudson, Ramapo, Wanaque County(ies) Passaic

Author COE Title News Report, Nov. 1971 Library No. 202 (P-6A)
News Summary Rpt. 7/77 229.07
Rpt. Alt. WSP-Hazen & Sawyer 1206.01 (1974)

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	24.0			250.0	

Limitations on yield _____

Narrative description Figure: No ☐ Yes ☒

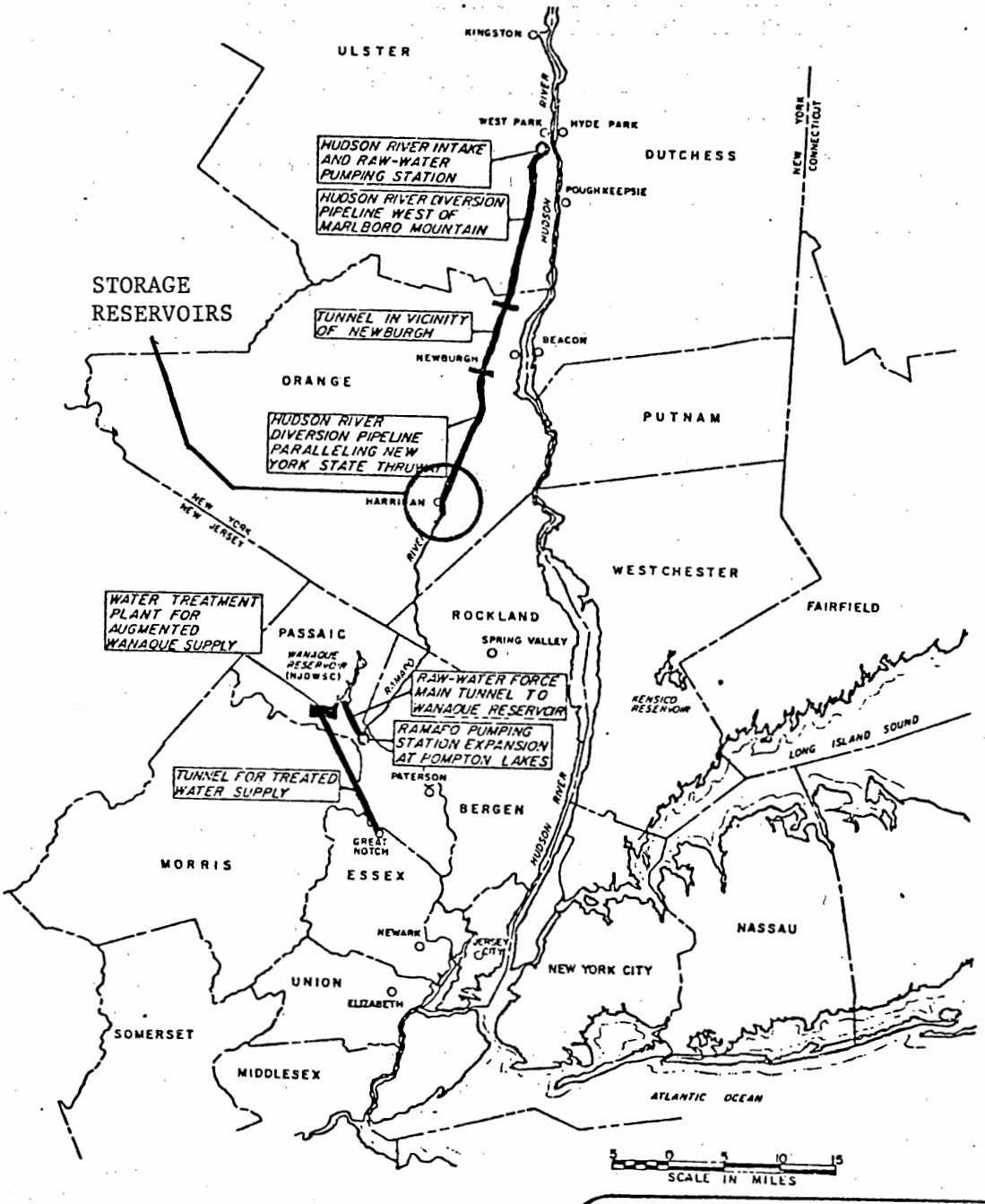
High flow skimming of Hudson River diverted to the Ramapo River to supplement the North Jersey District Water Supply Commission and the Hackensack Water Company. The project would include a pumping station at West Park, NY and a 31-mile aqueduct to the headwaters of the Ramapo River at Harriman, a pumping station at Pompton Lakes and Force main to Wanaque Reservoir; treatment plant and tunnel to Great Notch. Storage in three reservoirs near the Ramapo headwaters, off-stream, for release during low-flow periods.

Cost ($ million) Capital $409.8 Year 1974 Note To Great Notch: (not including Reservoirs)
O & M $50.0(est) ENR _____
$/MG <$573/MG Source 1206.01

Identified Problems Possible adverse environmental impacts of off-stream reservoirs. Expensive.

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/16/78 Revised 1 _____ Revised 2 _____



PROJECT 33

HUDSON RAMAPO DIVERSION
STORAGE RAMAPO (P-6A)
(REF. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 34 Name Hudson River - Little Falls Continuous Skimming L.O.R.D.S. No. Atlas Sheet 23

Region(s) 1 Basin(s) Hudson Passaic County(ies) Passaic

Author COE Title Library No.

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Same as Project 35, with continuous skimming.

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified
Problems

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/16/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 35 Name Hudson River to Little Falls Storage in New York L.O.R.D.S. No. Atlas Sheet 23

Region(s) 1 Basin(s) Hudson, Passaic County(ies) Passaic

Author COE Title News Report 1971; Newark Alt. WS Plans 1974; NJ-NYC-CN Alt. WS Plans Library No. 202 (NEWS HU-6); 1206.01; 1008.04

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			150, 350 (to N. J.)	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Project involves high flow skimming of the Hudson River at West Park and a regional treatment plant at the diversion. Water would be pumped from this plant by pipeline to point near Newburgh, N. Y. where NYC's Delaware and Catskill Aqueducts cross, and a portion would continue southward to Great Notch. Local purveyors in Orange County, N. Y. would divert supplies enroute. Supply to N. J. would be via an independent conduit. Whenever increased transmission capacity was required, a second aqueduct into N. J. would be constructed and a branch tunnel driven under the Hudson to Kensico Reservoir in N. Y. Storage would be located in Upper Hudson River Reservoirs.

Stage I: 800 mgd filtration plant at West Park; tunnel to N. Y. C. aqueducts; extension of 72-inch pipeline to N. J..
Stage II: expansion of treatment plant to 1300 mgd and construction of complete aqueduct system along with Upper Hudson River Impoundments.

Stage I costs: ref. 202, ENR 1400, 1971:
($290 million capital; $30 million O & M; $172/MG)

Cost ($ million)					Note
	Capital	1266	Year	1971	Stage II costs, to Great Notch and Kensico Reservoir
	O & M	110	ENR	1400	
	$/MG	232	Source	202	

Identified Problems (Environmental Impact of N. Y. Storage Reservoirs)

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/21/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 36 Name Hudson River - Great Notch Diversion - Storage in N. J. L.O.R.D.S. No. Atlas Sheet 23

Region(s) 1 Basin(s) Hudson, Passaic County(ies) Passaic

Author COE Title News Report 1971 Library No. 202(HU6a)

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS				150, 350 (to N. J.)	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

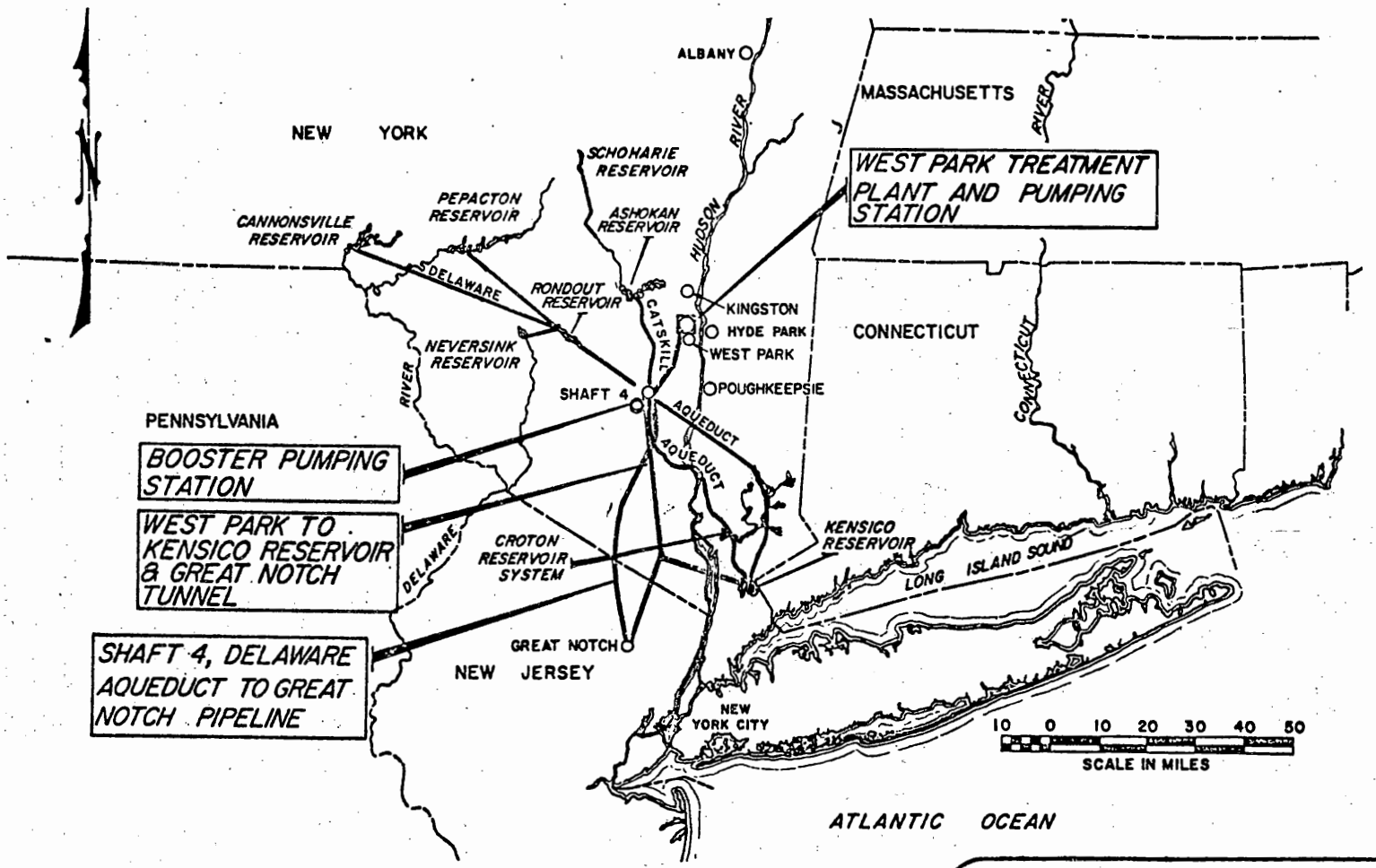
Same as Project 35, with storage in New Jersey at Two Bridges Reservoir or elsewhere.

Cost ($ million)				
Capital		Year		Note: None Available
O & M		ENR		
$/MG		Source		

Identified Problems

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/21/78 Revised 1 Revised 2



Project 35, 36
Hudson River - Little Falls
Diversion - Storage in New York
(ref. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 37 Name Delaware River Control - Transfer from Kensico L.O.R.D.S. No. Atlas Sheets 22,23,26

Region(s) 1 Basin(s) Delaware, Passaic, Hudson County(ies) Bergen, Passaic

Author COE Title News Report Nov. 1971 Library No. 202 (D-2)

Data Availability/Reliability Good

Purpose(s)	Storage	Yield (mgd)	30's drought	60's drought	Other
WS, FA	(BG) 65.0 (TILP)			300.0	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Water in Tocks Island Reservoir assigned to New Jersey would be released to provide some of the downstream flow regulation requirement of New York City. Some or all of the yield (300 mgd) realized from this mode of using Tocks Island would be utilized in New Jersey: via a pressure tunnel built from Kensico Reservoir (NYC) to Great Notch (NJ). Connections with principal NJ supplies could be made enroute or at the terminus.

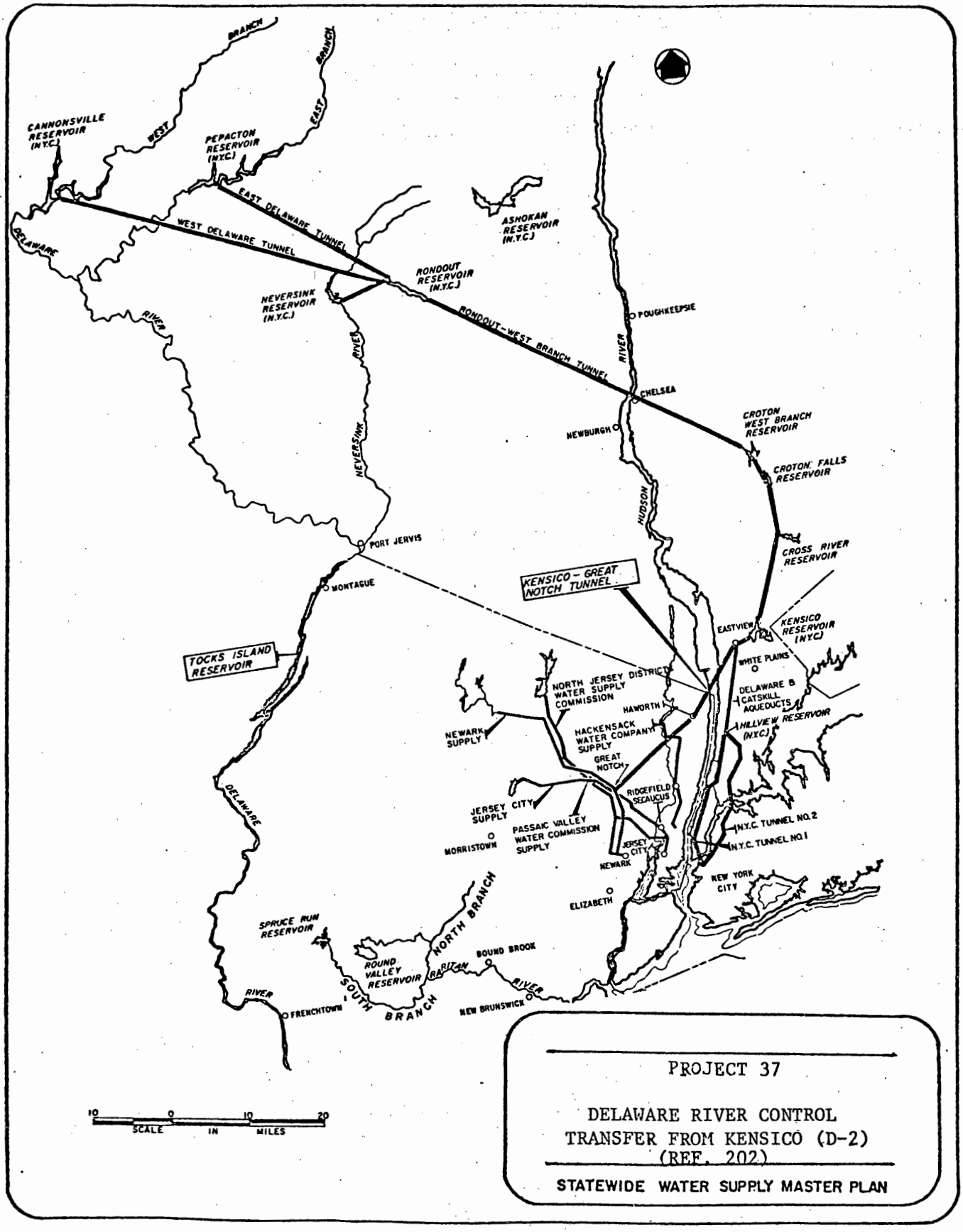
Pumping Station: 13,200 HP
Pressure Tunnel: 27 miles long, 11 ft. diameter

Cost ($ million)				
Capital	$239.4	Year	1971	Note To Great Notch: (300 mgd)
O & M	$ 18.4	ENR	1400	
$/MG	$168/MG	Source	202	

Identified Problems Contingent on Tocks Island Reservoir.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/13/78 Revised 1 Revised 2



PROJECT 37

DELAWARE RIVER CONTROL
TRANSFER FROM KENSICO (D-2)
(REF. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 38 Name Oradell Pipeline L.O.R.D.S. No. 23-40-000
Atlas Sheet 23

Region(s) 1 Basin(s) Hackensack, Passaic County(ies) Passaic, Bergen

Author NJ HWC Title Two Bridges - Ramapo Diversion-Env.Analy.-1977 Library No. 1011

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS				40.0	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Project involves utilization of Hackensack Water Company's Oradell Reservoir on the Hackensack in conjunction with diversion of Passaic River flows. Various alternative schemes have been suggested, including:

1. Wanaque - Oradell Pipeline - see Project 39 Diversion at Two Bridges
2. Wanaque - Oradell Pipeline - Diversion at Little Falls, Delivery to Wanaque, then to Oradell
3. Wanaque - Oradell Pipeline - Diversion below Great Falls, Delivery to Wanaque, then to Oradell
4. Two Bridges - Oradell Pipeline - Diversion at Two Bridges, Delivery to Oradell (and Wanaque)

5. Great Falls - Oradell Pipeline - Diversion at Great Falls, Delivery to Oradell (and Wanaque)

Cost ($ million): Capital 73, O & M 8, $/MG 270 — Year 1977, ENR, Source 1011 — Note: Alternate No. 5; costs based on average year (1968) flows

Identified Problems: Protection of Passaic River water quality; Urban disruption over pipeline routes

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒ — Alternative No. 1 preferred (Proj. 39)

Prepared 2/21/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 39 Name Wanaque - Oradell Pipeline L.O.R.D.S. No. 23-40-000
Atlas Sheet 23

Region(s) 1 Basin(s) Passaic, Wanaque, Hackensack County(ies) Passaic, Bergen

Author HWK, NJDWSC Title Two Bridges - Ramapo Diversion - Env. Eval. 1977, TB-Ramapo 1975 Library No. 1011, 1202.03

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, IC				40	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

As part of the Two Bridges - Ramapo Diversion Project (see Proj. 40), an 11-mile pipeline from Two Bridges to Wanaque Reservoir would be constructed. The Wanaque - Oradell pipeline project involves construction of a Hackensack Water Company Pump Station and a 17-mile force main to Oradell Reservoir- The new pump station would be located near the existing Pompton River pumping station.

Cost ($ million)					Note
	Capital	19	Year	1977	O & M estimated
	O & M	3.4	ENR		
	$/MG	236	Source	1011	

Identified Problems

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/21/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 40 Name Two Bridges - Ramapo Water Diversion Project L.O.R.D.S. No. Atlas Sheets 23, 26

Region(s) 1 Basin(s) Pompton, Ramapo, Passaic County(ies) Passaic, Essex

Author NJDWSC / HWC / NJ Title TB-Ramapo W.D. Project Envir. Eval. April 1977 News Report Library No. 1011 / 202

Data Availability/Reliability Good

Purpose(s) WS Storage(BG) - Yield (mgd) 30's drought 60's drought 79 Other

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Project involves diversion of Ramapo River water to the Wanaque Reservoir utilizing the existing Ramapo River pump station (50 mgd additional, up to 150 mgd, and passing flow of 40 mgd); diversion of water from the confluence of the Pompton and Passaic Rivers at Two Bridges, with construction of an intake and pump station; and transmission of the Two Bridges diversion to Wanaque Reservoir via an 11-mile pipeline (250 mgd). In addition, the project involves construction of a new pump station and a 17-mile pipeline for 40 mgd to Oradell Reservoir (see Project 39) Passing flow at Two Bridges would be 92.6 mgd.

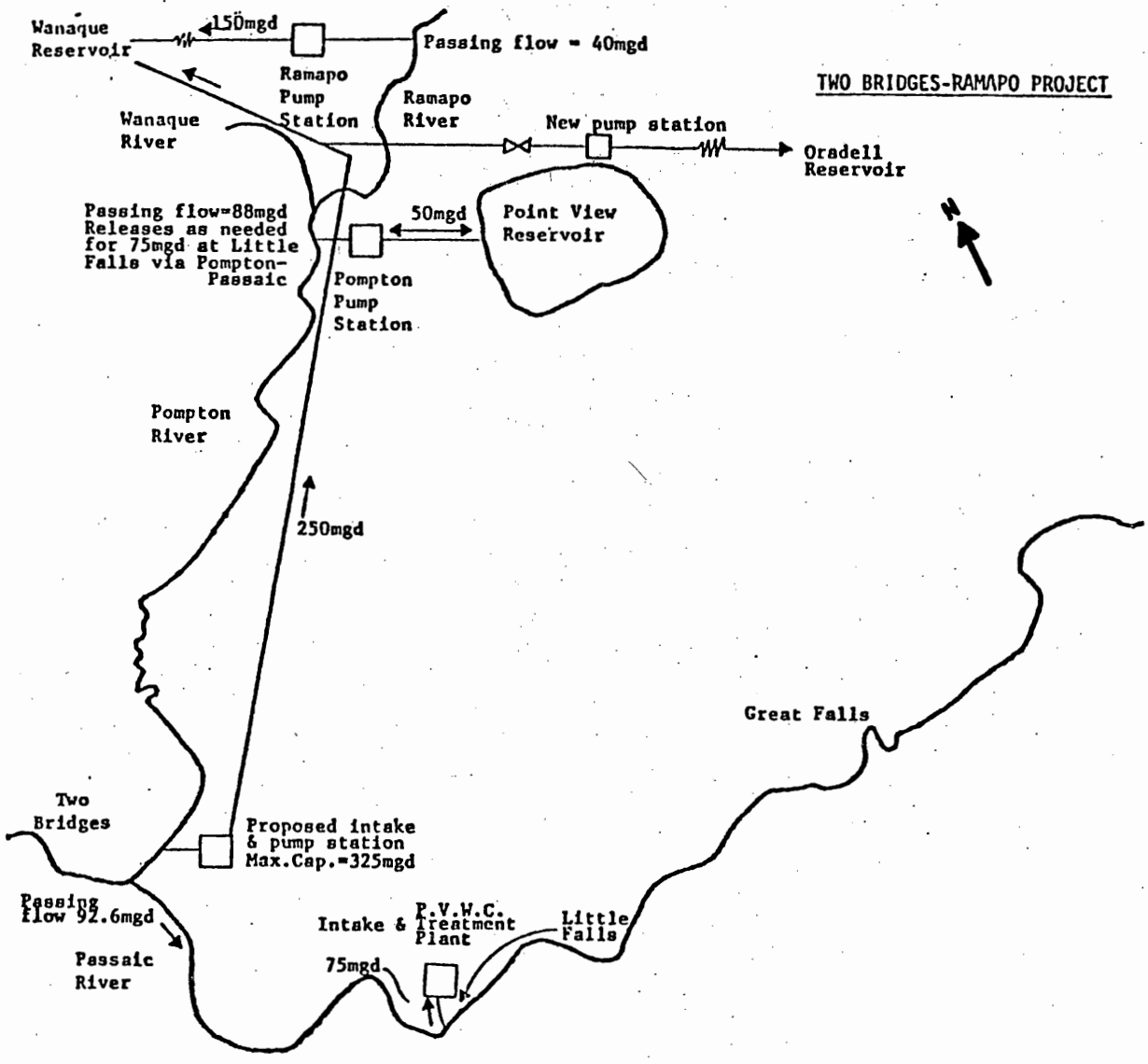
SEE UPDATED DESCRIPTION IN TASK 3D AND TASK 3E

Cost ($ million) Capital 52.6 O & M 6.3/6.8 $/MG 217/236 Year 1977 ENR Source 1011 Note O&M and $/MG: basis - normal year (1968)/drought year (1965)

Identified Problems Passaic River water quality below Two Bridges

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared Revised 1 Revised 2



SEE UPDATED CONFIGURATION IN TASK 3E

Project 40
Two Bridges - Ramapo
Water Diversion Project
(ref. 1011)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 41 Name Monksville Reservoir with Ramapo Pump Station L.O.R.D.S. No. 23-21-700

Region(s) 1 Basin(s) Wanaque, Ramapo County(ies) Passaic

Author NJDWSC Title Pre. Eng. Rpt. "Monksville Project" NJDWSC, Nov. 1972 Library No. 1207.02

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	7.0			25.0	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

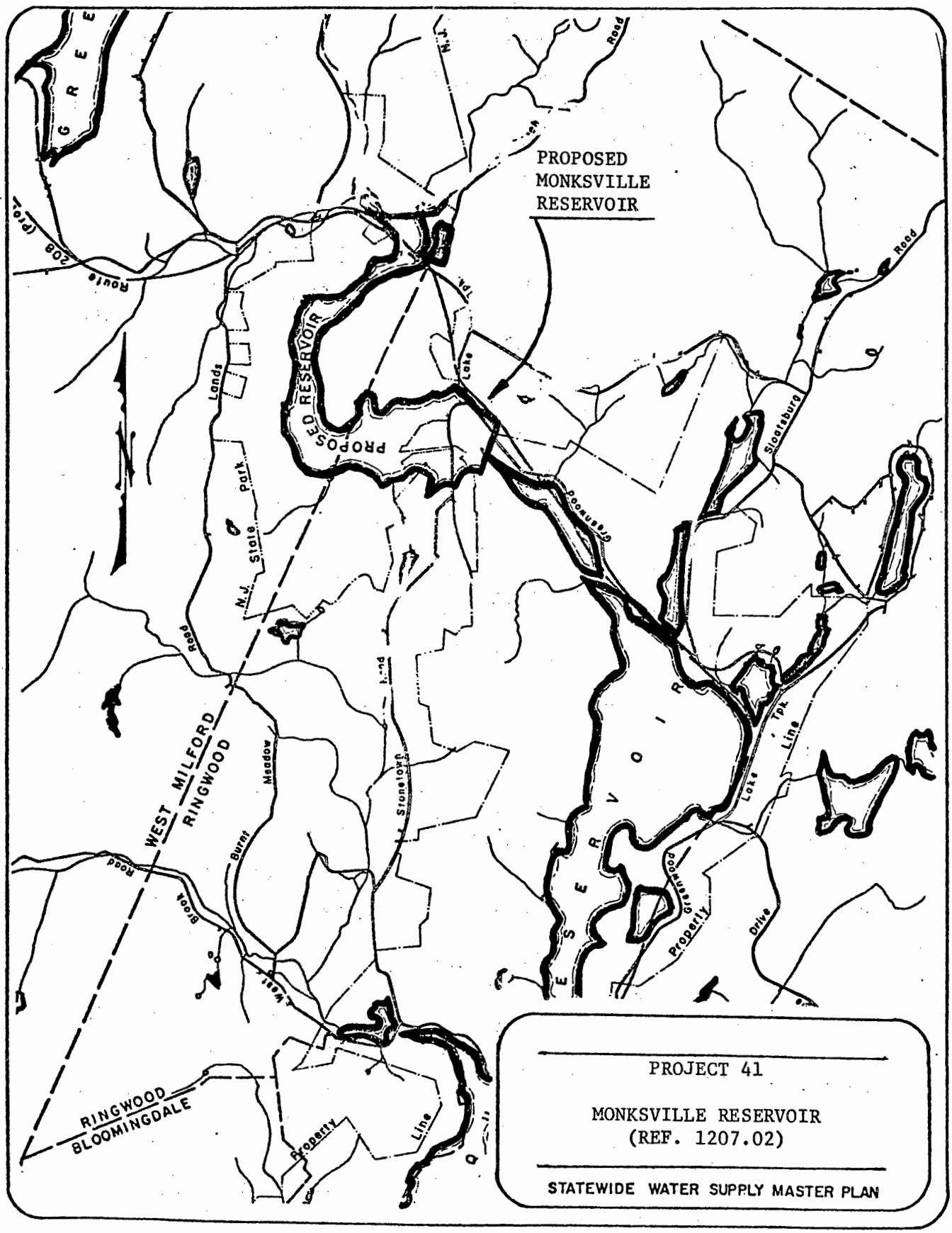
Proposed reservoir would be created by construction of a 2,000 foot long dam across the Wanaque River at Monksville, NJ. The lake created by this dam would cover 500 acres at an average depth of 43 feet, on the Green Acre tract upstream of the Wanaque Reservoir. The water to fill this reservoir would come from the 40 square mile Wanaque River watershed which includes Greenwood Lake. It is proposed that the Ramapo River be tapped for the additional 25.0 mgd to be pumped into the Wanaque Reservoir while the natural flow from the Wanaque River fills the Monksville Reservoir. Monksville will provide a back-up reserve to the Wanaque-Ramapo system. (NJDWSC already diverts 25 mgd to Wanaque from Ramapo. This would increase it to 50 mgd.)

Cost ($ million)				
Capital	21.7	Year	1973	Note
O & M	67	ENR		
$/MG	280	Source	1207.02	

Identified Problems: Effects on Passaic River watershed and thus Passaic Valley Water Commission flows and diversion rights from Pompton River. Competition for Ramapo River Water.

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 1/24/78 Revised 1 Revised 2


PROPOSED
MONKSVILLE
RESERVOIR
PROPOSED RESERVOIR
WEST MILFORD
RINGWOOD
RINGWOOD
BLOOMINGDALE
RESERVOIR
Road
Lands
Park
Meadow
Burnt
Brook
Stonetown
Lake
Property
Line
Drive
Turnpike
Greenwood
Sloatsburg
PROJECT 41
MONKSVILLE RESERVOIR
(REF. 1207.02)
STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 42 Name Great Notch Interconnection L.O.R.D.S. No. 26-02-500

Region(s) 1 Basin(s) Passaic County(ies) Essex

Author COE Nat'l. Board of Fire Underwriters Title Engr. Feas. Rpt. 1971 WSW of No. NJ 1952 Library No. 202 1338

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) Yield (mgd) 30's drought 60's drought Other

Limitations on yield Existing distribution systems

Narrative description Figure: No ☐ Yes ☒

Identified terminus for several interbasin transfer alternatives (see Projects 28, 29, 31, 32, 33, 36, 37).

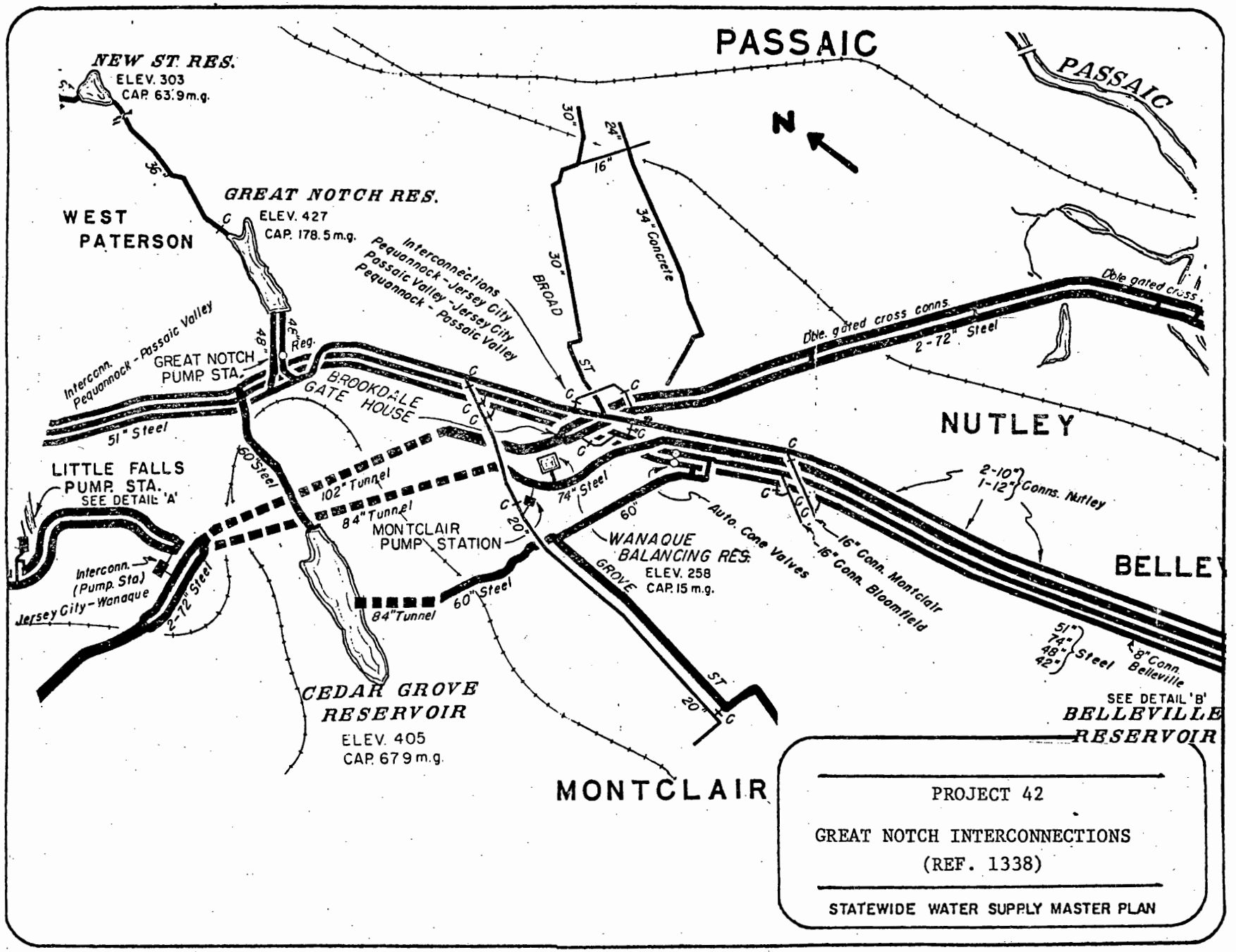
In the Great Notch area, major northeast water supply aqueducts and purveyor distribution systems interconnect (NJDWSC, PVWC, JCWC, NWK). These interconnections provide a localized point for distribution of water transferred from outside the Passaic River Basin.

Cost ($ million) Capital Year Note See individual projects
O & M ENR
$/MG Source

Identified Problems

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/22/78 Revised 1 Revised 2



PROJECT 42

GREAT NOTCH INTERCONNECTIONS

(REF. 1338)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 43 Name Washington Valley Reservoir L.O.R.D.S. No. 25-13-200

Region(s) 1 Basin(s) Whippany, Passaic County(ies) Morris

Author MCMUA Title MC Water Sup. Plan 1970; NEWS Report 1971 Library No. 1205.03; 202

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	1.2			7.0	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Endorsed by State. One of four sites being purchased for development by MCMUA for future supply. Reservoir on the Whippany River in Morris Township to supply water for treatment and distribution to municipalities in the area.

Spillway elevation 335
Drainage area 14.5 mi.

Also possible for Washington Valley to serve as a terminal storage reservoir for Delaware River diversion to Passaic Basin (with Bartley and/or Hardscrabble). Storage might be increased to 2.0 BG, and pumped diversion from Whippany North Branch could yield 20 mgd.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note Total surface water plan for MC estimated as $60 million.

Identified Problems

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/2/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 44 Name Longwood Valley Reservoir L.O.R.D.S. No. 22-43-100

Region(s) 1 Basin(s) Rockaway River County(ies) Morris

Author Jersey City Title Jersey City's W.S. Needs 4/70; News Report 11/71; Rpt. on Longwood Valley Res. 9/56 Library No. 1203.02 202 1203.04

Data Availability/Reliability Good

Purpose(s) WS, HY, FC Storage(BG) 5.2 Yield (mgd) 30's drought 60's drought 10.3 Other

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

The project site is located about four miles north of Route 15 on the west side of the Rockaway River in Jefferson Township. The reservoir would regulate some 23 square miles of the Rockaway River watershed and occupy 670 acres. Spillway crest elevation for 5.2 BG storage would be 750 feet above msl.

As conceived, the project would be a joint potable water supply and power development project between Jersey City and Jersey Central Power and Light Co. Jersey City's work would include construction of two storage reservoirs (Upper and Lower); one on Beaver Brook with five earth dams and one on the Rockaway River with one earth dam. An interconnecting waterway facility also is involved in the project.

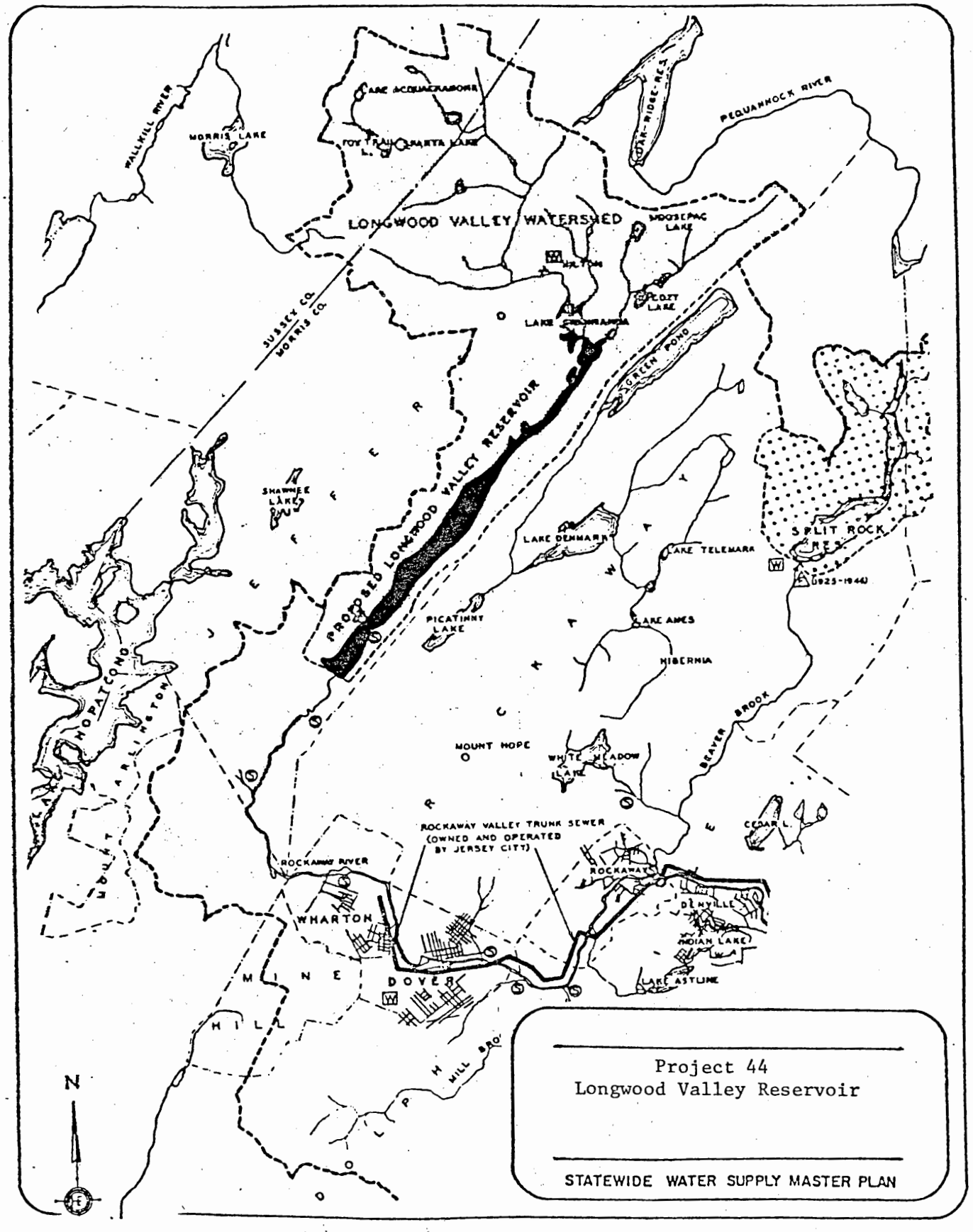
Detailed plans and contract documents were completed and bids taken in August 1969. However, marked increase in costs over original estimates resulted in reevaluation of the project. Various alternatives considered, including construction of lower reservoir; project as originally conceived found to be most economical. Lack of available monies has resulted in "no further action" on the project.

Cost ($ million) Capital 45 Year 1970 Note
O & M 2.5 ENR
$/MG 671 Source 1203.02

Identified Problems Morris County interest in surface supplies.
Implementation of joint interest project.
Development

Project Status: Proposed ☐ Realistic ☒ (Dormant)
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 3/8/78 Revised 1 Revised 2


LONGWOOD VALLEY WATERSHED
PROPOSED LONGWOOD VALLEY RESERVOIR
WALLKILL RIVER
MORRIS LAKE
LAKE ACOSMACRABOMA
FOX TRAIL L.
MARTA LAKE
OAK RIDGE RES.
PEQUANNOCK RIVER
MOOSEPAC LAKE
HILTON
PLOZY LAKE
LAKE CROMARTIA
SUSSEX CO.
MORRIS CO.
GREEN POND
SHAWNEE LAKE
LAKE DENMARK
LAKE TELEMARK
SPLIT ROCK RES.
(1923-1944)
PICATINNY LAKE
LAKE AMES
HIBERNIA
MOUNT HOPE
WHITE MEADOW LAKE
BEAVER BROOK
CEDAR L.
ROCKAWAY VALLEY TRUNK SEWER (OWNED AND OPERATED BY JERSEY CITY)
ROCKAWAY RIVER
ROCKAWAY
DENVILLE
INDIAN LAKE
LAKE ASTLINE
WHARTON
DOVER
MINE HILL
LAKE HOPATCONG
N
Project 44
Longwood Valley Reservoir
STATEWIDE WATER SUPPLY MASTER PLAN
LEGEND
STREAM FLOW GAGE
SAMPLING STATION
RAINFALL STATION
MORRISTOWN
MILES

ALTERNATIVE PROJECT DESCRIPTION

No. 45 Name Whippany Reservoir (Troy Meadows) L.O.R.D.S. No. 25-05-700

Region(s) 1 Basin(s) Whippany River (Passaic River) County(ies) Morris

Author	Title	Library No.
Corps	Passaic Flood Plan	231
NJ	NJ Res. Site Cap.	810
	NJ Site Acq. 1966	1017

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
FC	18.6				

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Dry detention reservoir near Rt. 280 in Troy Meadows area. Acquisition area of 3,800 acres - some lands purchased under Green Acres program. See Project No. 27.

Site acquisition cost per ref. 1017 is $7,125,000 (1966).

Cost ($ million)					
	Capital		Year		Note Ref. 231 has costs for total project including Two Bridges and Myers Road reservoirs.
	O & M		ENR		
	$/MG		Source		

Identified Problems: Not water supply project.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒

Does not meet technical criteria.

Prepared 2/13/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

22-33-300

No. 46 & 75 Name Dunkers Pond Reservoir with Wallkill River Diversion L.O.R.D.S. No. 22-23-800

Region(s) 1 Basin(s) Hudson - Wallkill, Passaic - Pequannock County(ies) Sussex, Passaic, Essex

Author Newark Title Rpt. on Alt. WSP 1974 H&S & Clinton Bogert Assc. Library No. 1206.01

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, PS	11.0			20	

Limitations on yield Wallkill minimum stream flow.

Narrative description Figure: No ☒ Yes ☐

Pumping station two miles downstream (north) of confluence with Papakating to divert Wallkill wet weather flow to Pequannock via existing Oak Ridge Reservoir. Pumped storage to new Dunker's Pond reservoir. Pumping required 1-2 years of every 10. Pumped storage in Wallkill basin is alternative to Dunker's Pond site (Sussex North, Beaver Run, or Franklin). Proposed project includes expanded treatment plant. Alternative A transmission to Farber Brook upstream of Oak Ridge; Alternative B transmission direct to Oak Ridge.

Cost ($ million) Capital 31.5 Year Note
O & M ENR
$/MG 437 Source 1206.01

Identified Problems Implementation (interbasin transfer NY-NJ) water quality of Wallkill.

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 1/25/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 47 Name Tourne Reservoir L.O.R.D.S. No. 25-03-100

Region(s) 1 Basin(s) Passaic, Rockaway County(ies) Morris

Author MCMUA Title MC Water Supply Plan 1970 Library No. 1205.03
Res. Site Capacity 1966 810
NEWS Report 1971 202

Data Availability/Reliability Good

Purpose(s) WS, PS, GWR Storage(BG) 3.3 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Endorsed by State. One of four sites being considered for development by MCMUA for future supply. Off-river reservoir in Mountain Lakes, Denville, and Boonton to be used for storage of water pumped from the Rockaway River. Released water would be treated and conveyed by pipeline to municipalities in southeast Morris County. County will have rights only to the surplus river flow. It is proposed to divert as much water as possible, particularly in wet years, and during these periods of time to both rest existing well fields and provide direct recharge to wells in the Parsippany-Morristown-Madison-Chatham-Florham Park area. This will permit the storage of excess Rockaway River waters in these underground aquifers (with declining groundwater tables over the past years). Storage of 3.3 BG at elevation 595 feet. County's Tourne Mountain Park at site. Acquisition of site continuing by MCMUA. Mixing of surface and groundwater and effects on quality should be assessed.

Cost ($ million) Capital ____ Year ____ Note Total surface water plan for MC estimated as $60 million.
O & M ____ ENR ____
$/MG ____ Source ____

Identified Problems Diversion not to encroach upon development of the Boonton, Split Rock, or Longwood Valley Reservoirs. County will only have "rights" to surplus river flow per Supreme Court decision. Economics of pump station idle during periods when wells do not require recharge.

Project Status: Proposed ☐ Realistic ☐ Discarded by MCMUA
Potential ☐ Unrealistic ☒
Discarded ☒

Prepared 2/2/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 48 Name Hardscrabble Reservoir L.O.R.D.S. No. 25-13-700

Region(s) 1 Basin(s) Passaic, Upper Passaic County(ies) Morris, Somerset

Author	Title	Library No.
NJ	Res. Site Capacity 1966	810
	TAMS 1955	757
	NEWS Report 1971	202

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, PS	2			5	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir on the Passaic River, north of Bernardsville and Rte. 202. Project D-2, NEWS Report recommends storage at Hardscrabble Delaware River water enroute to Two Bridges to supply Passaic Basin. While the site could store 20 BG (spillway crest 500 feet MSL) only 6 BG may be needed to develop 8 mgd from the 9 square mile drainage area. Additional storage might be used for pumped storage in a Delaware or Raritan regional plan. Reduction in size from 20 BG is essential to reduce adverse effects. Project now is for 2 BG storage to develop 5 mgd.

Cost ($ million) Capital 26.4 Year ____ Note Note : estimated $1,320/MG of storage.
O & M ____ ENR ____
$/MG ____ Source 202

Identified Problems Limitation on size due to National Park at Jockey Hollow. Not a viable project by itself.

Project Status: Proposed ☐ Realistic ☒ (Not alone)
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 1/31/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 49 Name Darlington Reservoir (Ramapo) L.O.R.D.S. No. 23-31-900

Region(s) 1 Basin(s) Passaic, Ramapo County(ies) Passaic

Author NJ Title Reservoir Site Capacity Library No. 810
TAMS 1955 757
NEWS Report 1971 202

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
FC, WS	9.2				

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Considered as a wet, dry and multiple purpose reservoir. Site has first priority for flood control. Drainage area is 137 sq. mi. TAMS found in 1955 that this was not a favorable location for development of a major supply for NJ, although it might be considered for small supplies for local demands. A lower level reservoir might provide such local supply; however, direct tap of the Wanaque-Oradell pipeline (Proj. 39) could better serve these needs.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None available.

Identified Problems 200 yr.-old homes and new developments; implementation (70% basin in NY); high passing flow for downstream users (NJDWSC, PVSC) and to maintain minimum stream flows.

Project Status: Proposed ☐ Potential ☐ Discarded ☒ Realistic ☐ Unrealistic ☒ Does not meet environmental or technical screening criteria.

Prepared 2/2/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 50 **Name** Harrisons Brook Reservoir **L.O.R.D.S. No.** 25-22-900

Region(s) 1 **Basin(s)** Passaic River **County(ies)** Somerset

Author NJ **Title** Res. Site Cap. in NJ, 1966 **Library No.** 810

Data Availability/Reliability Fair

Purpose(s) WS **Storage(BG)** 4.0 **Yield (mgd)** 30's drought 60's drought 14.0 Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Potential alternative to Great Swamp Reservoir Site (Proj. 53). Pumped storage site on Harrison's Brook.

Cost ($ million) Capital Year Note None Available.
O & M ENR
$/MG Source

Identified Problems Lost to Large Housing Developments

Project Status: Proposed ☐ Realistic ☐ Does not meet environmental screening criterion.
Potential ☐ Unrealistic ☒
Discarded ☒

Prepared 2/13/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 51 Name Corys Brook Reservoir (Myers Road Reservoir) L.O.R.D.S. No. 25-23-800 -900

Region(s) 1 Basin(s) Passaic River County(ies) Somerset

Author COE Title Site Capacity in N. J. Kroeck 1966 Library No. 810

Data Availability/Reliability Fair

Purpose(s) FC WS Storage(BG) Yield (mgd) 30's drought 60's drought Other

Limitations on yield Flood storage

Narrative description Figure: No ☒ Yes ☐

On Stream reservoir site located on the Passaic River just below Corys Brook near Smalleytown. Corps. of Engineers suggested this site as an alternative to the Great Swamp Reservoir (Proj. 53). The site has limited storage available and first priority was placed on flood control operation, thereby reducing its potential for water supply.

Cost ($ million) Capital Year Note None available
O & M ENR
$/MG Source

Identified Problems Priority to flood storage
Myers Road preferable for water supply

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/2/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 52 Name Como Reservoir L.O.R.D.S. No. 25-03-100

Region(s) 1 Basin(s) Passaic, Rockaway County(ies) Morris

Author MCMUA Title Res. Site Capacity 1966; NEWS Report 1971 Library No. 810; 202

Data Availability/Reliability Fair

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS, PS	N/A				

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

This is an off-stream reservoir on Beaver Brook, north of Rock Ridge Lake in Western Boonton Township at Denville border, with a spillway crest elevation of 650 feet MSL. As proposed by MCMUA, it would be operated as a pumped storage reservoir for supplement in-County supplies. The site is downstream of Split Rock Reservoir. High storage capability at Split Rock reduces the value of Como.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None available.

Identified Problems: Expensive and disruptive. State endorsement of Tourne means better off-stream pump storage project is available. Storage at Split Rock makes Como unnecessary.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒ Does not meet environmental and implementation criteria.

Prepared 2/13/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 53 Name Long Hill Reservoir (Great Swamp Reservoir) L.O.R.D.S. No. 25-23-500

Region(s) 1 Basin(s) Passaic, Upper Passaic County(ies) Morris

Author	Title	Library No.
Hazen, et. al.	Water Res. of State 1922	1014
COE	NEWS Report 1971	202
NJ-TAMS	TAMS 1955	757

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	182				>600

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Proposal in 1922 for rock dam 110 feet high and 850 feet long in Upper Passaic at Millington, NJ west of Long Hill would store 328 BG of which 182 BG would be available in upper 40 feet. At elevation 320 feet MSL, some 24 sq. mi. would be flooded, including the Great Swamp, Chatham, Passaic, Harding and Morris Townships as far north as the center of Morristown. As conceived for phased development with upper Raritan and Delaware basin supplies, total catchout area is 645 square miles. Yield would exceed 600 mgd and might reach 1.5 bgd.

Safe yield (30's) for Long Hill alone is 44 mgd.

Cost ($ million)				
	Capital	Year 1922	Note	Not appropriate.
	O & M	ENR		
	$/MG	Source		

Identified Problems: Numerous. No longer feasible or essential. Excessive dislocations. Shallow storage. Jet port ban.

Project Status: Proposed ☐ Potential ☐ Discarded ☒ Realistic ☐ Unrealistic ☒

Developed site. Does not meet any screening criteria.

Prepared 3/1/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 54 Name Greenwood Lake L.O.R.D.S. No. 22-25-400

Region(s) 1 Basin(s) Passaic, Wanaque County(ies) Passaic

Author NJ, COE Title Res. Site Capacity 1966, NEWS Report 1971 Library No. 810, 202

Data Availability/Reliability Fair

Purpose(s) WS (Emerg) Storage(BG) 6.9 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Possible emergency storage at Greenwood Lake would increase Wanaque sub-basin development from 88% (79 mgd) to 97%. Greenwood Lake's drainage area is 27 sq. mi. and a spillway crest of 621 ft. MSL provides 6.9 BG storage. NJ indicates some day permission may be obtained to use flood storage at Greenwood Lake and Lake Hopatcong, but such storage is not currently available.

Cost ($ million) Capital Year Note None available.
O & M ENR
$/MG Source

Identified Problems Emergency storage only.

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/2/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 55 Name Tocks Island Lake Project (TILP) L.O.R.D.S. No.
Atlas Sheet 21

Region(s) 6 Basin(s) Delaware County(ies) Sussex

Author COE, DRBC Title TILP & Alternatives 1975 News Report Library No. 230, 202

Data Availability/Reliability Good

Purpose(s) WS, HY, FC, R Storage(BG) 275 (Total) Yield (mgd) 30's drought 60's drought 300 Other

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

Project involves a major impoundment on the Delaware River. 160 ft. high earthfill dam on the main stem of the Delaware River approximately 5 miles north of the Delaware Water Gap; reservoir extends some 37 miles in length up the Delaware to Port Jervis, N. Y., and some 9 miles up Flat Brook. Total land required is 63,000 acres.

Use	Elev. (ft. msl)	Storage (BG)	Surface Area
FC	432	105	-
WS, HY, R	410	139	12,425 ac
Inactive	356	31	-

Related project nos. 4,5,6,9,28,29,30,31.

DRBC did not support appropriation of construction funds, 7/31/75. NJ, PA and DRBC testified to Congress against deauthorization. Attempts in 1978 to have Delaware declared a wild and scenic river, if successful, will kill the project.

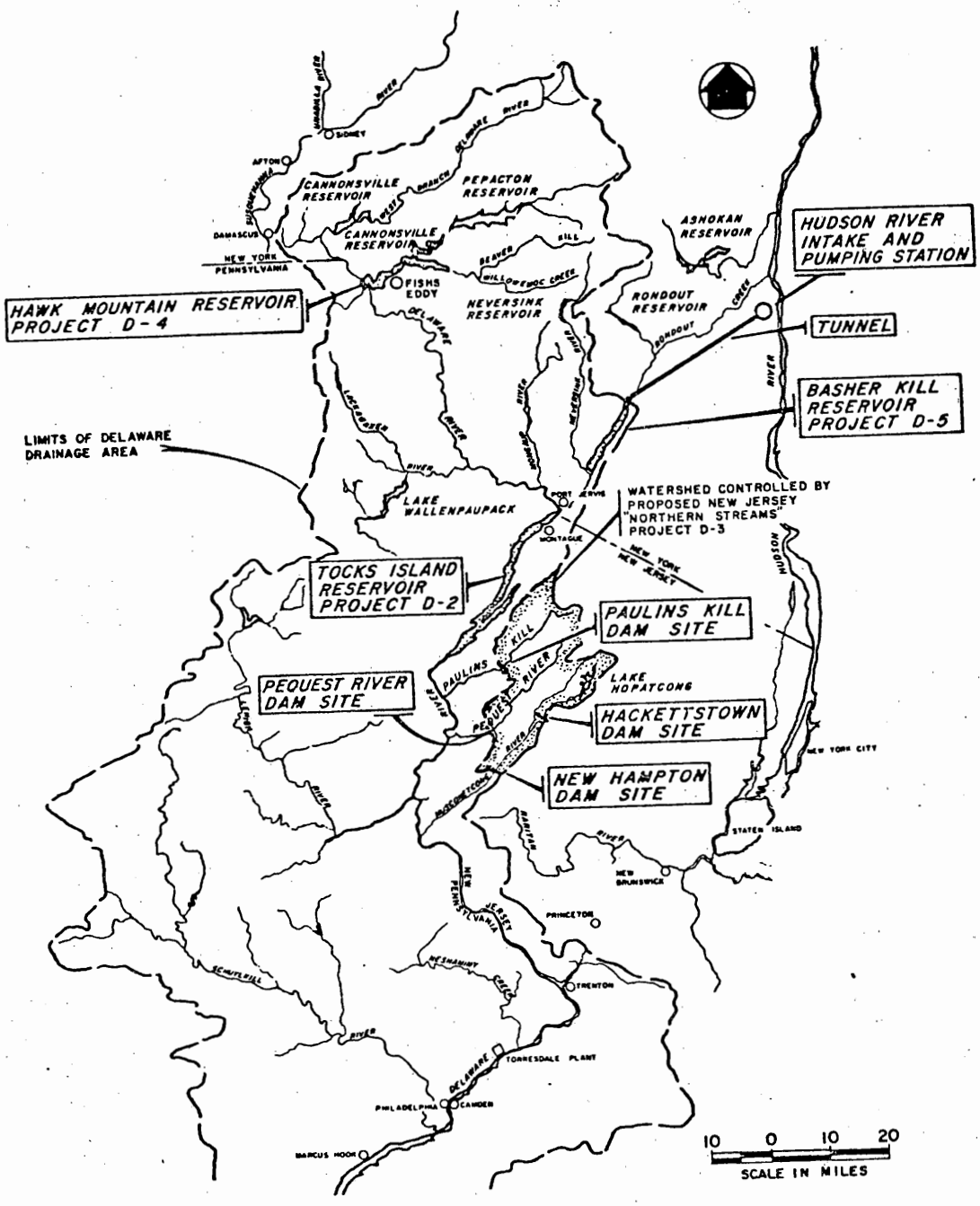
This is still realistic until de-authorized by Congress.

Cost ($ million) Capital 722 O & M 93 $/MG Year 1975 ENR Source 230 Note

Identified Problems: Adverse environmental impacts; Public controversy; Effects on community cohesiveness

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐ COE recommended deauthorization

Prepared 2/22/78 Revised 1 10/24/78 Revised 2



Project 55
Tocks Island Lake Project
(ref. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 56 Name Hackettstown Reservoir L.O.R.D.S. No. 24-04-600

Region(s) 6 Basin(s) Delaware, Musconetcong County(ies) Warren, Sussex, Morris

Author NJ, COE Title Sussex-Warren Plan 1974; Allamuchy Park Plan 1968; DRBC Plan 1972 Library No. 1209.01, 1013, 502.03

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, R, FA	9.9			40	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

The reservoir will stretch from Saxton Falls, Warren Co. to Jefferson Lake, Sussex Co. along the Musconetcong River, a distance of 5.5 miles. 1,050 feet long dam. (2.5 sq. mi. lake between Allamuchy and Schooley's Mountain.)

Stage (1): recreation development (land and recreation)
Stage (2): water supply (dam & appurtenances, relocations and reservoir clearing) Land being purchased under Green Acres Program.

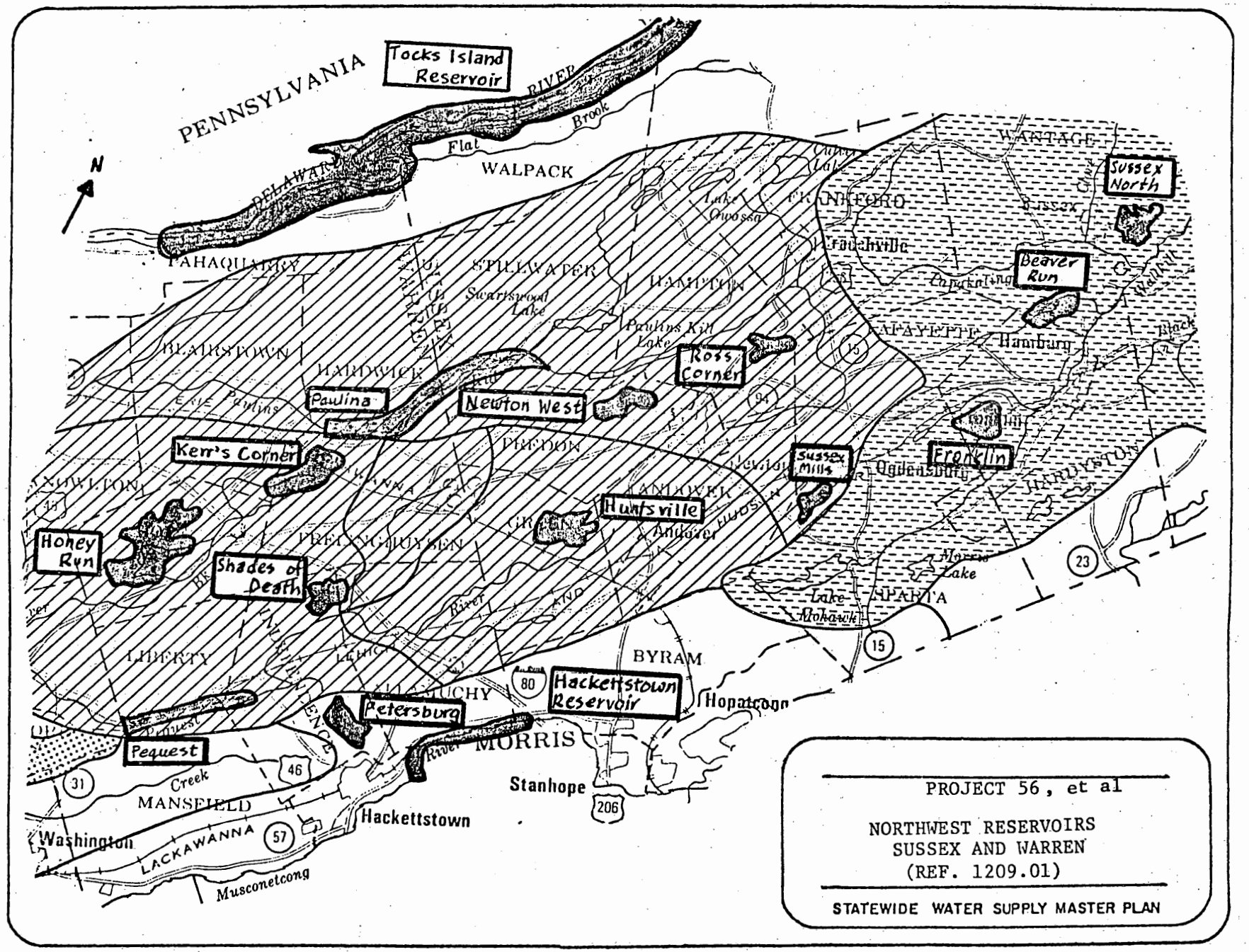
One of seven sites authorized for acquisition by 1969 bond issue for $27 million. Some $4 million has been spent with $2.5 million to be spent (as of 12/76: 4605 acres purchased; 770 acres to be acquired).

Cost ($ million)				Note
	Capital		Year	Capital: (1) 17.1 Year 1972
	O & M		ENR	(2) 10.9 1972
	$/MG		Source 502.03	

Identified Problems: Relocation of six miles of railroads; portions of Federal Highway, several county roads and local power and telephone lines. Relocate or dike Waterloo Village. Treat or bypass Lake Hopatcong effluent - 5 mgd.

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 1/31/78 Revised 1 Revised 2



PROJECT 56, et al

NORTHWEST RESERVOIRS
SUSSEX AND WARREN
(REF. 1209.01)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 57 Name Flat Brook Reservoir L.O.R.D.S. No. 21-23-800 (Dam Site)

Region(s) 6 Basin(s) Delaware River, Flat Brook County(ies) Sussex

Author NJ Title Comp. Study TILP 1975; Tech. Memo 9/29/72; TAMS Report 1955 Library No. 230.04; 1008.11; 757

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, FA, FC	80			236	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Project involves creation of an impoundment on the Flat Brook through high flow skimming of the Delaware River to supplement natural tributary flows (drainage area of 65 SM).

Flow line elevation of 520 feet msl; requires a 400 mgd pumping station.

TAMS: 185 feet high dam located about 0.8 miles upstream from the junction with the Delaware River. Total storage capacity of 84 BG (63 BG usable).

See Project No. 15, 58, 69.

Alternative to Tocks Island Lake Project (Proj. 55)

Cost ($ million)				
Capital	95.5	Year	1975	Note
O & M	7.7	ENR		
$/MG		Source	230.04	

Identified Problems: Inundation of large area; Trout stream preservation; See TILP, Project 55

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 1/31/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 58 Name Flat Brook - Raritan Continuous Diversion L.O.R.D.S. No. Atlas Sheets 21,24

Region(s) 1, 6 Basin(s) Delaware, Flat Brook, Raritan County(ies) Sussex

Author Env. Def. Fund Title Alt. to Tocks Island Res.; M. Disko Assoc., Oct. 1973 TAMS REPORT 1955 Library No. 511 757

Data Availability/Reliability Good

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS, PS, FA	44			300	
	80				

Limitations on yield Capacity and outlet of Round Valley

Narrative description Figure: No ☐ Yes ☒

Construction of a 400 mgd pumping station on the Delaware River at Frenchtown for continuous diversion to Round Valley Reservoir. Contingent on proposed 108-inch pipeline (interconnecting Round Valley, proposed Two Bridges Res. and four smaller reservoirs: Schooley's Mt., Bartley, Hardscrabble and Washington Mt.) During periods of low Delaware River flow, water would be released from Flat Brook Reservoir. Flat Brook 44 BG storage assumes no compensating releases for 3000 cfs at Trenton; no diversions when flow at Trenton is less than 3000 cfs; no oyster maintenance releases; 1750 cfs at Montage by NYC; 400 mgd pumping capacity at Frenchtown. Assume 80 BG required if low flow of 3000 cfs is maintained at Trenton by releases from Flat Brook Reservoir, no releases for oyster maintenance, NYC maintains 1750 cfs at Montague; and 400 mgd pumping capacity at Frenchtown. See project 15 for alternate scheme.

Flow line elevation: Flat Brook Reservoir
For 44 BG Storage - 480 ft.
For 80 BG Storage - 520 ft.

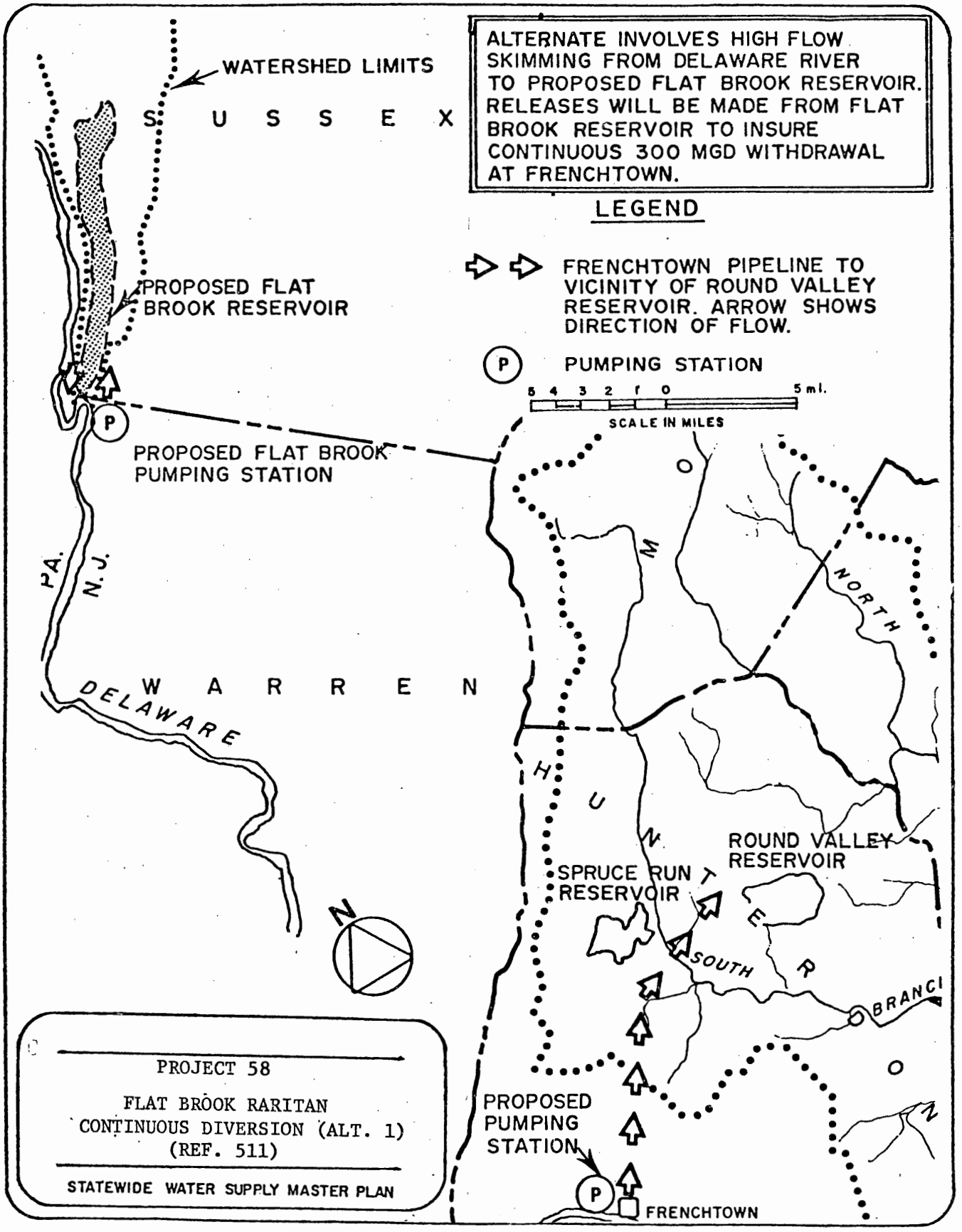
(TAMS: RESERVOIR ELEV. 520, 84 BG storage)

Cost ($ million) Capital _____ O & M _____ $/MG _____ Year _____ ENR _____ Source _____ Note None Available

Identified Problems Environmental impact on inundated Flat Brook watershed.
EDF preferred project 15 over this
Ability to obtain 300 mgd yield and maintain 3000 cfs at Trenton

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/9/78 Revised 1 _____ Revised 2 _____


ALTERNATE INVOLVES HIGH FLOW SKIMMING FROM DELAWARE RIVER TO PROPOSED FLAT BROOK RESERVOIR. RELEASES WILL BE MADE FROM FLAT BROOK RESERVOIR TO INSURE CONTINUOUS 300 MGD WITHDRAWAL AT FRENCHTOWN.
LEGEND
FRENCHTOWN PIPELINE TO VICINITY OF ROUND VALLEY RESERVOIR. ARROW SHOWS DIRECTION OF FLOW.
P PUMPING STATION
5 4 3 2 1 0 5 mi.
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WATERSHED LIMITS
S U S S E X
PROPOSED FLAT BROOK RESERVOIR
PROPOSED FLAT BROOK PUMPING STATION
PA.
N.J.
W A R R E N
DELAWARE
SPRUCE RUN RESERVOIR
ROUND VALLEY RESERVOIR
SOUTH BRANCH
PROPOSED PUMPING STATION
FRENCHTOWN
N
PROJECT 58
FLAT BROOK RARITAN CONTINUOUS DIVERSION (ALT. 1) (REF. 511)
STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 59 Name Sussex Mills Reservoir L.O.R.D.S. No. 22-31-600

Region(s) 6 Basin(s) Delaware, Paulins Kill County(ies) Sussex

Author NJ Title Hudson & Del. Basins Poten. Res. Sites Data Library No. 1008.09(a)

Data Availability/Reliability Fair

Purpose(s) WS, PS Storage(BG) 3.4 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoir"

Off stream pumped storage for water supply in Sparta about 2.5 miles northwest of Lake Mohawk. Spillway crest at 680 feet MSL. Area needed: water 300 acres, land 900 acres. Drainage area 36 square miles. Not considered by BWR-NJDEP 1008.10 Paulins Kill report 2/74. Located at top of drainage basin and in the proximity of an active quarry.

Cost ($ million) Capital Year Note 1966 Site cost $0.7 million.
O & M ENR
$/MG Source

Identified Problems Redundant to Huntsville, Newton West and Ross Corner.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒ Does not meet implementation screening criteria.

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 60 Name Ross Corner Reservoir L.O.R.D.S. No. 22-21-800

Region(s) 6 Basin(s) Delaware, Paulins Kill County(ies) Sussex

Author NJ Title Paulins Kill Hydrology & Reservoirs 1974 Library No. 1008.10

Data Availability/Reliability Good, but need cost information

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, PS	10			20	

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoirs"

This reservoir site is on a minor tributary of the Paulins Kill at the common boundary of Frankford, Lafayette, and Hampton Townships west of U.S. Route 206. The dam site lies about a mile southwest of US Route 206 and New Jersey Route 15 intersection at Ross' Corner.

Drainage area	36 sq. mi.
Pool Elevation	580 feet MSL
Pool Area	650 acres
Passing Flow	9.0 mgd
Land Acquisition	$680,000 (1,400 acres)
Yield	20 mgd

Ref. 1008.10 indicates this site preferred of three including Kerrs Corner, Newton-West. Possible source for Town of Newton and would enable elimination of some Wallkill River diversions to allow in-basin use.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None available.

Identified Problems: Possible lack of recharge water-storage of stream flows from the Delaware River or its tributaries in upstream reservoirs may not be permitted during March, April and May.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 1/31/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 61 Name Newton-West Reservoir L.O.R.D.S. No. 21-35-400

Region(s) 6 Basin(s) Delaware, Paulins Kill County(ies) Sussex

Author NJ Title Paulins Kill Hydrology & Reservoirs 1974 Library No. 1008.10

Data Availability/Reliability Good, but need cost information.

Purpose(s) WS, PS Storage(BG) 5.5 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoirs"

Location of this potential reservoir site is about one (1) mile west of the Town of Newton and one (1) mile east of Paulins Kill Lake. It is situated in Fredon Twp. and straddles N.J. Hwy. Route 94.

Elevation:	800 feet
Pool Area:	450 acres
Drainage Area:	77 sq. mi.
1966 Land Cost	$630,000 (800 acres)

Proposed to be part of a three-site watershed development system with Ross Corner Reservoir and Kerrs Corner Reservoir: Total sustained flow (1960's drought).

Ross Corner	20.0 mgd
Newton-West	38.0 mgd*
Kerrs Corner	59.0 mgd*

*includes yield(s) from upstream facility(ies)

NJ Route 94 passes through the middle of the proposed site.

Cost ($ million) Capital ____ Year ____ Note None available.
O & M ____ ENR ____
$/MG ____ Source ____

Identified Problems: Hump in middle of site reduces storage capacity. High elevations and roadway problems. Three reservoir site unlikely, lack of demand and large financial investment. Newton-West is least likely of three.

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 1/31/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 62 Name Kerrs Corner Reservoir L.O.R.D.S. No. 21-43-300

Region(s) 6 Basin(s) Delaware, Paulins Kill County(ies) Warren

Author NJDEP Title Paulins Kill Hydrology & Reservoirs 1974 Library No. 1008.10

Data Availability/Reliability Good, but need cost information

Purpose(s) WS/PS Storage(BG) 5.7 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

This reservoir site is about 3,500 feet south of the Paulins Kill at the Paulina U.S. Geological Survey gage and about one (1) mile southeast of Blairstown with a dam site directly south of NJ Hwy. Route 94. It is situated in Blairstown and Frelinghuysen Twps.

Elevation: 600 feet
Pool Area: 500 acres
Drainage Area: 131 sq. mi.
1966 Land Cost = $470,000 (940 acres)

Option 1: with Ross' Corner Reservoir - Total sustained flow (1960's drought): 49 mgd*

Option 2: with Ross' Corner and Newton-West Reservoirs - Total sustained flow (1960's drought): 59 mgd*

*includes flows sustained by upstream facilities.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None available

Identified Problems Lack of recharge water during March, April and May. Innundate portion of Lackawanna and Western RR. Need does not exist.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒

Prepared 1/31/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 63 Name Paulina Reservoir L.O.R.D.S. No. 21-43-200

Region(s) 6 Basin(s) Delaware, Paulins Kill County(ies)

Author COE Title NEWS Study 1971, Reservoir Site Capacity 1966 Library No. 202, 810

Data Availability/Reliability Fair

Purpose(s) R Storage(BG) 17.9 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒
"Northwest Reservoirs"

On stream site considered as one of four reservoirs in NEWS D-3 alternative. Considered by NJ as primarily for recreation.

Drainage Area:	122 sq. mi.
Capacity:	51,000 ac. ft.
Top of pool Elev.:	465 ft. msl

Cost ($ million) Capital Year Note
O & M ENR
$/MG Source

Identified Problems Discarded by State of NJ as primarily for recreation.

Project Status: Proposed ☐ Realistic ☐
Potential ☐ Unrealistic ☒
Discarded ☒

Does not meet implementation or technical screening criterion.

Prepared 2/1/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 64 Name Huntsville Reservoir L.O.R.D.S. No. 21-45-100

Region(s) 6 Basin(s) Delaware, Pequest County(ies) Sussex

Author NJ Title Hudson & Del. Bas.-Res. Site Data S-W Res. Con. & Dev. Proj. 1974 Library No. 1008.9(a) 1209.01

Data Availability/Reliability Fair

Purpose(s) WS, PS, FA Storage(BG) 2.0 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoirs"

Off-stream pumped storage reservoir in Green Twp., north of the Pequest River at Huntsville. Reservoir would have a drainage area of some 31 sq. miles. Crest Elev. - approx. 625 ft. above msl; total of 800 acres, of which 500 acres innundated.

Site is redundant to Germany Flats groundwater. However, potential contamination problems due to salt storage near Germany Flats dictates that Huntsville Site be preserved while using groundwater supplies.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None available, 1966 site costs $0.32 million per NJ.

Identified Problems Residential development; low yield; redundant to Germany Flats groundwater

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒ (Preserve Site)

Prepared 2/14/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 65 Name Shades of Death Reservoir L.O.R.D.S. No. 24-04-100

Region(s) 6 Basin(s) Delaware, Pequest County(ies) Warren

Author NJ Title Hud.-Del. Bas.-Res. Site Data S-W Res. Con. & Dev. Proj. 1974 Library No. 1008.9(a) 1209.01

Data Availability/Reliability Fair

Purpose(s) WS, PS Storage(BG) 5.5 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoirs"

Off-stream pumped storage reservoir north of the Pequest River, above Bear Swamp, in Independence Township. Reservoir would have a total of 800 acres, with 250 acres inundated. Located in Stokes State Park.

Crest elevation is approximately 700 ft. above msl; drainage area of the reservoir would be about 86 sq. mi. Would work in tandem with Petersburg site (Proj. 66)

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None available. 1966 site costs of $.62 million per NJ.

Identified Problems

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/14/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 66 Name Petersburg Reservoir L.O.R.D.S. No. 24-04-400

Region(s) 6 Basin(s) Delaware, Pequest County(ies) Warren

Author NJ Title Hud-Del. Bas. Res. Site Data W-S Plan 1974 Library No. 1008.9(a) 1209.01

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, PS	8.0				

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoirs"

Off-stream pumped storage reservoir south of Pequest River near Petersburg , in Independence Township. Drainage area of 86 sq. mi. Crest Elev. - approximately 600 fe. above msl.

Area: Water 500 acres
Land 215 acres

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None available. 1966 Site Costs of $0.57 million per NJ.

Identified Problems Residential Development.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/14/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 67 Name Honey Run Reservoir L.O.R.D.S. No. 24-03-400

Region(s) 6 Basin(s) Delaware, Pequest County(ies) Warren

Author NJ Title Hud-Del. Bas. Res. Site Data S-W Res. Con. & Dev. Proj. 1974 Library No. 1008.9(a) 1209.01

Data Availability/Reliability Fair

Purpose(s) WS, PS Storage(BG) 30.5 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoirs"

Off-stream pumped storage reservoir in Hope, NJ along Honey Run, Brookaloo Swamp and Muddy Brook, just west of Beaver Brook.

Crest Elevation:		480 feet msl
Area:	Water	2,000 acres
	Land	2,425 acres

This site is to be supplied by Delaware River water as an addition to and in conjunctive use with Flat Brook Reservoir (Proj. 57) and Frenchtown Reservoir (Proj. 116).

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None available. 1966 Site Costs of $3.5 million per NJ.

Identified Problems Not needed with TILP; possible political opposition to addition land acquisition in an area where much of land is State owned.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/14/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 68 Name Oxford Watershed L.O.R.D.S. No. 24-13-100

Region(s) 6 Basin(s) Delaware, Pequest County(ies) Warren

Author NJ Title Sussex-Warren Plan 1974 Library No. 1209.1

Data Availability/Reliability Fair

Purpose(s) FC, FA Storage(BG) Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒
"Projects 68 and 71"

PL 566 Watershed authorized for construction.

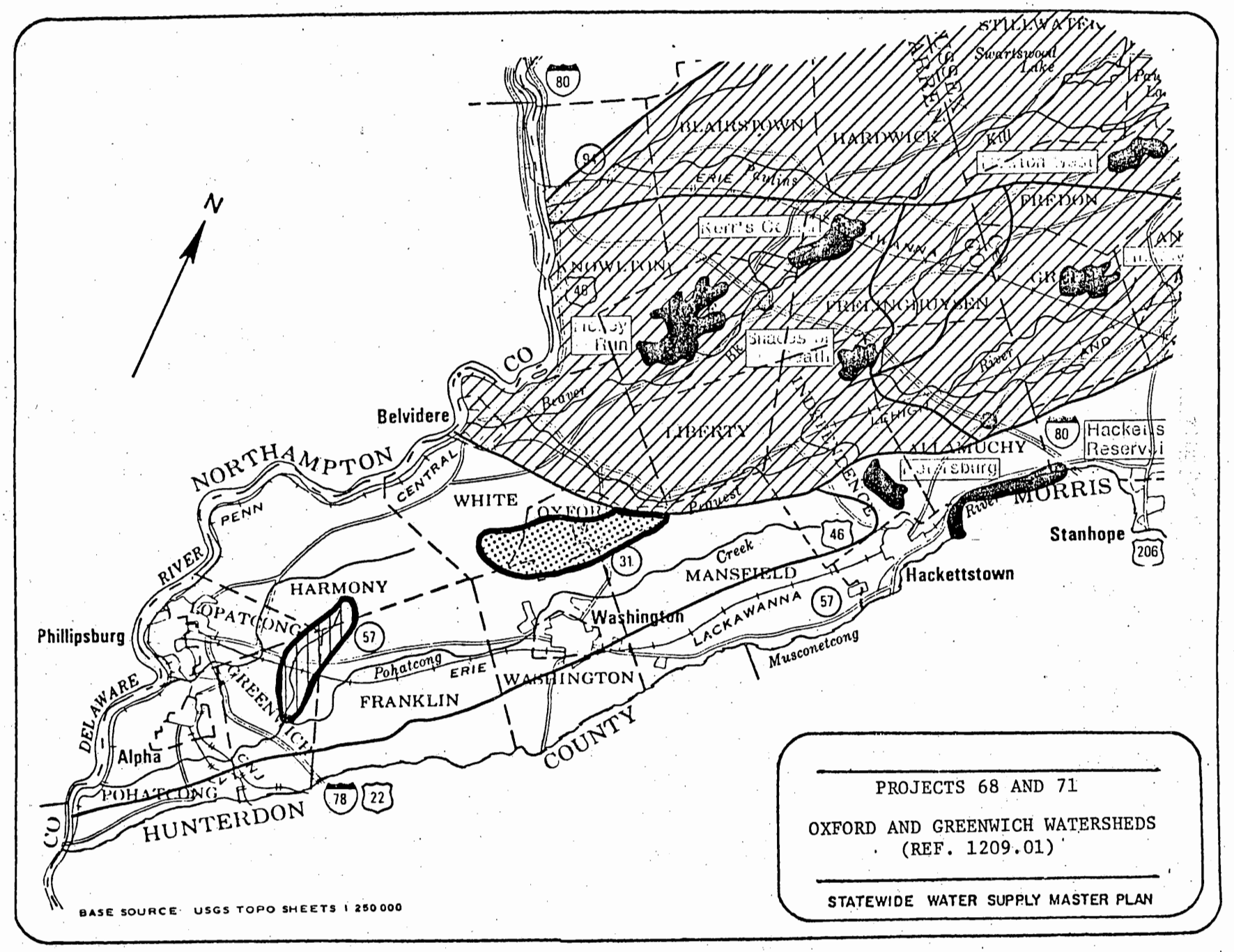
Primarily for flood control, soil conservation and flow augmentation.

Cost ($ million) Capital Year Note
O & M ENR
$/MG Source

Identified Problems Not a water supply project

Project Status: Proposed ☒ Realistic ☐
Potential ☐ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2



PROJECTS 68 AND 71

OXFORD AND GREENWICH WATERSHEDS
(REF. 1209.01)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 69 Name Wallpack Bend Reservoir L.O.R.D.S. No. 21-33-100 (Dam Site)

Region(s) 6 Basin(s) Delaware River County(ies) Sussex, Warren

Author COE, TAMS Title TILP, TAMS Report 1955 Library No. 230.04, 757

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, R, FC, HY	121	91 Usable	300		

Limitations on yield Combined operation with Flat Brook Reservoir

Narrative description Figure: No ☒ Yes ☐

This project involves creation of a 26-mile long main stem reservoir extending from Bushkill, Pa., to Port Jervis, N. Y., formed by a dam on the Delaware River just above the confluence of Flat Book and the main river. The dam would be concrete and approximately 170 feet high above bedrock. Maximum water level would be at elevation 420 and would be controlled by a row of 17 Tainter gates 24 feet high.

TAMS describes utilization of Walpack Bend Reservoir in combination with Flat Brook Reservoir (Proj. 57) for various Delaware River Diversion plans - gravity tunnel diversion plans either to the Raritan Basin or the Passaic Basin; and pumped diversion plans to the Raritan Basin. Alternatives were also presented for river regulation to compensate for out-of-basin diversion by New Jersey.

Corp. of Engineers completed extensive studies in the Delaware River Basin and subsequently abandoned the main stem Wallpack Bend site in favor of Tocks Island Lake Project site (Proj. 55) because of more favorable geological and environmental conditions (See Project Nos. 4, 9, 28 29, 30, 31, 55 - Tocks Island Lake Project)

Cost ($ million)					Note
	Capital	47.15	Year	1955	Two Reservoirs:
	O & M	7-8	ENR		O&M, $/MG range for
	$/MG	60-70	Source	757	various diversion plans
					30% cost to N.J.

Identified Problems Tocks Island preferred site; same type of environmental problems as Tocks Island.

Project Status: Proposed ☐ Realistic ☐
Potential ☐ Unrealistic ☒
Discarded ☒

Prepared 3/6/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 70 Name Pequest Reservoir L.O.R.D.S. No. 24-03-800

Region(s) 6 Basin(s) Delaware, Pequest County(ies) Warren

Author NJ Title NEWS Study, 1971; Res. Site Capacity 1966 Library No. 202, 810

Data Availability/Reliability Poor

Purpose(s) WS Storage(BG) 13.3 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoirs"

On-stream site for gravity release. NJ considers it too small to warrant the displacement.

Elevation - top of pool	507 ft. msl
Capacity	38,000 ac. ft.
Drainage area	100 sq. mi.

Cost ($ million) Capital Year Note None available.
O & M ENR
$/MG Source

Identified Problems

Project Status: Proposed ☐ Realistic ☐ Potential ☐ Unrealistic ☒ Discarded ☒

Does not meet any screening criteria.

Prepared 2/1/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 71 Name Greenwich Watershed L.O.R.D.S. No. 24-21-600

Region(s) 6 Basin(s) Delaware, Pohatcong County(ies) Warren

Author NJ Title Sussex-Warren Plan 1974 Library No. 1209.01

Data Availability/Reliability Fair

Purpose(s) FC Storage(BG) Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Projects 68 and 71"

PL 566 Watershed Project authorized for planning.

Cost ($ million) Capital Year Note
O & M ENR
$/MG Source

Identified Not a water supply project
Problems

Project Status: Proposed ☒ Realistic ☐
Potential ☐ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 72 Name Franklin Reservoir L.O.R.D.S. No. 22-22-800

Region(s) 1 Basin(s) Hudson, Wallkill County(ies) Sussex

Author NJ Title Wallkill Hyd. & Res. 1975; Sussex-Warren Plan 1974 Library No. 1008.9; 1209.01

Data Availability/Reliability Fair

Purpose(s) WS, PS Storage(BG) 7.6 Yield (mgd) _____ (Table attached) 30's drought _____ 60's drought _____ Other _____

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoirs"

Located on the Wildcat Branch of the Wallkill Reservoir, west/southwest of Franklin Boro, on the common boundary of Hardyston and Sparta Twps. west of Rte. 23 and east of Rte. 94.

Crest Elevation	580 ft. above msl	
Area - Water	700 acres	USGS
Land	700 acres	

Drainage area of the Wallkill River at the intake pumping station is 32 sq. mi. Assumed passing flow is 4 mgd on 1/8 mgd/sq. mi. NJ has considered (1008.9) use alone (A), with Sussex North (B), and with Sussex North and Beaver Run (C).

Cost ($ million) Capital _____ O & M _____ $/MG _____ Year _____ ENR _____ Source _____ Note None available. 1966 site cost $0.84 million per NJ.

Identified Problems Proposed as a potential landfill site in Sussex County Solid Waste Plan

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/14/78 Revised 1 _____ Revised 2 _____

ALTERNATIVE PROJECT DESCRIPTION

No. 73 Name Beaver Run Reservoir L.O.R.D.S. No. 22-22-500

Region(s) 1 Basin(s) Hudson, Wallkill County(ies) Sussex

Author NJ Title Wallkill Hyd. & Res. 1975; Sussex-Warren Plan 1974 Library No. 1008.9; 1209.01

Data Availability/Reliability Fair

Purpose(s) WS, PS Storage(BG) 5.5 Yield (mgd) _____ (Table att.) 30's drought 60's drought Other

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒
"Northwest Reservoirs"

Off-stream pumped storage reservoir.

Water elev. spprox.		580 ft. above msl	
Area:	Water	750 acres	
	Land	775 acres	USGS
	Total	1,525 acres	

Located west of Wallkill River on the Beaver Run (north of and extending northeast of town of Beaver Run) in Wantage Township.

Passing Flow 7 mgd (1/8 MGD/SM)

Drainage area of Wallkill at proposed diversion point (near confluence with Beaver Run) is 54 sq. mi. with assumed passing flow of 7 mgd.

Cost ($ million) Capital _____ O & M _____ $/MG _____ Year _____ ENR _____ Source _____ Note None available. 1966 site cost $0.91 million per NJ.

Identified Problems

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/14/78 Revised 1 _____ Revised 2 _____

ALTERNATIVE PROJECT DESCRIPTION

No. 74 Name Sussex North Reservoir L.O.R.D.S. No. 22-12-900

Region(s) 1 Basin(s) Hudson, Wallkill County(ies) Sussex

Author NJ Title Wallkill Hyd. & Res. 1975; Sussex-Warren Plan 1974 Library No. 1008.9; 1209.01

Data Availability/Reliability Fair

Purpose(s) WS, PS Storage(BG) 14.4 Yield (mgd) _____ (Table att.) 30's drought _____ 60's drought _____ Other _____

Limitations on yield

Narrative description

Figure: No ☐ Yes ☒ "Northwest Reservoirs"

Off-stream pumped storage reservoir.

Water elev. approx. 500 ft. above msl.

Area:		
	Water	950 acres
	Land	320 acres USGS
	Total	1,270 acres

Located west of Wallkill River, northeast of Sussex, in Wantage.

Wallkill River drainage area at pumping station intake is 127 sq. mi. with an assumed passing flow of 16 MGD.

Cost ($ million) Capital _____ O & M _____ $/MG _____ Year _____ ENR _____ Source _____ Note None available. 1966 site cost $0.76 million per NJ.

Identified Problems Partly innundates State Route 84.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/14/78 Revised 1 _____ Revised 2 _____

Wallkill Basin Potential Off-River Reservoir Sites	Drainage Area (Square Miles)	Storage (BG)	Passing Flow (MGD)	Yield (MGD) Drought		Gross Yield (MGD) Drought	
				1960's	1930's	1960's	1930's
			[A]	[B]		[A + B]	
Alternative "A" Franklin Reservoir	32	7.6	4.0	14	25	18	29
Alternative "B"							
Franklin Reservoir	32	7.6	4.0	14	25	18	29
+ Sussex-North Reservoir	127	14.4	16.0	52	88	68	104
Total		22.0		66	113	86	133
Alternative "C"							
Franklin Reservoir	32	7.6	4.0	14	25	18	29
+ Beaver Run Reservoir	54	5.5	7.0	28	41	35	48
+ Sussex-North Reservoir	127	14.4	16.0	55	97	71	113
Total		27.5		97	163	124	190

PROJECTS 72, 73, 74
ALTERNATIVE YIELDS
WALLKILL RESERVOIRS

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

(REF. 1008.9)

ALTERNATIVE PROJECT DESCRIPTION

No. 75 Name Wallkill River Diversion L.O.R.D.S. No. _____
Atlas Sheet 22

Region(s) 1 Basin(s) Hudson-Wallkill, Passaic-Pequannock County(ies) Sussex, Passaic, Essex

Author NWK Title Rpt. on Alt. WSP 1974 Library No. 1206.01

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	-			20	

Limitations on yield Minimum Stream Flow

Narrative description Figure: No ☒ Yes ☐

See Project 46 - Dunkers Pond
Reservoir with Wallkill River Diversion

Cost ($ million)					Note
	Capital		Year		See Project 46
	O & M		ENR		
	$/MG		Source		

Identified _____
Problems _____

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 1/25/78 Revised 1 _____ Revised 2 _____

ALTERNATIVE PROJECT DESCRIPTION

No. 76 Name Upper and Lower Manasquan Reservoirs L.O.R.D.S. No. Atlas Sheet 29

Region(s) 2 Basin(s) Manasquan County(ies) Monmouth, Ocean

Author NJ Title Manasquan Reservoir System Project News Summary Rpt. 1977 Library No. 229.07

Data Availability/Reliability Good

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS PS, R	0.1 5.0				10.25

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Proposed is a pumped storage system with two reservoirs and an interconnecting pipeline. Two phase project:

Phase I Lower Reservoir (0.1 BG; 10 mgd) - an intake impoundment on the main stem of the Manasquan River in Wall Township (Allaire Intake Reservoir) to serve as an intake for a proposed raw water treatment plant and later for pumping to storage at the Upper Reservoir; yield capacity is directly from stream flow.

Phase II Upper Reservoir (5.0BG; 25 mgd) - an off river storage reservoir in Howell Township (Oak Glen Storage Reservoir) to store water from peak Manasquan River flows and surplus water during periods of low demand. A raw water treatment plant could be built at the Upper Reservoir for local purveyor use. A 100 mgd capacity force main would convey water pumped from the Lower Reservoir at periods of high flow and to convey released water to the lower reservoir (70 mgd) for treatment and distribution.

L. O. R. D. S. No. Lower Reservoir 29-33-100
Upper Reservoir 29-22-700

Cost ($ million)					Note
	Capital	24	Year	1975	(As of 12/76: Land purchased - 1211 acres/$3 million; to be acquired 9 acres/$90,000.)
	O & M	4	ENR		
	$/MG	282	Source		

Identified Problems: Reservoirs may require lining for leakage control; salinity of Manasquan estuary; effects of Upper Reservoir on GW; trout maintenace in Manasquan.

Project Status: Proposed ☒ Realistic ☒ Potential ☐ Unrealistic ☐ Discarded ☐

Rutgers Univ. conducting Environmental Impact Analysis

Prepared 1/23/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 77 Name Hackensack River Optimization L.O.R.D.S. No. _____
Atlas sheets 23 and 26

Region(s) 1 Basin(s) Hackensack River County(ies) Bergen

Author	Title	Library No.
HWC	TAMS Report 1955	757
COE	Site Capacity in N.J. 1966	810
	News Report 1969	201

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS					15

Limitations on yield _____

Narrative description Figure: No ☐ Yes ☒

Project involves in-basin water management optimization, expansion of pumping and transmission facilities and coordinated operation of Hackensack River Basin existing reservoirs. Development in the Basin precludes raising of dams or new reservoirs. Potential future water supplies may be available from out-of-basin supplies (Hudson or Ramapo Rivers) or from development of ground water projects; diversion of water from the confluence of the Pompton and Passaic Rivers is also possible (see Proj. 38).

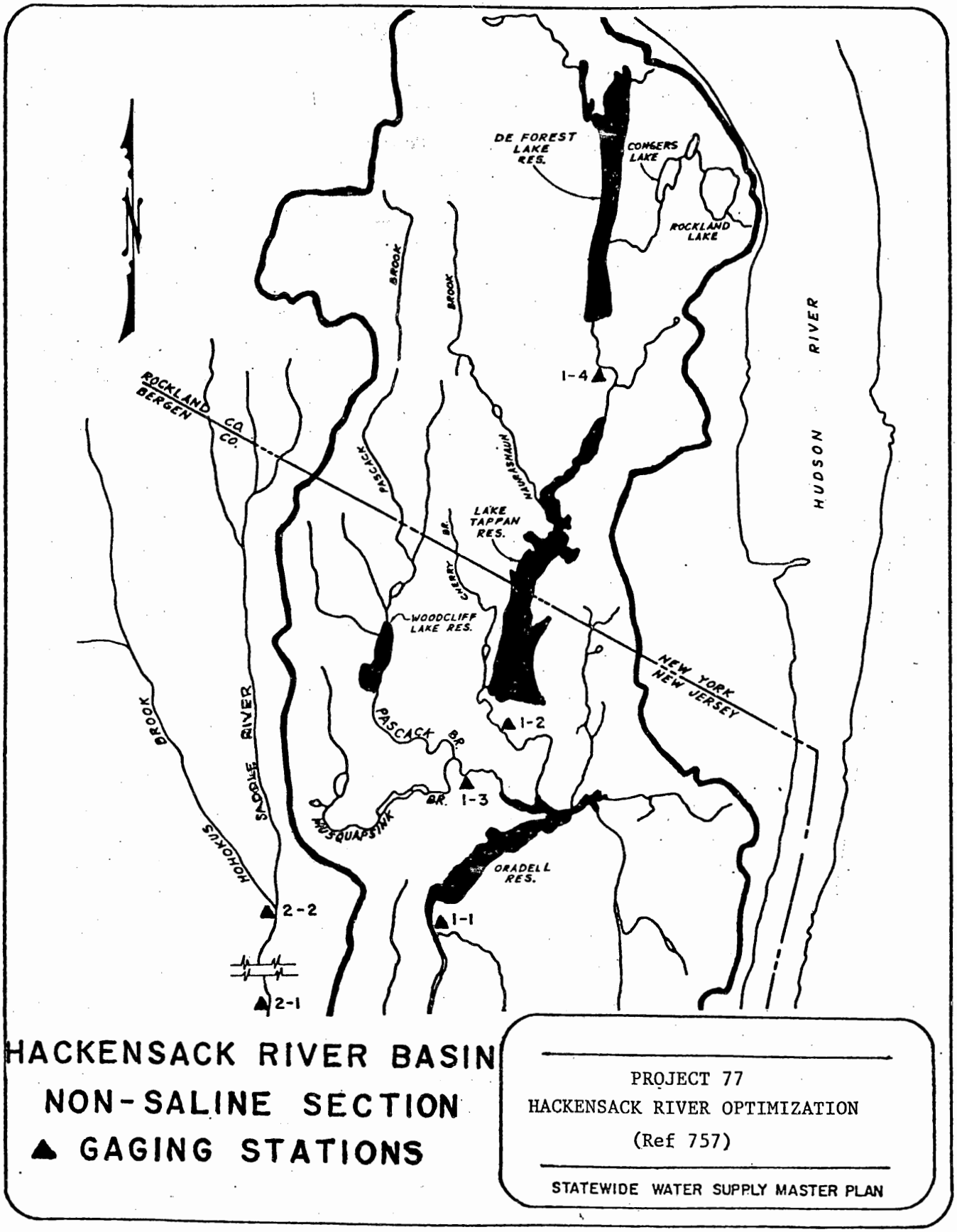
This in-basin project would increase storage volumes in de Forest Lake Reservoir and Lake Tappan Reservoir by reducing required releases in those reservoirs and below the Saddle River Pump Station. Maximum permissible diversion at Saddle River would be increased from 10 mgd to 15 mgd and the pump station and transmission facilities would be expanded. Excess Oradell Reservoir to Lake Tappan and excess Tappan water to de Forest Lake Reservoir.

Cost ($ million)				
Capital		Year		Note: None Available
O & M		ENR		
$/MG		Source		

Identified Problems _____

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 2/22/78 Revised 1 _____ Revised 2 _____


DE FOREST LAKE RES.
CONGERS LAKE
ROCKLAND LAKE
HUDSON RIVER
ROCKLAND CO.
BERGEN CO.
PASCACK BROOK
HACKENSACK BROOK
1-4
LAKE TAPPAN RES.
CHERRY BR.
WOODCLIFF LAKE RES.
NEW YORK
NEW JERSEY
1-2
PASCACK BR.
1-3
MUSQUAPSINK BR.
ORADELL RES.
1-1
SADDLE RIVER
HOHOKUS BROOK
2-2
2-1
HACKENSACK RIVER BASIN
NON-SALINE SECTION
▲ GAGING STATIONS
PROJECT 77
HACKENSACK RIVER OPTIMIZATION
(Ref 757)
STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 78 Name New York City Diversion from Manhattan L.O.R.D.S. No 26-04-900

Region(s) 1 Basin(s) Hudson River County(ies) _____

Author NJ Title - Library No. -

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) - Yield (mgd) 30's drought 60's drought Other -

Limitations on yield Availability

Narrative description Figure: No ☒ Yes ☐

This project has been suggested as an emergency water supply alternative. As required, a pipeline could be constructed across the George Washington Bridge to New Jersey from the New York City distribution system.

Cost ($ million) Capital _____ Year _____ Note None available
O & M _____ ENR _____
$/MG _____ Source _____

Identified Problems _____

Project Status: Proposed ☐ Realistic ☒ Emergency
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 3/2/78 Revised 1 _____ Revised 2 _____

ALTERNATIVE PROJECT DESCRIPTION

No. 79 Name New York City Diversion from Staten Island L.O.R.D.S. No. 26-32-000

Region(s) 1 Basin(s) Hudson River County(ies) Union, Middlesex

Author NJ Title Library No.

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) - Yield (mgd) 30's drought 60's drought Other -

Limitations on yield Availability

Narrative description Figure: No ☒ Yes ☐

This project has been suggested as an emergency water supply alternative. As needed, a pipeline or tunnel could be constructed from the New York City distribution system in Staten Island to New Jersey.

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified
Problems

Project Status: Proposed ☐ Realistic ☒ Emergency
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 80 Name South River Ground Water Pumped Storage Diversion L.O.R.D.S. No. 28-05-400

Region(s) 1 Basin(s) Raritan, South River County(ies) Middlesex

Author NJ Title Water Resources Circular 20, 1969 Library No. 1007

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, GWR	-				15-20

Limitations on yield See project no. 12

Narrative description Figure: No ☐ Yes ☒ #12

Additional water supply for the Sayreville area by pumped diversion of excess surface water from the South River at Duhernal Lake. Water to be delivered via pipeline to ponds in existing well fields on the outcrop area of Old Bridge Sand. Ponds would then recharge the aquifer (no treatment). Facilities include 60 mgd pumping station near Duhernal Dam and 3.79 miles of 54-inch delivery pipeline.

Proposed as alternative to South River Tidal Dam (Project 12).

Cost ($ million)				
Capital	2.170	Year	1969	Note: Exclusive of storage and recharge facilities.
O & M		ENR		
$/MG		Source	1007	

Identified Problems: Depends on availability of adequate storage and recharge facilities in the well fields to be benefited.

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 2/1/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 81 Name Weldon Brook Reservoir L.O.R.D.S. No. 22-42-300

Region(s) 1 Basin(s) Delaware, Musconetcong County(ies) Morris

Author MCMUA Title MC Water Supply Plan 1970 Library No. 1205.03

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd) 30's drought	60's drought	Other
WS	3.0		3.5	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Proposed by MCMUA for future supply. On-River reservoir located in Jefferson Township on the Musconetcong River. Proposed reservoir has a limited watershed of about 3.5 square miles and provides 3 BG storage at a high water elevation of 1060 feet MSL. (Future pumping of wet weather flows from the Musconetcong River could greatly increase the safe yield of the reservoir.) Compensating releases to Lake Hopatcong may be required. Some land has been acquired.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note Total surface water plan for MC estimated as $60 million.

Identified Problems Not endorsed by State. May conflict with Upper Longwood Valley Reservoir (Proj. 44)

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/3/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 82 Name Pulaski Reservoir L.O.R.D.S. No. 25-01-400

Region(s) 1 Basin(s) Delaware, Musconetcong County(ies) Morris

Author MCMUA Title MC Water Supply Plan 1970 Library No. 1205.03

Data Availability/Reliability Good

Purpose(s) WS, PS Storage(BG) 0.65 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Endorsed by State. One of four sites being purchased for development by MCMUA for future supply. Off-river reservoir located in Mount Olive Township in the Musconetcong River Watershed, supplied by river water initially pumped directly from the Musconetcong River with the supply eventually obtained from the proposed State Hackettstown Reservoir. Treatment and supply to area municipalities as supplementary supply. Provides 0.65 BG storage at elevation of 1,030 MSL. Acquisition of site is proceeding. High lift (600 ft.) costs may not justify small storage at site. Also to be used as local lake augmentation. Realistic only for minor local, in-basin supply.

Cost ($ million) Capital Year Note Total surface water plan for MC estimated as $60 million.
O & M ENR
$/MG Source

Identified Problems Limited storage at high cost.

Project Status: Proposed ☒ Realistic ☐ Possible local supply only.
Potential ☐ Unrealistic ☒
Discarded ☐

Prepared 2/3/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 83 Name Woodbourne Reservoir L.O.R.D.S. No. 22-12-700

Region(s) 6 Basin(s) Papakating Wallkill County(ies) Sussex

Author NJ Title NJ Res. Site Acq. Rpt. D.J. Kroeck, 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) 6.4 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir on the West Branch Papakating Creek. Approximate area of 600 acres.

Land acquisition cost - $300,000 (Ref. 1017), 1966.

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Small, redundant
Problems

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 84 Name Papakating Reservoir L.O.R.D.S. No. 22-22-300

Region(s) 6 Basin(s) Papakating, Wallkill County(ies) Sussex

Author NJ Title NJ Res. Site Acq. Rpt. DJ Kroeck, 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS FA, IRR	12.0				

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir located on the Papakating Creek near Papakating, NJ. Approximate area of 1,700 acres.

Land acquisition per ref. 1017, $840,000 (1966)

Cost ($ million)					
	Capital		Year	Note	None Available
	O & M		ENR		
	$/MG		Source		

Identified Problems

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 85 Name Bennets Mills Reservoir L.O.R.D.S. No. 29-31-500

Region(s) 2 Basin(s) Metedeconk County(ies) Ocean

Author NJ Title NJ Res. Site Acq. Rpt. Library No. 1017
DJ Kroeck, 1966

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) 2.4 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir site located on the South Branch Metedeconk River near Bennetts Mills. Approximate area of 800 acres.

Land acquisition cost per ref. 1017, $300,000 (1966)

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Small yield - redundant to Manasquan Project.

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 86 Name Toms River Reservoir L.O.R.D.S. No. 29-31-800

Region(s) 2 Basin(s) Toms River County(ies) Ocean

Author NJ Title NJ Res. Site Acq. Rpt. Library No. 1017
DJ Kroeck, 1966

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) 8.10 Yield (mgd) 30's drought 60's drought 100 Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Approximate reservoir area 840 acres. Located along Doves Mill Brook northwest of Toms River.
Land acquisition cost per ref. 1017, $420,000 (1966).

This site is a pumped storage facility supplied by pumping from the confluence of the Ridgeway Branch and Toms River.

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Yield may be excessive to need.

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 87 Name Crosswicks Reservoir L.O.R.D.S. No. 28-32-200

Region(s) 2,5,6 Basin(s) Crosswicks County(ies) Mercer, Burlington, Monmouth

Author NJ Title NJ Res. Site Acq. Rpt. Library No. 1017
DJ Kroeck, 1966

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) 5.10 Yield (mgd) 30's drought 60's drought Other
PS

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Storage reservoir situated on Crosswicks Creek, with or without pumpage from Doctors Creek. Approximate area of 1090 acres.

Site acquisition cost per ref. 1017, $560,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems High level impoundment near Fort Dix. Delaware River or groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 88 Name Deacons Reservoir L.O.R.D.S. No. 27-44-300

Region(s) 5 Basin(s) Assisscunk County(ies) Burlington

Author NJ Title NJ Res. Site Acq. Rpt. Library No. 1017
DJ Kroeck, 1966

Data Availability/Reliability Fair

Purpose(s) GWR, IRR Storage(BG) 9.4 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir located off-stream of Assisscunk Creek near Deacons, NJ. Approximate area of 960 acres.

Land acquisition cost per ref. 1017 is $1,800,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Delaware River, groundwater offer better sources of water supply.

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 89 Name Rancocas Reservoir L.O.R.D.S. No 31-05-100 32-01-400

Region(s) 5 Basin(s) Rancocas County(ies) Burlington

Author NJ Title NJ Res. Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	8.2				50.0
IRR					

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Four sided man-make pumped storage reservoir:
North - Route 38
South - Nebolds Corner to Vincentown Rd.
West - Mt. Holly
East - Route 206

Supplied from North Branch and South Branch Rancocas. Includes drainage area of Booby Run and Dimsdale Run. Approximate area of 1,650 acres.

Land acquisition cost per ref. 1017, $2,100,000 (1966).

Cost ($ million) Capital ____ Year ____ Note None Available
O & M ____ ENR ____
$/MG ____ Source ____

Identified Problems Delaware is better alternative, or groundwater supply.

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 12/15/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 90 Name Chews Reservoir L.O.R.D.S. No. 31-12-800

Region(s) 5 Basin(s) Big Timber County(ies) Camden

Author NJ Title NJ Res. Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) GWR Storage(BG) 5.2 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir near Chews Landing; water supplied from Big Timber Creek. Approximate area of 1,200 acres.

Site acquisition cost per ref. 1017, $1,500,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Delaware River or groundwater sources offer better water supply potential.

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 91 Name Pines Run Reservoir L.O.R.D.S. No. 31-12-700

Region(s) 5 Basin(s) Big Timber Creek County(ies) Camden

Author NJ Title NJ Res. Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) GWR Storage(BG) 2.10 Yield (mgd) 30's drought 60's drought Other
PS 6.0

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir located on Pines Run, supplied by Big Timber Creek. Approximate area of 600 acres; pool elevation 80 feet above MSL.

Land acquisition cost per ref. 1017, $750,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Delaware River or groundwater sources offer better water supply potential.

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 92 Name Mantua Reservoir L.O.R.D.S. No. 31-21-600

Region(s) 5 Basin(s) Mantua Creek County(ies) Gloucester

Author NJ Title NJ Res. Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) GWR, IRR, PS Storage(BG) 3.43 Yield (mgd) 30's drought 60's drought Other 18.0

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir; approximate area of 860 acres; pool elevation of 60 feet above msl; storage factor 217 MG/SM.

Site acquisition cost per ref. 1017, $749,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Delaware River or groundwater sources offer better water supply potential; need.

Project Status: Proposed ☐ Realistic ☐ Redundant, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 93 Name Chestnut Branch Reservoir L.O.R.D.S. No. 31-21-200

Region(s) 5 Basin(s) Mantua Creek County(ies) Gloucester

Author NJ Title NJ Res. Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) GWR, IRR, PS Storage(BG) 1.80 Yield (mgd) 30's drought 60's drought Other 9.0

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

A pumped storage reservoir located on Chestnut Branch Mantua Creek, approximate area of 400 acres; pool elevation of 60 feet above msl; storage factor 194 MG/SM.

Site acquisition cost per ref. 1017, $350,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Delaware River or groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 94 Name Swedesboro Reservoir L.O.R.D.S. No. 30-24-200

Region(s) 5 Basin(s) Raccoon Creek County(ies) Gloucester

Author NJ Title NJ Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) GWR IRR Storage(BG) 2.6 Yield (mgd) 30's drought 60's drought Other 3-35

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir located on a tributary of Raccoon Creek in South Harrison and Woolich Townships, approximately two miles southeast of Swedesboro. Project includes existing Lake Basgalore. Pool area would be 450 acres at elevation 70 feet above msl. Acquisition area of 1,300 acres, including corridor to Oldman's Creek; potential for supply from Nichomus Reservoir site (Proj. 98).

Drainage Area: minor - 3 SM (780 MG/SM Storage Factor)
major - 29 SM (additional pumping required)
Import potential - 20 and/or 24 SM

Site Acquisition Cost per ref. 1017 - $650,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Delaware River or groundwater sources offer better water supply potential; need Redundancy; need

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 95 Name Mullica Hill Reservoir L.O.R.D.S. No. 30-33-600 -900

Region(s) 5 Basin(s) Raccoon Creek County(ies) Gloucester

Author NJ Title NJ Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) GWR IRR Storage(BG) 4.1 Yield (mgd) 30's drought 60's drought Other 8-40

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir located in Harrison and South Harrison Townships on the South Branch Raccoon Creek, approximately one mile southwest of Mullica Hill, N.J. Pool area of 690 acres at 70 feet msl elevation. Acquisition area of 1,600 acres including corridor to Mantua Creek at Wenonah.

Drainage area: minor - 8 SM (540 MG/SM storage factor)
major - 29 SM (additional pumping required)
import potential - 20 and/or 24 SM

Land acquisition cost per ref. 1017 - $830,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Existing gravel, marl operations
Delaware River or groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Redundancy, need

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 96 Name Major Run Reservoir L.O.R.D.S. No. 30-33-500 -900

Region(s) 4 Basin(s) Salem River County(ies) Salem

Author NJ Title Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) GWR IRR Storage(BG) 1.4 Yield (mgd) 30's drought 60's drought Other 3-30

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir located in Mannington and Pilesgrove Townships on Major Runk a tributary of the Salem River, approximately one-half mile west of the Nichomus Reservoir site (Proj. 98) and one mile south of Sharptown; pool area would be 430 acres at 50 feet msl elevation. Acquisition area of 1,100 acres, including land adjacent to Nichomus Reservoir site.

Drainage area - minor - 2 SM
major - 30 SM (requires additional pumping)
import potential - 24 SM

Site acquisition cost per ref. 1017, $550,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Delaware River or groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 97 Name Alphano Reservoir L.O.R.D.S. No. 24-04-300

Region(s) 6 Basin(s) Pequest County(ies) Warren

Author NJ Title NJ Res. Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) WS SFA Storage(BG) 7.70 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

310 acre pumped storage reservoir near Alphano, NJ, supplied from the Pequest River.

Site acquisition cost per ref. 1017 - $160,000 (1966).

Plan was to use this site along with Petersburg (Proj. 66) and Shades of Death (Proj. 65)

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Panther Valley Development
Lack of demand

Project Status: Proposed ☐ Realistic ☐ Need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 98 Name Nichomus Run Reservoir L.O.R.D.S. No. 30-33-600 -34-700

Region(s) 4 Basin(s) Salem River County(ies) Salem

Author NJ Title Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) GWR IRR Storage(BG) 1.8 Yield (mgd) 30's drought 60's drought Other 5-30

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir located on Nichomus Run, a tributary of the Salem River, approximately one mile southwest of Woodstown and one-half mile east of the Major Run reservoir site (Proj. 96). Pool area would be 640 acres at elevation 50 feet msl. Acquisition area is 1,240 acres, including a corridor to Oldman's Creek and a potential supply from Swedesboro Reservoir site (Proj. 94).

Drainage area - minor - 5 SM
major - 30 SM (requires additional pumping)
import potential - 24 SM

Site acquisition cost per ref. 1017, $620,000 (1966).

Cost ($ million) **Capital** **O & M** **$/MG** Year ENR Source Note None available

Identified Problems Delaware River or groundwater sources offer better water supply potential; need.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒ Redundancy, need

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 99 Name Alloway Creek Reservoir L.O.R.D.S. No. 30-44-200

Region(s) 4 Basin(s) Alloway Creek County(ies) Salem

Author NJ **Title** NJ Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
GWR	3.4				2.0-10.0
IRR					

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir located on Alloway Creek south of the Salem River in Upper Pittsgrove Township (near Cool Run Reservoir Site). Water source is Alloway Creek. Pool area would be 595 acres at a pool elevation of 130 feet msl. Acquisition area is 1,275 acres, including a corridor to Alloway Lake.

Drainage area: minor - 2 SM
major - 16 SM (requires additional pumping)

Site acquisition cost per ref. 1017 is $637,500 (1966).

Cost ($ million)				
Capital		Year	Note	None Available
O & M		ENR		
$/MG		Source		

Identified Problems Delaware River or groundwater sources offer better water supply potential; need.

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 100 Name Stow Creek Reservoir L.O.R.D.S. No. 34-03-600 -900

Region(s) 4 Basin(s) Stow Creek County(ies) Salem Cumberland

Author NJ Title NJ Site Acq. Rpt., 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS GW	7.8			10.0	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

This project is located on Stow Creek in the Townships of Lower Alloway Creek, Stow Creek and Quinton. Pool area would be 1,230 acres at an elevation of 50 feet above msl. Acquisition area is some 2,120 acres. The reservoir project includes provisions for generation of hydroelectric power and desalination facilities.

Drainage area - 12 SM

Land acquisition cost, per ref. 1017, if $1,060,000 (1966).

Cost ($ million)					
	Capital		Year	Note	None Available
	O & M		ENR		
	$/MG		Source		

Identified Problems: Groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒ Redundancy, need

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 101 Name Cohansey Reservoir (Shiloh) L.O.R.D.S. No. 34-04-500 -800

Region(s) 4 Basin(s) Cohansey River County(ies) Cumberland

Author NJ Title Site Acq. Rpt., 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS GWR, IRR	6				4-40

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

This project consists of two off-river impoundments located west of the Cohansey River. One impoundment is along Bebe Run in Hopewell Township and would have a pool area of 730 acres at 100 feet elevation msl. L.O.R.D.S. No. for this site is 34-04-500. A second impoundment, adjacent to the first, is along Shaw Branch in Hopewell Township and Shiloh Boro. This site would have a pool area of 410 acres, also at elevation 100 feet msl. L.O.R.D.S. No. for this site is 34-04-800. Total land acquisition area for the combined project is 3,040 acres. The project has a local drainage area of 2 SM, and a major drainage area of 34 SM.

Land acquisition cost, per ref. 1017, is $1,520,000 (1966).

Cost ($ million)				
	Capital	Year	Note	None Available
	O & M	ENR		
	$/MG	Source		

Identified Problems: Groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒ Redundancy; need

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 102 Name Carmel Reservoir L.O.R.D.S. No. 35-01-900 -02-700

Region(s) 4 Basin(s) Maurice River County(ies) Cumberland

Author NJ Title Res. Site Acq. Rpt., 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS	2.2				10.0
PS					

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Off-stream pumped storage reservoir located west of the Maurice River in Deerfield Township, near the southeastern corner of Salem County. Water would be supplied to the site from the Maurice River. Pool area is 500 acres at 80 feet elevation; site acquisition area is 1,500 acres, including a corridor to the Maurice River. Drainage area is 180 SM. Site potentially connected, via pumping, with Indian Branch Reservoir (Proj. 107).

Site acquisition cost per ref. 1017 is $750,000 (1966).

Cost ($ million)					
	Capital		Year		Note None Available
	O & M		ENR		
	$/MG		Source		

Identified Problems Groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 103 Name South River Reservoir Project L.O.R.D.S. No. 35-15-100

Region(s) 3 Basin(s) Great Egg Harbor River County(ies) Atlantic

Author NJ Title Feas. Rpt. GEHR Basin for South River Project 1966 Library No. 1012

Data Availability/Reliability Good

Purpose(s)	Storage (BG)	Yield (mgd)	30's drought	60's drought	Other
WS, PS R, IRR	8.6			92.4	

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

The reservoir site is located on the South River, a tributary of the Great Egg Harbor River (GEHR), about 2 miles southwest of Lake Lenape. Maximum pool elevation would be 60 feet above msl, and water surface area would be approximately 1800 acres. The pool would be created by a dam 5000 feet long and rising 50 feet above the South River stream bed. Filling of the reservoir would be by natural stream flow (2.96 BG) and by pumping (5.64BG) from the GEHR. Pumping rate required would be 110 mgd.

As a water supply project, the reservoir can maintain a constant storage of aquifers and summer load assistance to coastal municipalities, guaranteeing 92 mgd annually.

When used for irrigation in the growing season, and year round for water supply, the reservoir can irrigate some 25,000 acres and guarantee a 9-month recharge to the aquifers, and constant yearly water supply averaging to 69 mgd.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note None Available

Identified Problems Assumes 0.125 mg/sm passing flow - may be too low. Inundation of 2 miles of medium duty roads, some 20 buildings, 3 miles of transmission line.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 2/1/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 104 Name Penny Pot Reservoir L.O.R.D.S. No. 31-44-300

Region(s) 3 Basin(s) Great Egg Harbor River County(ies) Atlantic

Author NJ Title Res. Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s) WS PS Storage(BG) 8.0 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir on Penny Pot Stream, a tributary of Great Egg Harbor River. Acquisition area is 1,600 acres.

Site acquisition cost per ref. 1017 is $600,000 (1966).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 105 Name Merrill Creek Reservoir L.O.R.D.S. No. 24-21-300

Region(s) 6 Basin(s) Delaware County(ies) Warren

Author DRB Electric Utilities Group Title Site Study for DRBEUG by TAMS, 1976 Library No.

Data Availability/Reliability Good

Purpose(s) WS Storage(BG) 17 Yield (mgd) 30's drought 60's drought Other 42-113

Limitations on yield In-house cooling water supply

Narrative description Figure: No ☒ Yes ☐

This pumped storage reservoir site is located on Merrill Creek in Harmony Township. Project includes a pump station of the Delaware River (mile pt. 193) and a 15,000 foot force main to the site. Water to be used primarily for make-up cooling water for the Delaware River Basin Electric Utilities Group.

Site Statistics:

Max. pool elevation - 920 ft. msl
Water Surface - 700 acres
Depth at Dam - 300 feet
Local Drainage Area - 3.2 SM
Force Main: Tunnel - 9600 ft. @ 8 ft. dia.
Pipe - 6000 ft. @ 54 in. dia.
Pump Rate - 142 MGD
Power Head - 800 ft.

Costs

Land - - 4.3 million
Dam - 17.6 million
Pump Station - 11.6 million
Tunnel /Shaft - 14.1 million
Other - 30.1 million

NOTE: As a streamflow augmentation project, the reservoir would assist in holding back salinity intrusion in the estuary protecting existing freshwater wells and intakes.

Cost ($ million) Capital 177.7 Year 1976 Note O&M - Power only
O & M 0.5 ENR
$/MG Source

Identified Problems Private, industrial water supply

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/2/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 106 Name Cool Run Reservoir L.O.R.D.S. No. 30-44-200

Region(s) 4 Basin(s) Alloway Creek County(ies) Salem

Author NJ Title Res. Site Acq. Rpt. 1966 Library No. 1017

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
GWR IRR	3				3-10

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir site located on Cool Run Branch of the Alloway Creek in Upper Pittsgrove and Alloway Townships, adjacent to Alloway Creek Reservoir (Proj. 99). Pool area would be 510 acres at elevation 110 feet msl. Acquisition area is 1,125 acres.

Drainage area - minor - 3 SM
major - 16 SM (requires pumping)

Site acquisition cost per ref. 1017 is $562,500 (1966)

Cost ($ million)					
	Capital		Year		Note None Available
	O & M		ENR		
	$/MG		Source		

Identified Problems Groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 107 Name Indian Branch Reservoir L.O.R.D.S. No. 31-42-200, 300 & 31-32-800, 900

Region(s) 5 Basin(s) Maurice River County(ies) Gloucester

Author NJ Title Library No.

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) 12.5 Yield (mgd) 30's drought 60's drought Other 55

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir located in Franklin Township off-stream of the Maurice River on Indian Branch. Pool area would be 2,300 acres at an elevation of 125 feet msl. Acquisition area is 3,800 acres, including a corridor to the Maurice River. The Carmel Reservoir (Proj. 102) is available for potential connection with this site. The Indian Branch Reservoir would have a local drainage area of some 6 SM, and a major drainage area at the Maurice River of 180 SM. The site is located approximately one-half mile northeast of Malaga Lake.

Site acquisition cost per NJ (1966) is $1,900,000.

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 108 Name New Hampton Reservoir L.O.R.D.S. No. 24-23-200

Region(s) 6 Basin(s) Delaware, Musconetcong County(ies) Warren, Hunterdon

Author _____ Title NEWS Report Nov. 1971 Library No. 202

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS, R, FC	14.3				

Limitations on yield _____

Narrative description Figure: No ☒ Yes ☐

Originally proposed by NJ and considered as one of four reservoirs for NEWS D-3 alternative. Located at New Hampton, one mile north of Hampton, this site has been discarded by the revision of the original Hackettstown Reservoir Project which has eliminated the flood storage component in favor of greater water supply storage.

Cost ($ million)				
	Capital	Year	Note	None available.
	O & M	ENR		
	$/MG	Source		

Identified Problems: Shallow, water quality problems. ~~Lack of Demand~~

Project Status: Proposed ☐ Realistic ☐
Potential ☐ Unrealistic ☒
Discarded ☒

Prepared 2/16/78 Revised 1 _____ Revised 2 _____

ALTERNATIVE PROJECT DESCRIPTION

No. 109 Name North Branch Timber Creek Reservoir L.O.R.D.S. No. 31-12-100

Region(s) 5 Basin(s) Big Timber Creek County(ies) Gloucester

Author NJ Title Pot. Res. Sites-Gloucester Co., NJ Library No.

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	5.22			20.0	
PS					

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Located off-stream of the North Branch Timber Creek, this pumped storage reservoir site would have a pool area of some 850 acres at elevation 50 feet msl. Local drainage area is 15.8 SM (10 mgd yield) at a storage factor of 330 MG/SM; major drainage area is 21 SM (additional pumping required).

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified Problems Interference with Interstate 295
Delaware River or groundwater sources offer better water supply potential.

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 110 Name Otter Brook Reservoir L.O.R.D.S. No. 31-12-500

Region(s) 5 Basin(s) Big Timber Creek County(ies) Gloucester, Camden

Author N.J Title Pot. Res. Sites in Gloucester Co. Library No.

Data Availability/Reliability Fair

Purpose(s)	Storage (BG)	Yield (mgd) 30's drought	60's drought	Other
WS, PS	1.3			5.0

Limitations on yield Local drainage area yield of 2.0 mgd.

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir off-stream of the North Branch Big Timber Creek on Otter Brook, northeast of Chews Landing. Pool elevation would be 50 feet above msl; 195 acres required. Local drainage area is 2.8 SM, with an additional 15.8 SM available via pumping from North Branch Big Timber Creek. Storage factor of the local drainage area is 465 MG/SM.

Cost ($ million) Capital ____ Year ____ Note None Available
O & M ____ ENR ____
$/MG ____ Source ____

Identified Problems Delaware River or groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☒ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 111 Name Monongahela Brook Reservoir L.O.R.D.S. No. 31-31-300

Region(s) 5 Basin(s) Mantua Creek County(ies) Gloucester

Author NJ Title Pot. Res. Sites - Gloucester Co. Library No.

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS	1.16			4.0	
PS					

Limitations on yield (2.0 local PA) (2.0 pumping)

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir located on Monongahela Brook, a tributary of the Mantua Creek. Pool area is some 370 acres at a pool elevation of 60 feet above msl. Local drainage is about 2.9 SM (2.0 mgd yield) with an additional drainage area of 30.0 SM (2.0 mgd) available through pumping; the storage factor of the local drainage area is some 400 MG/SM.

Cost ($ million) Capital ____ Year ____ Note None Available
O & M ____ ENR ____
$/MG ____ Source ____

Identified Problems Delaware River or groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/15/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 112 Name Dock Watch Hollow Reservoir L.O.R.D.S. No. 25-33-100 -200

Region(s) 1 Basin(s) Raritan River County(ies) Somerset

Author TAMS Title TAMS Report Library No. 757

Data Availability/Reliability Good

Purpose(s) WS PS Storage(BG) 15.8 Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Project involves erection of a single dam in a natural depression of the Watchung Mountains about three miles north of Bound Brook, to create a reservoir which, at a spillway elevation of 455 feet (131 foot high dam), would flood an area of 1060 acres and develop a storage volume of 15.8 BG. Total land acquisition would be 1,200 acres.

At full capacity, this reservoir would operate as a pumped storage reservoir (1) to increase Raritan River Basin yield at Bound Brook to 200 mgd in combined operation with Round Valley Reservoir or (2) to increase Raritan River Basin yield at Bound Brook to 200 mgd in combined operation with the East Branch Chimney Rock Reservoir (Proj. 22). The latter operation may also be favorable for installation of a pumped storage generation plant for peak load assistance; more extensive electrical energy recovery can be developed in the former operating scheme.

(An alternative plan could utilize Dock Watch Hollow as a high level emergency storage reservoir: elevation 389 feet; 1.33 BG usable storage; 190 mgd for seven days: Cost - $2.58 million)

Cost ($ million) Capital 6.6 Year 1955 Note First Cost - W. Round Valley/
O & M 5.2, 4.2 ENR Second Cost - W. Chimney Rock
$/MG 72,58 Source 757

Identified Problems Dislocation of residents, Spruce Run constructed

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 3/6/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 113 Name Raritan-Raritan Pipeline L.O.R.D.S. No. _____
Atlas Sheet 24

Region(s) 6 Basin(s) Delaware, Raritan County(ies) Hunterdon

Author NJ Title News Study Nov. 1971 Library No. 202

Data Availability/Reliability Good

Purpose(s) WS Storage(BG) _____ Yield (mgd) _____ 30's drought _____ 60's drought _____ Other _____

Limitations on yield _____

Narrative description — See Proj. 28 Figure: No ☐ Yes ☐

Part of project number 28, NEWS P-2, for diversion of Delaware water (300 mgd) through Round Valley to the Raritan and Passaic Basins. Because Round Valley cannot provide sufficient storage for P-2 as conceived, additional storage and this pipeline bypassing Round Valley are required.

Cost ($ million) Capital _____ O & M _____ $/MG _____ Year _____ ENR _____ Source _____ Note None available / See Project 28

Identified _____
Problems _____

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 3/6/78 Revised 1 _____ Revised 2 _____

ALTERNATIVE PROJECT DESCRIPTION

No. 114 Name Rainey Road Reservoir L.O.R.D.S. No. 30-23-900 -24-700

Region(s) 5 Basin(s) Oldmans Creek County(ies) Gloucester

Author NJ Title Pot. Res. Sites Gloucester Co. Library No.

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS PS	0.7				2.0

Limitations on yield 0.8 MGD from local drainage area.

Narrative description Figure: No ☒ Yes ☐

Off-stream pumped storage reservoir along Rainey Road approximately one-half mile southwest of Swedesboro. Pool elevation would be 80 feet above msl, on a 185 acre site. Local drainage area is 0.9 SM, with an additional 23 SM available by pumping from Oldmans Creek. Storage factor of the local drainage area is 780 MG/SM.

Cost ($ million) Capital Year Note None Available.
O & M ENR
$/MG Source

Identified Problems Delaware River or groundwater sources offer better water supply potential; need.

Project Status: Proposed ☐ Realistic ☒ Redundancy, need
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 115 Name Vestry Road Reservoir L.O.R.D.S. No.
Atlas Sheet 30

Region(s) 5 Basin(s) Oldsman's Creek County(ies) Gloucester

Author NJ Title Pot. Res. Sites Gloucester Co. Library No.

Data Availability/Reliability Fair

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS PS	1.3				2.0

Limitations on yield 1.0 mgd from local drainage area

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir site located along Vestry Road off-stream of Oldman's Creek. It is a 297 acre site with pool elevation of 90 feet above mal. Local drainage area is 1.33 SM, with an additional 17.6 SM available via pumping from Oldman's Creek. Local drainage area storage factor is 920 MG/SM.

(Specific Location Unknown)

Cost ($ million)					
	Capital		Year		Note None Available
	O & M		ENR		
	$/MG		Source		

Identified Problems Delaware River or groundwater sources offer better water supply potential; need

Project Status: Proposed ☐ Realistic ☐ Redundancy, need
Potential ☒ Unrealistic ☒
Discarded ☐

Prepared 2/15/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 116 Name Frenchtown Reservoir L.O.R.D.S. No. 24-32-500

Region(s) 6 Basin(s) Delaware County(ies) Hunterdon

Author NJ Title _____ Library No. _____

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) _____ Yield (mgd) 30's drought 60's drought Other
PS

Limitations on yield _____

Narrative description Figure: No ☒ Yes ☐

Pumped storage reservoir located on the Delaware Pipeline, north of Frenchtown in Mount Pleasant area, along Harihokake Creek. Estimated total area is 2,200 acres at a spillway crest elevation of 400 feet above msl.

Part of Project 28 or Flat Brook - Honey Run alternative (Proj. 57 and 67)

Cost ($ million) Capital _____ Year _____ Note None Available
O & M _____ ENR _____
$/MG _____ Source _____

Identified Problems Inundates Town of Mt. Pleasant

Project Status: Proposed ☐ Realistic ☒
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 2/16/78 Revised 1 _____ Revised 2 _____

ALTERNATIVE PROJECT DESCRIPTION

No. 117 Name Glen Alpin Reservoir L.O.R.D.S. No. 25-13-700-800

Region(s) 1 Basin(s) Passaic River County(ies) Morris

Author MCMUA Title MCMUA Rpt on Potential Reservoir Sites Feb. 1965 (E.T. Killam) Library No. 1205.04

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS PS,FA	0.8				2.3

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir site within Harding Township off stream of the Passaic River on a small tributary. The local drainage area is approximately 2.1 square miles. Pool elevation would be 460 Feet above msl, if the site were used for pumped storage (additional 2.2 BG storage).

Cost ($ million) Capital ____ Year ____ Note None available
O & M ____ ENR ____
$/MG ____ Source ____

Identified
Problems

Project Status: Proposed ☐ Realistic ☐ Redundant, small.
Potential ☐ Unrealistic ☒
Discarded ☒

Prepared 3/22/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 118 Name VanDoran Mills Reservoir L.O.R.D.S. No. 25-23-100

Region(s) 1 Basin(s) Passaic River County(ies) Somerset, Morris

Author MCMUA Title MCMUA Rpt on Potential Reservoir Sites, Feb. 1965 (E.T.Killam Library No. 1205.04

Data Availability/Reliability Good

Purpose(s) WS Storage(BG) 0.55 Yield (mgd) 30's drought 60's drought Other 3.7

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir site considered for regional water supply development. Located in Basking Ridge in Somerset County on the upper reach of the Passaic River, this site has a watershed area of about 8.8 square miles. Flow line elevation of 300 Feet above msl.

Cost ($ million) Capital Year Note None Available
O & M ENR
$/MG Source

Identified

Problems

Project Status: Proposed ☐ Realistic ☐ Redundant, small.
Potential ☐ Unrealistic ☒
Discarded ☒

Prepared 3/22/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 119 Name Silver Lake Reservoir L.O.R.D.S. No. 25-13-600 -14-700

Region(s) 1 Basin(s) Passaic River, Great Brook County(ies) Morris

Author MCMUA Title MCMUA Rpt. on Potential Reservoir Sites, Feb.1965 (E.T.Killam) Library No. 1205.04

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS FA	3.3				5.1

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Reservoir site located in Harding Township on the upstream watershed of the Passaic River drainage basin. The site would be located on Great Brook, a tributary of the Passaic River. The watershed is approximately 6.8 square miles in area. Flow line elevation 290 feet above msl.

Cost ($ million) Capital ____ Year ____ Note None Available
O & M ____ ENR ____
$/MG ____ Source ____

Identified Problems

Project Status: Proposed ☐ Potential ☐ Discarded ☒ Realistic ☐ Unrealistic ☒

Prepared 3/22/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 131 Name Well Field in Wharton Tract (Southwest NJ) L.O.R.D.S. No. 32-32-400

Region(s) 3,4,5 Basin(s) Mullica River, Batsto River County(ies) Atlantic & Burlington

Author NJ TAMS Title TAMS Report, 1955 Library No. 757

Data Availability/Reliability Good

Purpose(s) WS Storage(BG) NA Yield (mgd) 30's drought 60's drought Other 100

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Installation of 120 wells in 4 stages along the lower reaches of the Mullica and Batsto Rivers (including 20 as reserve capacity). Two sections of wells would extend upstream along the Mullica River from the mouth of the Batsto River, and the other two sections would extend upstream along the Batsto River from the same point. An intercepting pipeline would deliver water from the four sections to a central point. A booster pumping station would deliver water from the intercepting main to a transmission aqueduct. Most of the water developed will be from induced stream infiltration with only a small amount removed from storage. Only chlorination will be required and water will be transmitted to western and southwestern New Jersey areas.

Cost ($ million) Capital 15.6 O & M 1.4 $/MG 48 Year 1955 ENR Source 757 Note

Identified Problems Reduction in stream flow.

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 1/27/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 132 Name Well Field in Wharton Tract (Southeast N.J.) L.O.R.D.S. No. 32-33-500

Region(s) 2,3,5 Basin(s) Wading River County(ies) Burlington

Author NJ TAMS Title TAMS Report 1955 Library No. 757

Data Availability/Reliability Good

Purpose(s) WS Storage(BG) NA Yield (mgd) 30's drought 60's drought Other 22

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Installation of 28 wells in stages along the lower reaches of the East and West Branches of Wading River. One line of 14 wells would extend upstream along the West Branch of Wading River and the second line of 14 wells would be constructed along the East Branch upstream from the junction of the two branches near Harrisville. An intercepting pipeline would deliver water from the wells to a central point where a booster pumping station would then deliver the water to a transmission aqueduct. All the water will be developed from induced stream infiltration. Only chlorination will be required and water will be transmitted to eastern and southeastern New Jersey areas.

Cost ($ million) Capital 6.04 O & M 0.52 $/MG 176 Year 1955 ENR Source 757 Note

Identified Problems Reduction in stream flow.

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 1/27/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 133 Name South Jersey Ground Water L.O.R.D.S. No.

Region(s) 1,2,3,5 Basin(s) Atlantic, Coastal, Delaware County(ies) Atlantic, Burlington, Camden, Ocean

Author COE Title NEWS Studies: Nov. 1971; June, 1973; July, 1977 (Summary) Library No. 202, 205.03, 229.07 (NEWS SJ1,SJ2)

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS				200-400	

Limitations on yield

Narrative description Figure: No ☐ Yes ☒

News Project SJ-1 involves the installation of 200 wells in the Fort Dix Military Reservation and adjacent Lebanon State Forest area. Each well would have an average yield of one mgd. Included in the project are a force main through the well field to a treatment plant and pumping station at the northern edge of the field, plus a treated water main to New Brunswick. Determination of whether water will be developed by induced stream infiltration or from aquifer storage will be dependent on future studies. Iron removal will be necessary and water will be transmitted to New Brunswick for distribution in the northeast part of the state. Additional well field in Wharton Tract could increase project yield from 200 to 400 mgd (NEWS SJ-2).

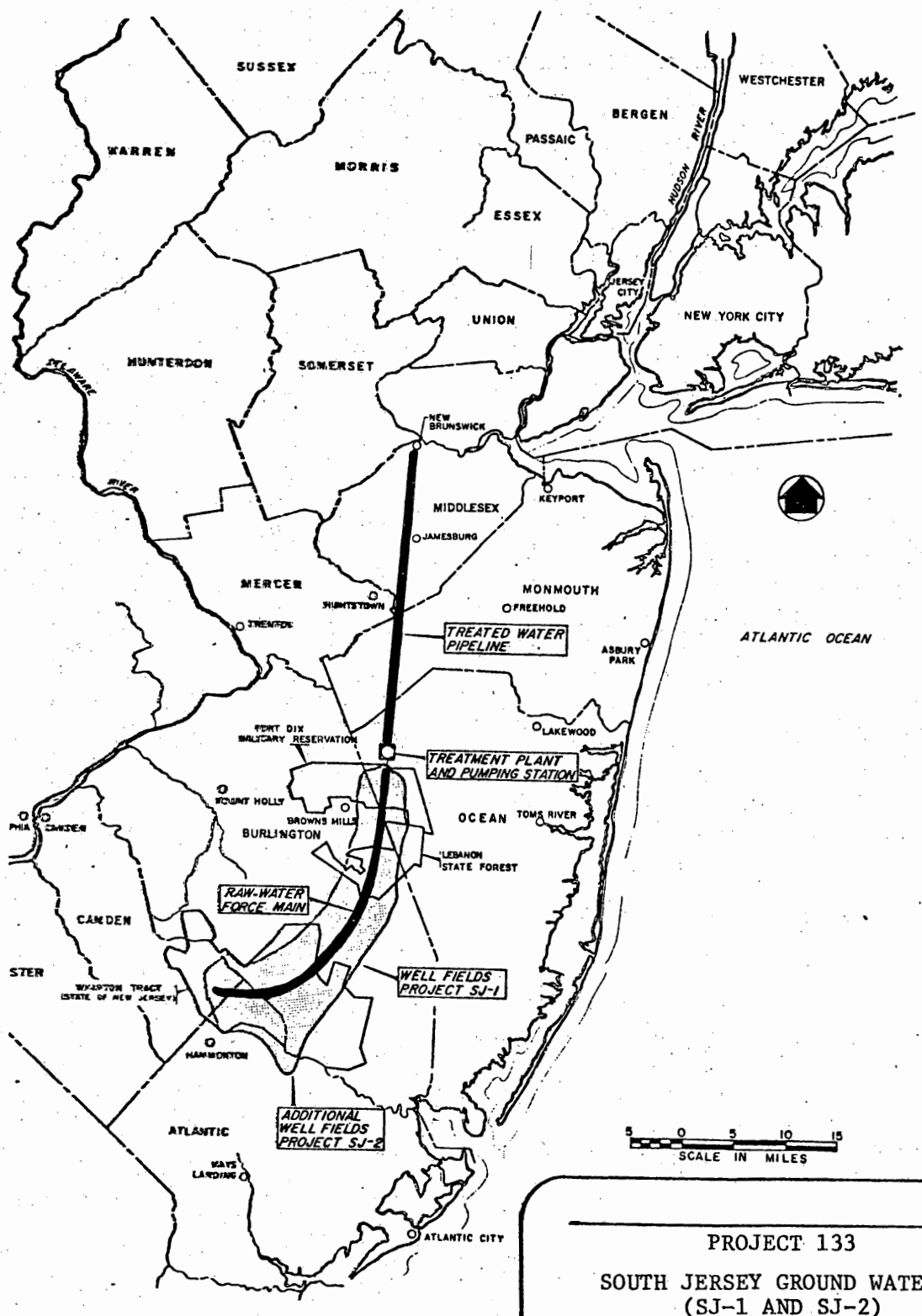
1971 Cost Estimates (Ref. 202, 1971 ENR 1400)
Project SJ-1 (200 mgd):
(Capital) $188.5 million; (O&M) $14.5 million; $199/MG
Project SJ-2 (400 mgd):
(Capital) $299.8 million; (O&M) $24.7 million; $169/MG

Cost ($ million)				
Capital	310	Year	1975	Note Delivery to New Brunswick Proj. SJ-1, 200 mgd yield
O & M	32	ENR		
$/MG	434	Source	229.07	

Identified Problems Reduction in stream flow if induced stream infiltration is used to develop supply. Increased salinities in estuaries and salt water intrusion. Prove No local need to allow export.

Project Status: Proposed ☒ Realistic ☐
Potential ☐ Unrealistic ☒
Discarded ☐

Prepared 1/25/78 Revised 1 Revised 2



PROJECT 133

SOUTH JERSEY GROUND WATER
(SJ-1 AND SJ-2)
(REF. 202)

STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT DESCRIPTION

No. 134 Name Sanford Plan L.O.R.D.S. No. 28-13-500

Region(s) 1 Basin(s) Millstone River County(ies) Mercer

Author J.H. Sanford Title Spec. Rpt. 35-Wtr. Res. of the Upper Millstone River Basin Library No.

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS GWR	1.1				24

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Construction of two dams, one on the Millstone River and the other on Big Bear Brook along with troughs excavated behind each dam. These troughs will receive excess runoff and recharge and increase the yield of the Pennsauken Formation. Water would be pumped from the troughs for supply during low flow periods after filling up during high flow periods.

Cost ($ million)					
Capital	15.2	Year	1971	Note	Special Report 35
O & M	1.032	ENR			
$/MG	256	Source			

Identified Problems: Special Report 35 - showed the plan to be hydrologically unfeasible and the costs per mgd as compared to development of groundwater by wells to be unfavorable.

Project Status: Proposed ☐ Realistic ☐ Potential ☐ Unrealistic ☒ Discarded ☒

Abandoned per Special Report 35 - Geraghty & Miller

Prepared 1/25/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 135 Name Burlington County East Zone Well Fields L.O.R.D.S. No. See Description Note

Region(s) 3,5 Basin(s) Batsto River, Wading River County(ies) Burlington

Author Land Engrg. & Surveying Co., Inc. Title Water Fac. Study-Burlington Co., NJ 1970 Library No. 1211.01

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS					113

Limitations on yield

Narrative description Figure: No ☒ Yes ☐

Construction of two dams and impounding reservoirs on the Batsto and Wading Rivers. Installation of 58 wells along the Banks of the two rivers to derive the entire supply from induced river infiltration. Water will be transmitted by aqueduct to coastal areas of Burlington and Atlantic Counties and to central and western Burlington County, and Camden area. Staged development through the year 2000. Costs include transmission by aqueducts, a booster pumping station (at Green Bank), reservoirs and interceptors.

Aqueducts:

To East Zone Burlington Co. and Atlantic Co. $13,000,000 (1955)
To Central and West Zones Burlington Co. and Camden Co. $31,650,000 (1955)

Note

Booster Station	L.O.R.D.S. No. 32-32-900
Lower Dam	L.O.R.D.S. No. 32-43-600
Upper Dam	L.O.R.D.S. No. 32-32-400

Cost ($ million) Capital 56.3 Year 1970 Note O & M costs and $/MG not available.
O & M ENR
$/MG Source

Identified Problems Reduction in stream flow. Environmental concern of Pine Barrens

Project Status: Proposed ☒ Realistic ☒
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared 1/27/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 136 Name Alamatong Well Field and Recharge Basin L.O.R.D.S. No. 25-02-700

Region(s) 1 Basin(s) Raritan, Lamington, Black R. County(ies) Morris

Author MCMUA Title MC Water Supply Plan 1970 Library No. 1205.03

Data Availability/Reliability Good

Purpose(s) WS Storage(BG) Yield (mgd) 30's drought 60's drought Other

Limitations on yield East-central Morris County municipalities.

Narrative description Figure: No ☒ Yes ☐

Endorsed by State. One of four sites being purchased for development by MCMUA for future supply. Regional well water supply development on the Black River in Randolph and Roxbury Townships. (Stage 1) Eventual construction of a low dam for the storage of surface water during periods of high stream flow to create a retention basin for groundwater recharge - provides assurance of maximum storage in the water bearing aquifer and will increase well yields. (conjunctive use)

Excellent quality water/treatment by chlorination only.

- Booster pumping station and transmission mains to connected systems included in cost estimates. Land acquisition proceeding. (MCMUA has grant offer of $1.5 million from HUD.)

Cost ($ million) Capital 4.0* O & M 0.25 $/MG

Year 1970 ENR Source 1205.03

Note *Stage I costs only.

Identified Problems Diversion rights.

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐

Water is now being delivered to Randolph Township - this project.

Prepared 2/2/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 137 Name Delaware River Diversion to Dunker Pond Reservoir L.O.R.D.S. No. 22-33-300

Region(s) 1, 6 Basin(s) Passaic (Pequannock) County(ies) Passaic, Sussex, Warren

Author Newark Title City of Newark - Alternative Water Supply Projects Library No. 1206.01 Interview

Data Availability/Reliability Good

Purpose(s) WS PS Storage(BG) 11.0 Yield (mgd) 30's drought 60's drought 30 Other

Limitations on yield Pequannock Watershed presently overdrawn by some 20 mgd.

Narrative description Figure: No ☐ Yes ☐

The proposed project involves high flow skimming of the Delaware River at Yard's Creek and pumping through a 26-mile transmission main to Dunker Pond Reservoir. The project would increase the capacity of the Pequannock Watershed from 14.4 BG to 25.4 BG. Transmission of some 100 mgd is conceivable. Pumping would be over the 26-mile New York Susquehanna & Western R.R. right-of-way (owned and maintained by the City of Newark). Water from Dunker Pond would be fed, by gravity, to Oak Ridge Reservoir. A 300ft head would be utilized for hydro-electric generation for peaking demands. The reservoir created by a dam and dike at Dunker Pond would provide 11 BG of storage volume at a flow line elevation of 1190 feet above msl.

The project has potential as a regional supply. The proposed reservoir would be the highest elevated reservoir in the State, thereby facilitating gravity feed to the Wanaque system of NJDWSC, the Hackensack system, the Pequannock system, and/or the Raritan.

Cost ($ million) Capital 8.5 O & M $/MG Year 1968 ENR Source Note Cost for Pump Station, Pipeline and Reservoir

Identified Problems Funding

Project Status: Proposed ☒ Potential ☐ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 6/14/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 138 Name Source - Source Interconnection Delaware and Raritan Canal L.O.R.D.S. No.

Region(s) 1, 6 Basin(s) Delaware, Raritan County(ies) Hunterdon, Somerset Middlesex

Author Middlesex Water Co. NJ Title Interview Library No.

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) Yield (mgd) 30's drought 60's drought ~ 25 Other

Limitations on yield

Narrative description Figure: No ☐ Yes ☐

Low lift pumping at the confluence of the Millstone and Raritan Rivers to the D & R Canal would increase useable supply from the Canal by making up for loss due to leakage. Capability for meeting peak needs depends on the hydraulic capacity of the Canal. Middlesex Water Company's Raritan Basin Contract #5 (June 1, 1970) authorizes the Company to construct a low-lift pumping station, if necessary. Alternative would increase flows in the lower reaches of the Canal which would be depleted upstream of the pumping area by increased user withdrawal.

Cost ($ million) Capital O & M $/MG Y:Year E:ENR S:Source Note

Identified Problems Hydraulic limitations of Canal

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☒ Unrealistic ☐

Prepared 6/20/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 139 Name Interstate Transfer - PA to Camden L.O.R.D.S. No. 31

Region(s) 5 Basin(s) Delaware County(ies) Camden

Author Camden Water Dept. Title Interview May/June 1978 Library No.

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) NA Yield (mgd) 30's drought 60's drought Other

Limitations on yield

Narrative description Figure: No ☐ Yes ☐

A water treatment plant at Toresdale in Philadelphia has excess capacity. It is conceivable that water could be supplied across Betsy Ross Bridge to Camden. Consideration of this alternative has not yet passed the conceptual stage.

Cost ($ million) Capital Year Note
O & M ENR
$/MG Source

Identified Problems Implementation problems with interstate transfer

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 6/20/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 140 Name Delaware River Intake at Camden L.O.R.D.S. No.

Region(s) 5 Basin(s) Delaware County(ies) Camden

Author Camden Water Dept. Title Interview May 8, 1978 Library No.

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) NA Yield (mgd) 30's drought 60's drought variable Other

Limitations on yield

Narrative description Figure: No ☐ Yes ☐

River intake to supplement or replace groundwater sources of Camden Water Department. Concept similar to existing facilities of Trenton Water Department. Current County supply is about 46 mgd of which CWD supplies 24 mgd. Increased need for 2020 for Camden County is about 20 mgd.

Assuming slightly more than half the increased need will be met by CWD, a project to replace Camden well fields must provide an average of up to 35 mgd.

Cost ($ million) Capital Year Note
O & M ENR
$/MG Source

Identified Problems Acquisition of diversion right

Project Status: Proposed ☐ Realistic ☐
Potential ☒ Unrealistic ☐
Discarded ☐

Prepared 6/20/78 Revised 1 Revised 2

ALTERNATIVE PROJECT DESCRIPTION

No. 141 Name Hudson River Diversion at Stony Point L.O.R.D.S. No. _____

Region(s) 1 Basin(s) Hudson, Hackensack County(ies) Bergen

Author Hackensack Water Co. Title Meeting May, 1978 Library No. -

Data Availability/Reliability Fair

Purpose(s) _____ Storage(BG) _____ Yield (mgd) _____ 30's drought _____ 60's drought _____ Other _____

Limitations on yield _____

Narrative description Figure: No ☐ Yes ☐

Alternative to Hyde Park diversion scheme to Ramapo River (32,33). This project would divert Hudson River water at Stony Point, NY and transfer to Hackensack River system, utilizing NY and NJ existing reservoirs on the Hackensack. Yield is flexible depending on needs.

Cost ($ million) Capital _____ O & M _____ $/MG _____ Year _____ ENR _____ Source _____ Note _____

Identified Problems Implementation problems with Hudson diversion.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☐

Prepared 6/20/78 Revised 1 _____ Revised 2 _____

ALTERNATIVE PROJECT DESCRIPTION

No. 142 Name Use of Lake Hopatcong Drawdown L.O.R.D.S. No. ____

Region(s) 1 Basin(s) Passaic County(ies) ____

Author - Title Meeting, May 1978 Library No. -

Data Availability/Reliability Fair

Purpose(s) WS Storage(BG) ____ Yield (mgd) ____ 30's drought ____ 60's drought ____ Other ____

Limitations on yield Drawdown occurs only once in five years or so

Narrative description Figure: No ☐ Yes ☐

Every five years or so, some 4 BG of water (5 ft) are released from Lake Hopatcong to the River in order to provide for dock maintenance around the lake. This water, normally lost to the river, could be utilized to augment stroage or supply in the Passaic River system.

Cost ($ million) Capital ____ O & M ____ $/MG ____ Year ____ ENR ____ Source ____ Note ____

Identified Problems Removal of 4 BG in 100 day period would require 40 mgd facility for pumping and transmission. Such a project could only be justified under emergency conditions.

Project Status: Proposed ☐ Potential ☒ Discarded ☐ Realistic ☐ Unrealistic ☒ Emergency Only

Prepared 6/20/78 Revised 1 ____ Revised 2 ____

ALTERNATIVE PROJECT DESCRIPTION

No. 143 Name Round Valley Outlet Pipeline to South Branch Rockaway Creek L.O.R.D.S. No. _____

Region(s) 1 Basin(s) Raritan _____ County(ies) Middlesex, Hunterdon Somerset

Author NJ Title _____ Library No. _____

Data Availability/Reliability Good

Purpose(s)	Storage(BG)	Yield (mgd)	30's drought	60's drought	Other
WS				80	

Limitations on yield _____

Narrative description Figure: No ☒ Yes ☐

Construction of the outlet pipeline from the North Dam of Round Valley Reservoir to the South Branch of Rockaway Creek enables the release of 230 mgd to the Raritan to supplement release from Spruce Run of 20 mgd. The two reservoirs can provide based on the 60's drought 90 mgd passing flow at Bound Brook, 80 mgd contracted by EWC and MWC, plus an additional 80 mgd for water supply, currently available. This project involves intake, treatment & distribution of the 80 mgd by one or some combination of purveyors.

NOTE: Construction completed June 1977.

Cost ($ million) Capital _____ Year _____ Note _____
O & M _____ ENR _____
$/MG _____ Source _____

Identified Problems Facilities required for intake treatment and distribution.

Project Status: Proposed ☒ Realistic ☐
Potential ☐ Unrealistic ☐
Discarded ☐

Prepared _____ Revised 1 _____ Revised 2 _____

NEW JERSEY

STATEWIDE WATER SUPPLY MASTER PLAN

SUBTASK 3C

PROJECT DATA FILE

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I. INTRODUCTION

This report contains the additional future project data file required to complete Subtask 3C which was submitted in part by Havens and Emerson in the Interim Output for Task 3ABC. The Task 3.C data submitted in the Task 3ABC report included a description of the alternative projects under consideration, costs of the project (if available) and identification of problems and problem areas. This output contains the data obtained and developed for use in the analysis of future projects by model simulation using the HEC-5C computer program and additional discussion of the proposed groundwater alternatives. Data on existing facilities are also included when the future project includes the use of existing water supply facilities.

The future projects modeling approach and results are also contained in this report. The future projects data base and the results of the modeling effort will be used in the overall evaluation of the projects.

In the Task 3ABC output report 60 projects in the State are identified as being realistic and 65 as being unrealistic. As a result of further study and screening of the realistic projects, the Association has developed a list of 24 preferred alternative projects. These projects were analyzed by the Association to determine for which projects computer simulation models should be developed to evaluate their supply capabilities. Of the 24 preferred projects nine alternative projects within three study area basins are selected for model development and analysis. They include the following, by basin:

Raritan River Basin

- No. 2, Raritan - Passaic Pipeline (South Route, Main Stem Development)
- No. 3, Confluence Reservoir, Pump Station and Force Main
- No. 14, Round Valley Reservoir Expansion
- No. 80, South River Ground Water Pumped Storage Diversion

Passaic River Basin

No. 40, Two Bridges - Ramapo Diversion Project
No. 41, Monksville Reservoir with Ramapo Pump Station
No. 43, Washington Valley Reservoir
No. 44, Longwood Valley Reservoir

Manasquan River Basin

No. 76, Upper and Lower Manasquan Reservoirs

The project numbers given in the above list correspond to the numbers assigned to each project in the Task 3ABC output. The sources of information used to develop the alternative project models include the project description in the output of Task 3ABC and the reports that are referenced in the output for each alternative project.

In addition to the data on proposed alternatives presented here, additional information was presented in Task B4. for alternatives No. 56 Hachettstown Reservoir, No. 74 Sussex North Reservoir and No. 76 Upper and Lower Manasquan Reservoirs. Eight of the 24 proposed projects were not modeled because the projects were not located in the basins which were modeled or because modeling of the alternative was inappropriate. These eight alternatives are listed below:

No. 7, Delaware and Raritan Canal Improvements
No. 8, Six Mile Run Reservoir
No. 10, Delaware-Raritan Canal Optimization
No. 42, Great Notch Interconnection
No. 60, Ross Corner Reservoir
No. 67, Honey Run Reservoir
No. 139, Interstate Transfer - Pa. to Camden
No. 140, Delaware River Intake at Camden

Of the four ground water alternatives, No. 80 South River Ground Water Pumped Storage Diversion was modeled to estimate the available surface water for diversion to ground water recharge. The Alamatong Well Field and Recharge Basin (No. 136) is being implemented and is therefore not an alternative. The

remaining ground water alternatives in the Wharton Tract (Nos. 131 and 132) are discussed in this report.

II. FUTURE PROJECTS

Fifty years of naturalized historical monthly flows, water year 1928-1977, are the basis of the input hydrology to the simulation models of the projects. In the analysis of synthetic traces as part of Task B of Amendment No. 1, the historical 50 year period proves to be a more severe condition than the two worst synthetic traces which are applied to the model for the analysis of existing facilities and current demands. Therefore the analysis of all future projects also considers the most severe condition, historical flows.

The naturalized monthly flows of the 50 year period developed for the analysis of the future projects are given in Appendix A. The appendix consists of computer printout bound in a large folder. The printouts are input data listings for the alternative project computer runs. They include a listing of control cards followed by the total flows for the 50 year period at the control points. Also included in the appendix is a general explanation of the control cards, and for each printout a description of those control points whose total flow is a factor of the given flow values of another control point.

Varying diversions are imposed on the project to determine the probability of shortage corresponding to each diversion. Several of the future projects are associated with present water supply facilities. Where existing reservoirs have a State mandated minimum flow release, these releases are also used in the analysis of the future projects associated with them. For the remaining future reservoir projects a minimum flow release equal to the natural 7-day 10-year low flow at the reservoir site is imposed on the modeled system. These flows are determined as a function

of the drainage area and the following formula developed by the Association in Task 7A from an analysis of 7-day 10-year low flows for USGS gages in New Jersey:

$$q = 0.42A^{-0.242} \quad (1)$$

where:

q = cfs/sq. mi.

A = drainage area in sq. mi.

Each alternative project is presented in the following sections which include a project description, the data developed for model application, the modeling approach and the results of the analyses.

ALTERNATIVE PROJECT NO. 2, RARITAN - PASSAIC PIPELINE (SOUTH ROUTE, MAIN STEM DEVELOPMENT)

The project consists of the expansion of the Elizabethtown Water Company's treatment plant at Bound Brook and the construction of a transmission main to Newark and the meadowlands in Hudson County. The project assumes that the Round Valley - Spruce Run Reservoir system can provide 160 mgd for sale. This project does not include the development of additional supplies of water. Its sole function is to increase treatment plant capacity to handle the existing available water supply.

The analysis of this project is carried out by simulating diversions at Elizabethtown for existing facilities. The future project system networks for the Raritan River Basin is given in Figure 3C-1. The diversion modeled at Elizabethtown is shown at control point 15.

The Spruce Run - Round Valley Reservoir system is simulated in the analyses of this alternative. Spruce Run (control point 2) and Round Valley (control point 4) Reservoirs operate to maintain minimum flow requirements downstream and provide water for sale. The Hamden pumping station (control point 3) pumps water from the South Branch at Stanton to

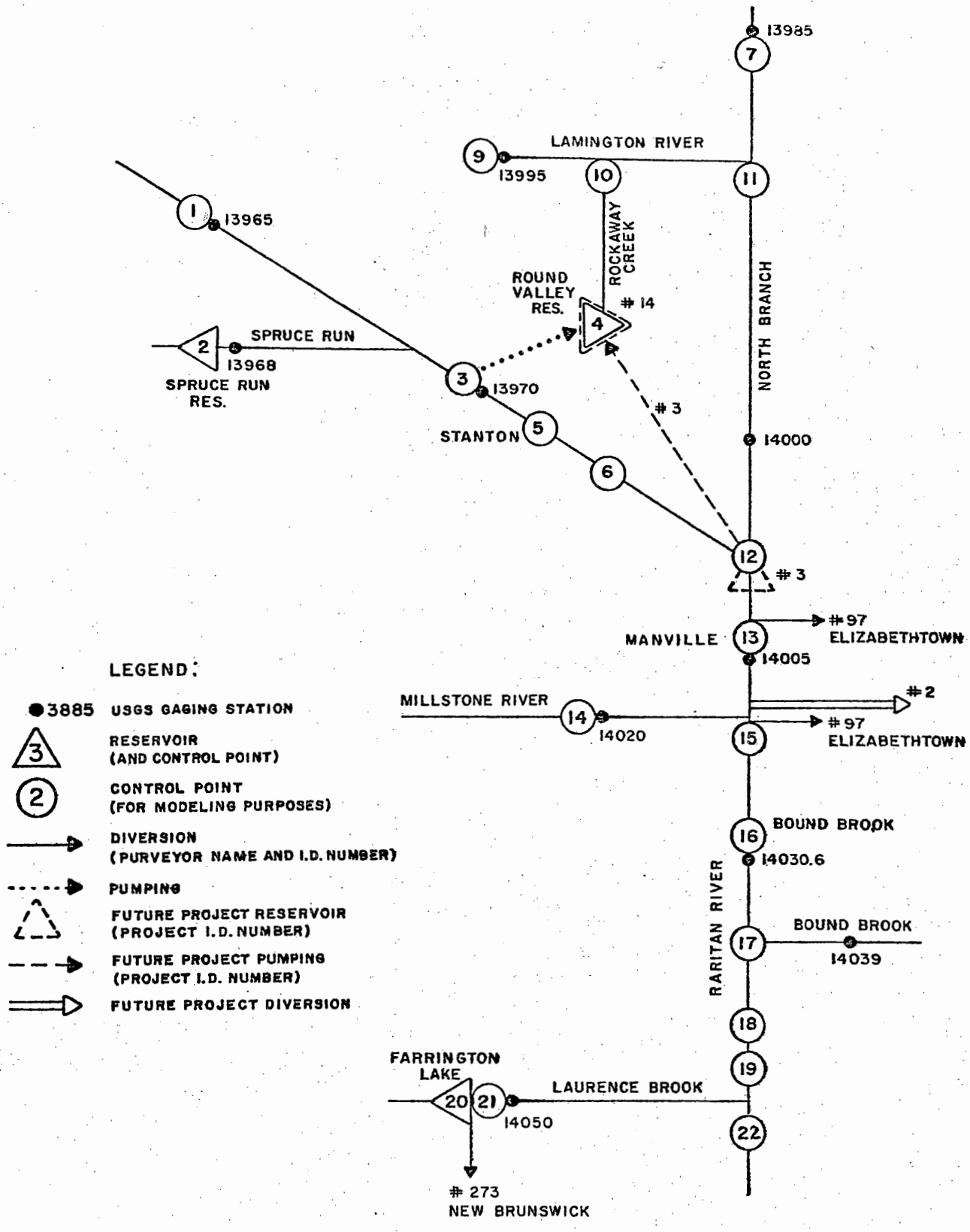


FIGURE 3C-1

FUTURE PROJECT SYSTEM NETWORK FOR
RARITAN RIVER BASIN

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

fill Round Valley reservoir. The pumping operation is simulated in the model by pumping flows in excess of the minimum flow requirement at Stanton of 40 mgd to a maximum pump capacity of 350 mgd. When natural runoff is not sufficient to meet the minimum flows of 40 mgd at Stanton (modeled as control point 5), 70 mgd at Manville (control point 13) and 90 mgd at Bound Brook (control point 16); the model, which keeps an accounting of the flows at these control points, releases the proper amount of water from Spruce Run Reservoir storage to maintain the flow requirement, the most downstream minimum flow requirement at Bound Brook is the controlling flow i.e., in order to meet the 90 mgd, flows of 40 mgd or 70 mgd at the other control points may be exceeded in some cases, but will in any case always be met. Spruce Run Reservoir is modeled with two different storage levels in order to simulate its operation of maintaining minimum flow in coordination with Round Valley Reservoir. When necessary all the storage in Spruce Run Reservoir is released to maintain the minimum flow requirements until the storage reaches the 4 BG level. At this point the model transfers control of maintaining the minimum flows at Manville and Bound Brook to the Round Valley Reservoir. Spruce Run Reservoir, however, with its remaining storage below the 4 BG level releases to meet a minimum flow of 5 mgd at the reservoir site and the 40 mgd requirement at Stanton.

Elevation storage and elevation area curves for each reservoir, operating rules and pumping procedures for Hamden pumping station were provided by Michael Galley of the Bureau of Water Facility Operations, N.J. Department of Environmental Protection. Elevation storage and elevation area relationships are presented in Table 3C-1.

Varying diversions are imposed in the model at Elizabethtown to determine the probability of shortages. The results are given in Figure 3C-2. The maximum yield with zero shortages for water supply at Bound Brook is estimated to be approximately 187 mgd. These results are based on the monthly simulation model. Monthly naturalized flows are routed throughout the system. the pumping from the Hamden pump station to fill Round Valley is based on a maximum monthly pump capacity of 350 mgd and a minimum monthly flow-by requirement of 40 mgd. Monthly releases from Spruce Run and Round Valley to provide water for sale and meet the minimum requirements are also based on monthly flows at Stanton, Manville and Bound Brook.

TABLE 3C-1

SPRUCE RUN AND ROUND VALLEY
RESERVOIR DATA

SPRUCE RUN RESERVOIR

Spillway Elevation : 273 FT/MSL

Dead Storage Plus
10% Usable Storage: 1.10 BG

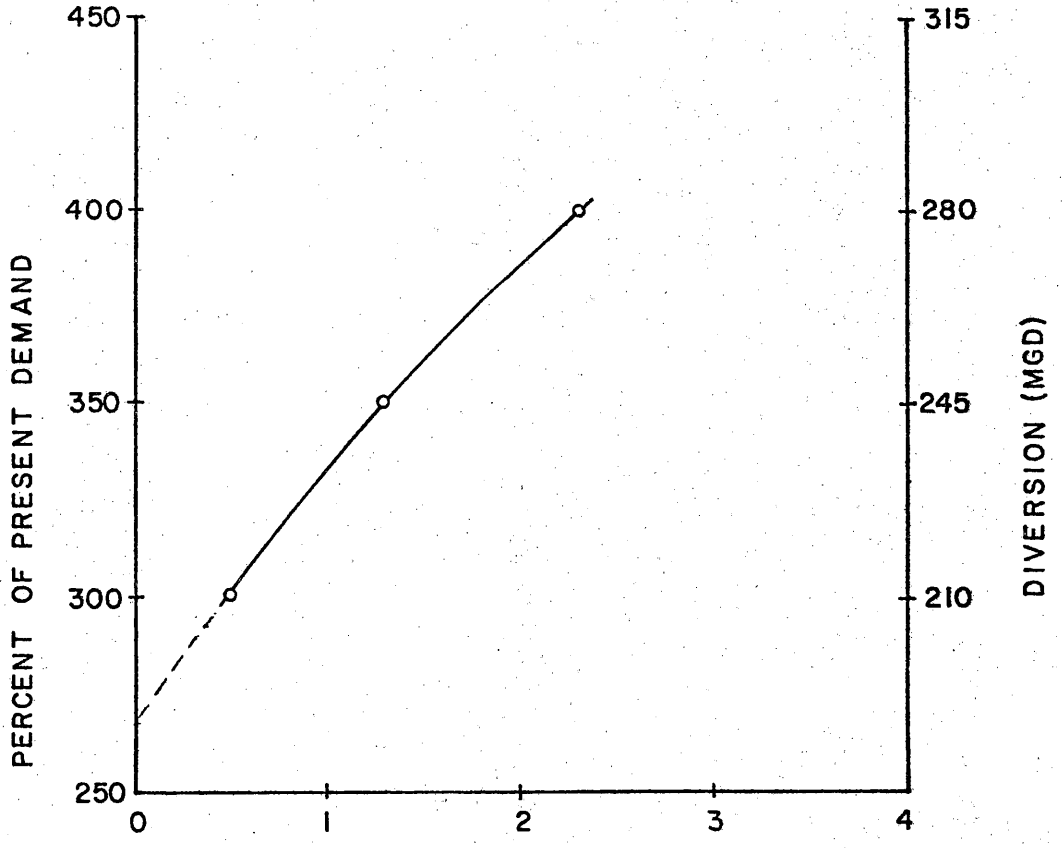
ELEVATION (FT/MSL)	STORAGE (BG)	AREA (Acres)
210	0.10	55
220	0.40	150
230	1.00	263
240	2.11	425
250	4.01	660
260	6.32	908
270	9.73	1195
273	11.00	1305

ROUND VALLEY RESERVOIR

Spillway Elevation : 385 FT/MSL

Dead Storage Plus
10% Usable Storage: 5.50 BG

ELEVATION (FT/MSL)	STORAGE (BG)	AREA (Acres)
280	2.21	425
295	5.11	785
310	9.83	1175
325	16.24	1565
340	24.06	1815
355	33.00	2010
370	43.82	2190
385	55.00	2340



Note: Probability based on 50 years of monthly stream flow.

FIGURE 3C-2

PROBABILITY OF SHORTAGE FOR VARYING DEMANDS
FOR EXISTING FACILITIES

#97 ELIZABETHTOWN WATER CO.,
RARITAN RIVER

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

A great amount of time and effort has been spent by the State in developing a daily flow model of the Raritan River Basin to simulate the operation of Spruce Run, Round Valley and Hamden pump station to meet water supply demands and the 90 mgd minimum flow requirement at Bound Brook. Daily simulation of the system during the 1960's drought shows the water supply yield at Bound Brook to be 160 mgd. The monthly model estimates this yield to be 17 percent higher.

Several factors are involved in the differences of the two results. In general a monthly model and a daily model will give comparable results, say, within 5 to 10 percent, when considering an on-line reservoir system whose storage is used to meet diversions from the reservoir or immediately downstream of the reservoir, and minimum flow requirement at the reservoir or immediately downstream where incremental runoff is not a major factor. The Spruce Run - Round Valley system is much different from any other system modeled as part of this study. The system not only includes pumping to fill Round Valley with a minimum flow-by requirement, but also Spruce Run and Round Valley release water for sale and to meet minimum flow requirements at locations which are distant from the point of release and where incremental flows to the points of diversion and minimum flow play a major role in the amount of water to be released from the reservoirs.

The differences of the monthly and daily model are mainly due to the differences in monthly and daily streamflows simulated, the limited capacity of the pump station at Hamden and the differences in the reservoir releases simulated for monthly and daily water supply and minimum streamflow requirements.

Generally speaking, daily and monthly results for a system similar to that of Spruce Run and Round Valley would approach each other as the quantity of pumping and reservoir storages increase. More water could be captured and more water could be stored so that daily fluctuation of flow and release have less of an impact on the system. This phenomenon is very well demonstrated in the modeling of future projects number 3 and 14 discussed in the following section.

ALTERNATIVE PROJECT NO. 3, CONFLUENCE RESERVOIR, PUMP STATION AND FORCE MAIN; AND ALTERNATIVE PROJECT NO. 14, ROUND VALLEY RESERVOIR EXPANSION

Alternative Project No. 3 involves a 1.0 billion gallon reservoir at the confluence of the North and South Branches of the Raritan River, a pumping station at the reservoir and a force main to Round Valley. Alternative project No. 14 includes enlargement of Round Valley Reservoir from 55 BG to 75 BG by modification to two dams and a dike, raising storage water by 25 feet to elevation 410 msl.

These two projects are considered in combination for the analysis of the system yield of the confluence pumping plus the expansion of Round Valley Reservoir. The existing facilities system configuration of the Raritan River basin model is revised to simulate the two projects and is shown in Figure 3C-1. The elevation storage and elevation area relationships for the expanded Round Valley Reservoir are given below:

ELEVATION (FT/MSL)	STORAGE (BG)	AREA (ACRES)
280	2.2	425
310	9.8	1175
340	24.0	1815
370	43.7	2190
410	75.0	2570

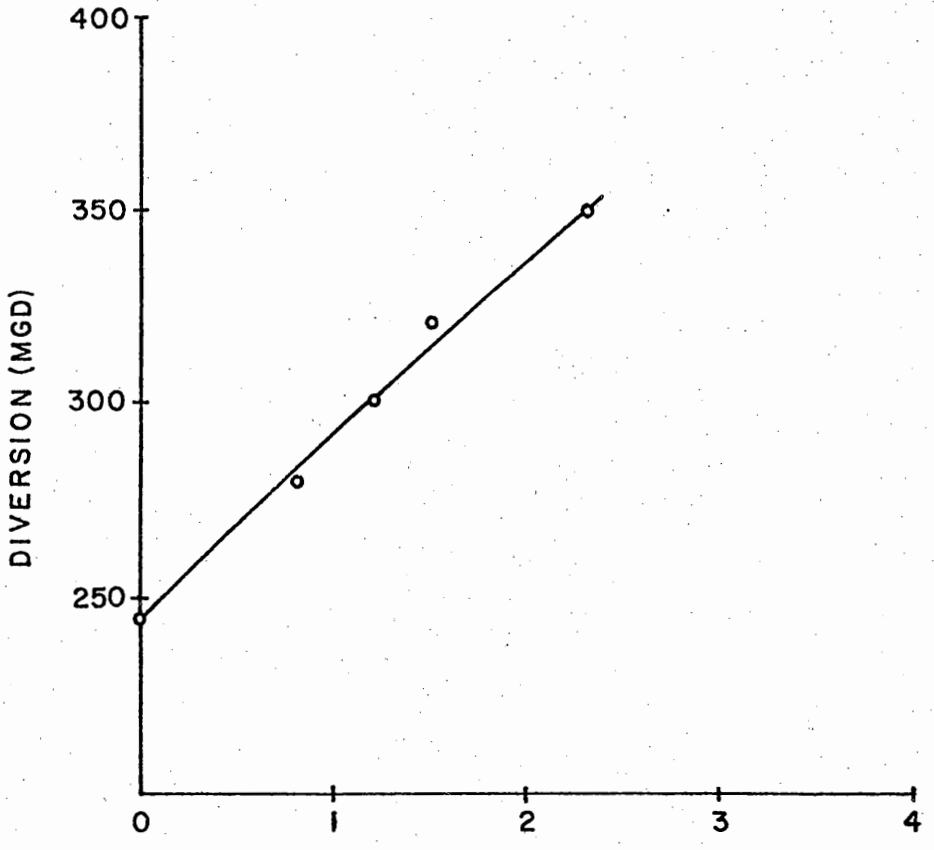
Ten percent of the storage is retained, which amounts to 7.5 BG. The elevation storage and elevation area relationships for Spruce Run are for the existing conditions and are given in Table 3C-1.

At present Round Valley is filled by pumping from the South Branch at the Hamden pump station which has a maximum capacity of 350 mgd and a flow-by requirement of 40 mgd. The South Branch pumping is modeled in the same manner as for the study of existing facilities. In addition to the pumping from Hamden, pumping from the confluence is simulated in the model with a maximum design capacity of 200 mgd. Spruce Run and Round Valley reservoir

are operated as in the existing facilities model to maintain the minimum flow requirements of 40 mgd at Stanton, 70 mgd at Manville and 90 mgd at Bound Brook. Spruce Run releases to meet all requirements until it reaches the 4 BG level at which time Round Valley releases to meet the Manville and Bound Brook requirements. Spruce Run must continue to meet the requirement at Stanton.

No pumping from either source may occur when the reservoirs are releasing to meet minimum flow requirements. Pumping from the confluence to Round Valley is modeled to commence when the natural flow at the confluence exceeds the downstream diversion at Elizabethtown plus the 90 mgd minimum flow requirement at Bound Brook. The 50-year period of historical monthly flows are simulated in the model with various diversions at Elizabethtown and the associated probability of shortage is determined. The results are given in Figure 3 C-3. No shortages occur for a diversion of approximately 250 mgd and the two percent probability of failure level is reached with a diversion of 340 mgd. These results are based on the monthly simulation model developed for this study. The State has simulated the combination of these projects with a daily flow model during the drought of the 1960's. The daily model predicts a maximum yield with zero shortages of 237 mgd. The monthly results show a five percent increase in yield over the daily model.

The monthly and daily model simulations of the existing facilities show a wider range of predicted yields. The factors which influence these differences are discussed in the preceeding section. However, for the simulation of the future projects the two models predict a dependable yield to within five percent. The predicted yields for monthly and daily models of a system such as Spruce Run and Round Valley with pumping and release to maintain flows great distances downstream will approach each other the greater the pumping and the greater the storage in the system. This is clearly demonstrated with the alternative project simulation of the confluence pumping, which is in addition to the Hamden pumping, and the increase in the Round Valley Reservoir storage capacity.



Note: Probability based on 50 years of monthly stream flow.

FIGURE 3C-3

PROBABILITY OF SHORTAGE FOR VARYING DEMANDS

ALTERNATIVE PROJECT NO. 3, CONFLUENCE RESERVOIR, PUMP STATION AND FORCE MAIN COMBINED WITH ALTERNATIVE PROJECT NO. 14, ROUND VALLEY RESERVOIR EXPANSION

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

ALTERNATIVE PROJECT NO. 80, SOUTH RIVER GROUND WATER
PUMPED STORAGE DIVERSION

This project will produce an additional water supply for the Sayreville area by pumping excess surface water from the South River at Duhernal Lake to ponds in existing well fields on the outcrop area of the Old Bridge Sand. Facilities for delivering water to the ponds include a 60 mgd pump station and 3.79 miles of 54-inch pipe. Pumping cannot be initialized until 6 inches of water are spilling over the dam. This restriction is imposed to assure the Duhernal Water Company, that the diversion to the ponds will not affect their supply.

The simulation model used to analyze the potential of this project to supply water to the ponds for ground water recharge is developed so that the only water diverted up to the maximum pump capacity of 60 mgd is the spillage over the dam in excess of the minimum release requirement. The minimum flow requirement below the dam used in this analysis is 8.7 mgd, which is the 7-day 10-year low flow as estimated by equation (1).

Gaging stations on the South River are regulated by several lakes and ponds. The monthly inflows to Duhernal Lake are modeled by applying a drainage area ratio to the flows at the USGS gage 140100 on Stony Brook. The Duhernal Lake is modeled with a surface area of 178 acres and a total capacity of 0.138 billion gallons. Figure 3C-4 shows the system network for the South River project.

The model simulation run is analyzed to determine the percent of time that flows over the spillway (which are above the minimum flow requirement) are less than the required spill, and hence cannot be pumped for diversion to the recharge ponds. These results are given in Figure 3C-5. This figure shows that a monthly diversion of 2.7 mgd for recharge can expect to have a two percent probability of failure and that a monthly diversion of 6.8 mgd can expect to have a five percent probability

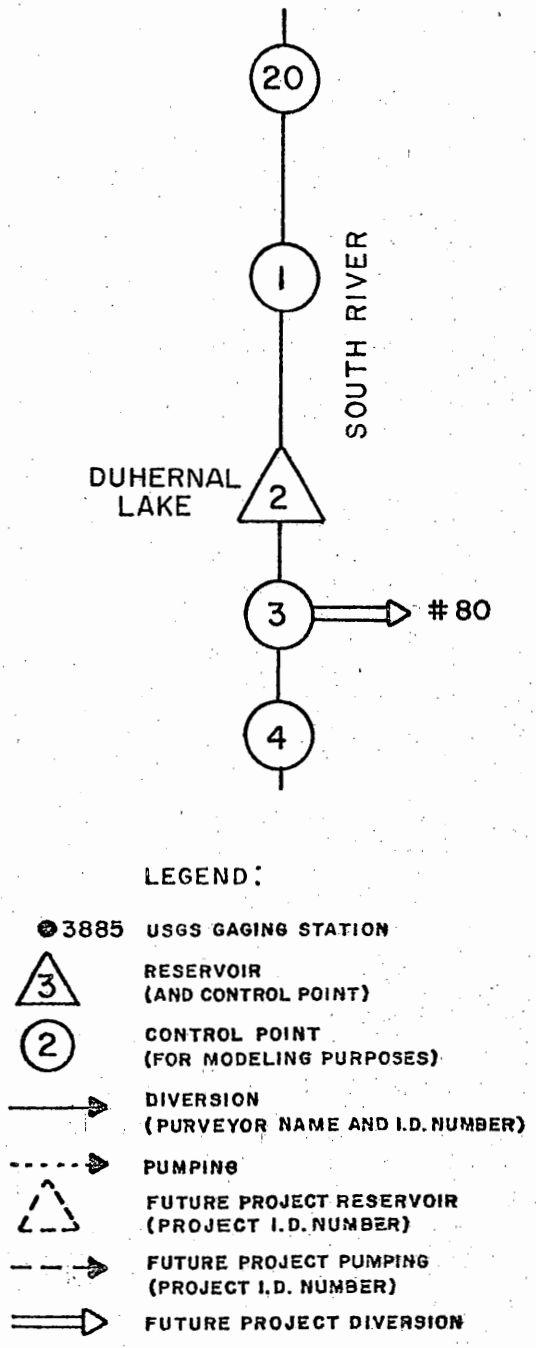
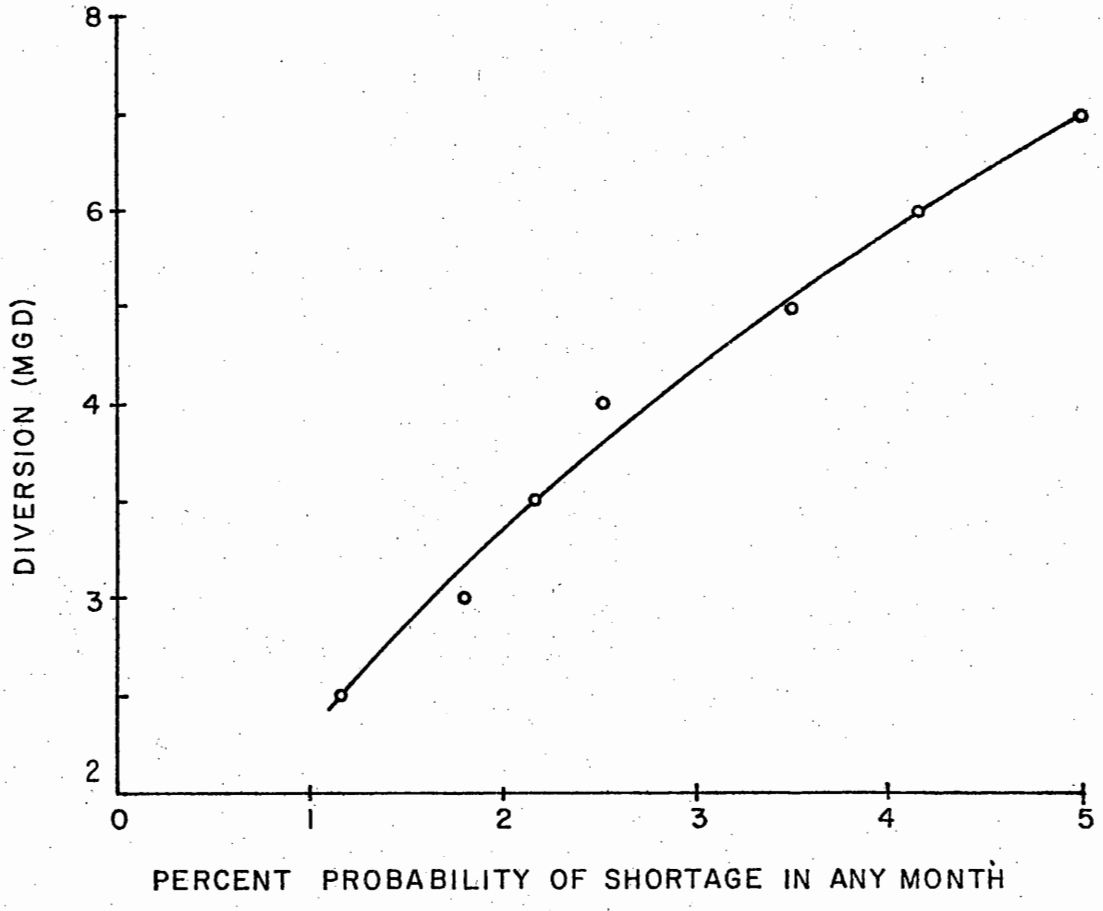


FIGURE 3C-4

SYSTEM NETWORK FOR FUTURE PROJECT
IN SOUTH RIVER BASIN

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN



Note: Probability based on 50 years of monthly stream flow.

FIGURE 3C-5

PROBABILITY OF SHORTAGE FOR VARYING DEMANDS

ALTERNATIVE PROJECT NO. 80,
SOUTH RIVER GROUND WATER
PUMPED STORAGE DIVERSION

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

of failure. The average monthly pumping for the 50 years is 39.4 mgd with a maximum pumping of 60 mgd, the pump capacity. For the driest year of the simulation period an average monthly flow of 22 mgd can be pumped to the recharge ponds.

ALTERNATIVE PROJECT NO. 40, TWO BRIDGES - RAMAPO WATER DIVERSION PROJECT

The Two Bridges project includes: (1) diversion from the Ramapo River to the Wanaque Reservoir utilizing the existing Pompton Lake pump station with a maximum pumping rate of 150 mgd, and a passing flow of 40 mgd; (2) diversion of water from the confluence of the Pompton and Passaic Rivers at Two Bridges, with construction of an intake and pump station; and (3) transmission of the Two Bridges diversion to Wanaque Reservoir via an 11-mile pipeline, with a maximum pumping capacity of 250 mgd. The passing flow at Two Bridges is 92.6 mgd. In addition, the project involves construction of a new pump station and a 17-mile pipeline for 40 mgd to Oradell Reservoir.

The original model system configuration of the Passaic River basin is revised, as shown in Figure 3C-6 to include pumping from the Pompton and Passaic Rivers at Two Bridges (control point 28) to the Wanaque Reservoir (control point 20). The 50 year flow regime of naturalized historical monthly flows is used with the project in place. Pumping from Pompton Lakes to the Wanaque Reservoir commences when the flow at the site is greater than 40 mgd, the flow-by requirement. The maximum pumping rate is 150 mgd which is a 50 mgd increase over the present maximum rate. Water is also pumped to the Wanaque Reservoir at Two Bridges when the flow at the confluence is greater than the 92.6 mgd. The maximum pumping rate is 250 mgd. The present minimum release requirement of 10 mgd from the Wanaque Reservoir is also simulated for the future project.

The Wanaque Reservoir and Pompton Lakes elevation storage and elevation area relationships used to simulate the system are given in Table 3C-2.

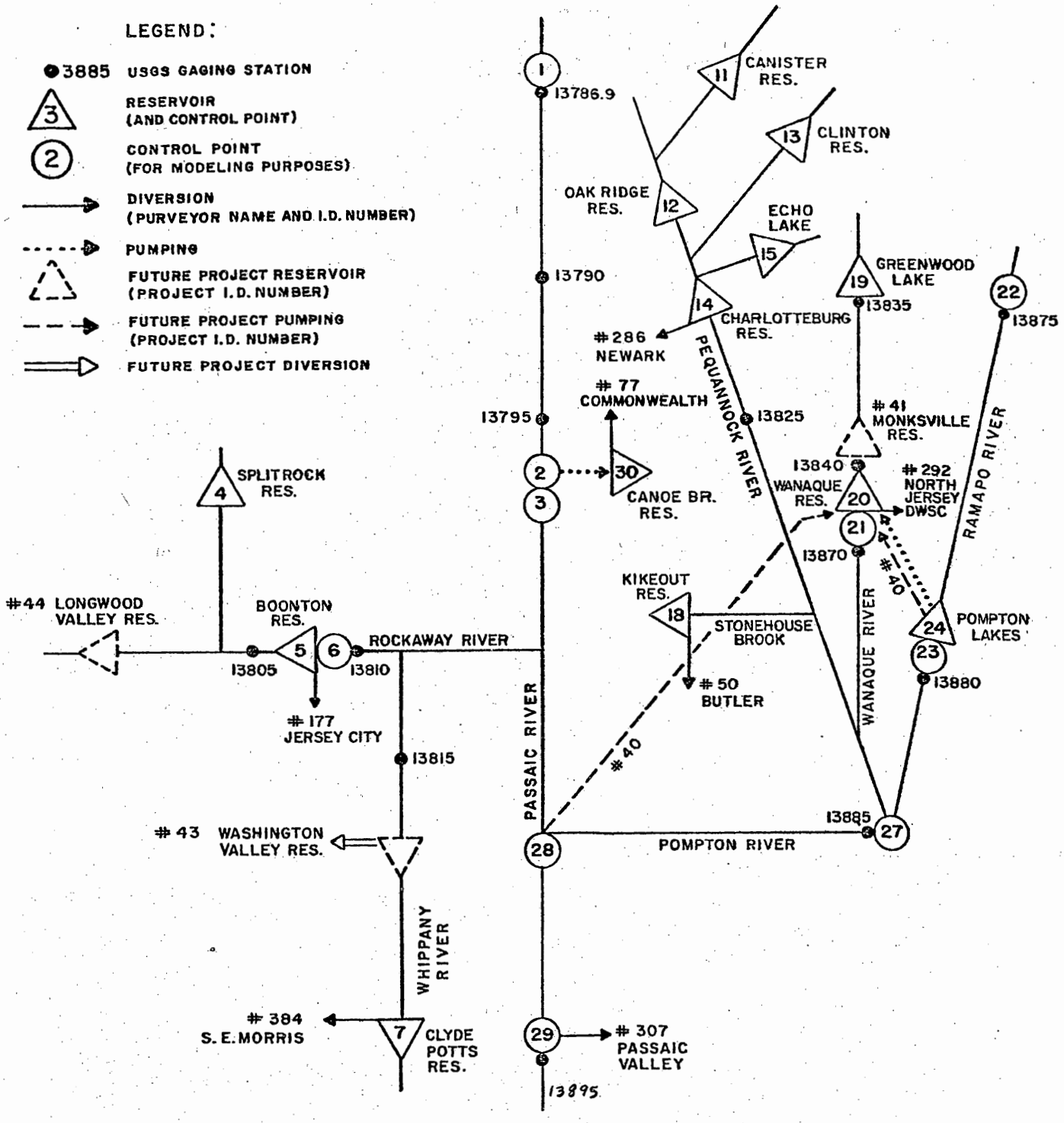


FIGURE 3C-6

FUTURE PROJECT SYSTEM NETWORK FOR
PASSAIC RIVER BASIN

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

TABLE 3C-2

WANAQUE AND POMPTON LAKES
RESERVOIR DATA

POMPTON LAKES

Spillway Elevation : 45 FT/MSL

Dead Storage Plus
10% Usable Storage: 0.030 BG

ELEVATION (FT/MSL)	STORAGE (BG)	AREA (Acres)
25	0.013	40
35	0.150	46
45	0.301	46

WANAQUE RESERVOIR

Spillway Elevation : 302.25 FT/MSL

Dead Storage Plus
10% Usable Storage: 4.301 BG

ELEVATION (FT/MSL)	STORAGE (BG)	AREA (Acres)
250	3.350	780
260	6.394	1060
270	10.210	1300
280	14.995	1620
290	20.827	1960
300	27.788	2310
302	29.518	2380

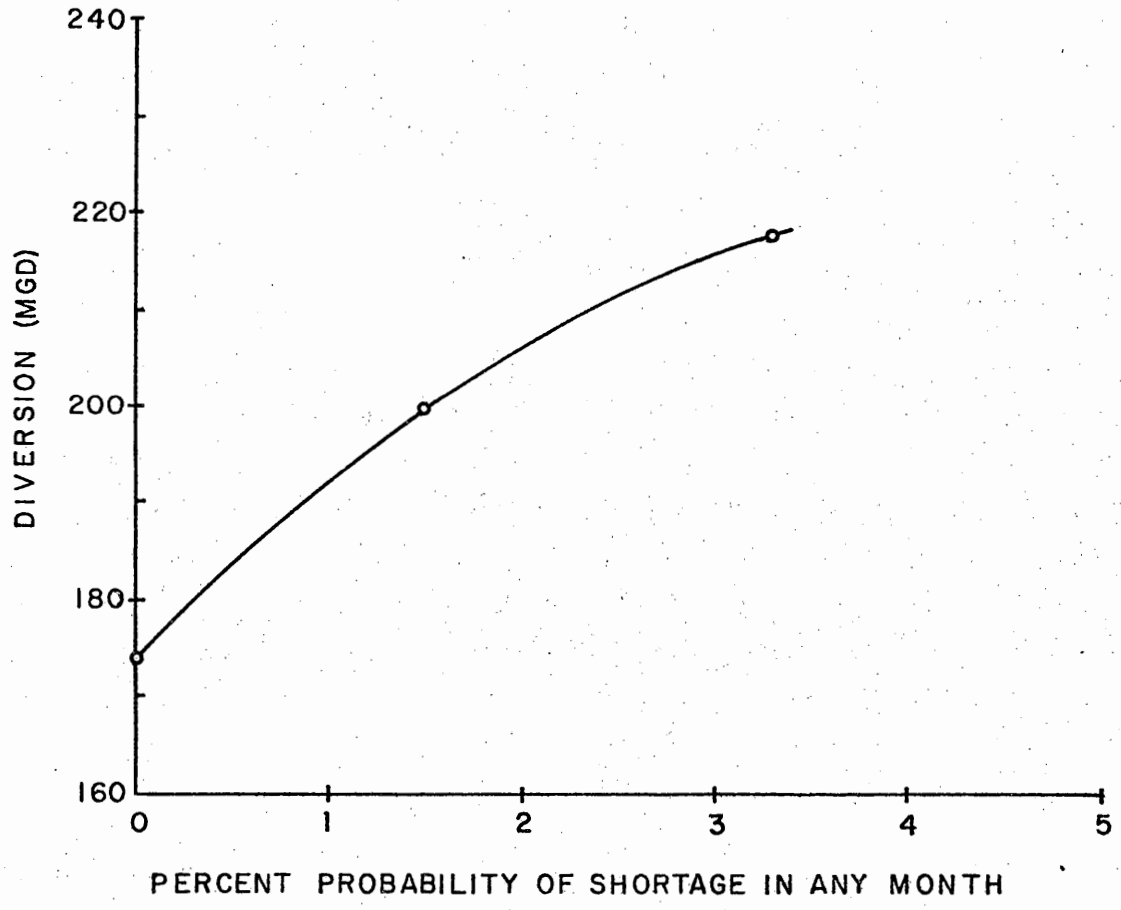
The supply capability of the project is analyzed by imposing various diversions on the Wanaque Reservoir and determining the probability of failure. The results are given in Figure 3C-7. For diversion flow of 174 mgd no shortages are predicted. A two percent probability of failure occurs when the diversion is approximately 206 mgd.

ALTERNATIVE PROJECT NO. 41, MONKSVILLE RESERVOIR
WITH RAMAPO PUMP STATION

The proposed project involves the construction of a 2000 ft dam across the Wanaque River at Monksville. The reservoir would cover 500 acres and have an average depth of 43 ft. The reservoir would be filled by natural flow from the 40 square mile watershed which includes Greenwood Lake, and by increased pumping from Pompton Lakes on the Ramapo River. The reservoir provides a back-up reserve for the Wanaque - Ramapo system.

The Monksville project shown in Figure 3C-6 is modeled in combination with the Two Bridges project, No. 40 which is discussed in the preceeding section. The Monksville Reservoir total storage capacity of 7 billion gallons is added to the Wanaque storage. Ten percent of this storage is retained as for all reservoirs studied. The Monksville addition increases the total storage of the Wanaque Reservoir from 29.5 BG to 36.5 BG. For the existing Wanaque Reservoir 4.3 BG is dead storage plus 10 percent of useable storage. The Wanaque dead storage plus 10 percent of the total useable storage for the two reservoirs combined is 5.0 BG. The elevation storage and elevation area relationships used in the model for the combined reservoirs are given below:

ELEVATION (FT/MSL)	STORAGE (BG)	AREA (ACRES)
250	3.3	780
260	6.4	1060
270	10.2	1300
280	15.0	1620
290	20.8	1960
302	36.5	2880



Note: Probability based on 50 years of monthly stream flow.

FIGURE 3C-7

PROBABILITY OF SHORTAGE FOR VARYING DEMANDS

ALTERNATIVE PROJECT NO. 40,
TWO BRIDGES-RAMAPO
WATER DIVERSION PROJECT

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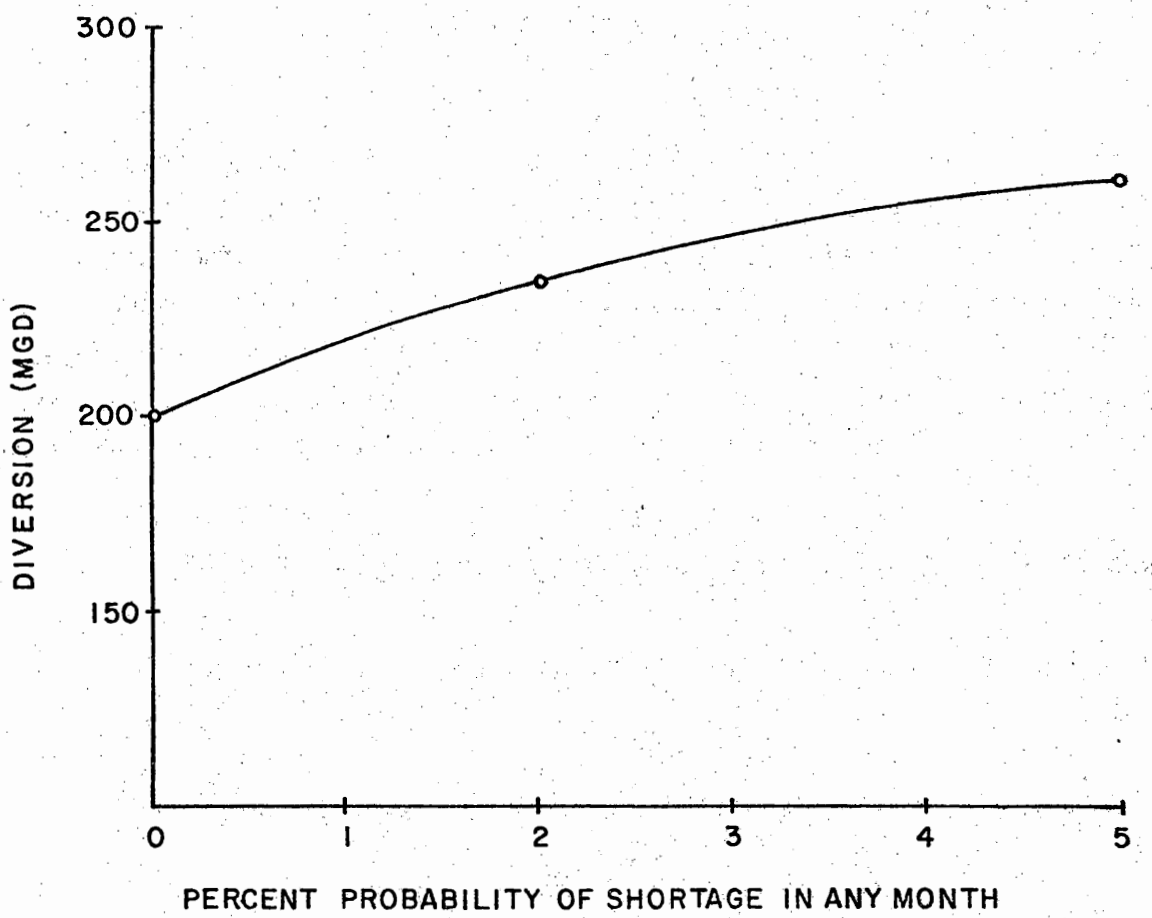
Fifty years of naturalized historical flows are simulated in the model with the combined reservoir storages and pumping from Pompton Lakes, and from Two Bridges. The maximum pumping rate from Pompton Lakes is 150 mgd with a flow-by requirement of 40 mgd, and the maximum pumping rate from Two Bridges is 250 mgd with a flow-by requirement of 92.6 mgd. The pumping schemes are the same as those used for the analysis of the Two Bridges project No. 40.

Varying diversions are imposed on the system and the corresponding probability of shortage is determined. The results are shown in Figure 3C-8. The increased capacity of the combined reservoir produces a larger yield for the system than the Two Bridges project alone. No shortages occur with a diversion of 200 mgd which is a 26 mgd increase in yield over project 40, and can be attributed to the additional storage of Monksville Reservoir. The two percent probability of failure level is reached for a diversion of 240 mgd.

ALTERNATIVE PROJECT NO. 43, WASHINGTON VALLEY RESERVOIR

The Washington Valley Reservoir, whose proposed location is on the Whippany River in Morris Township as shown in Figure 3C-9, is to supply water for treatment and distribution to municipalities in the area. The reservoir with 14.5 square miles of drainage area is designed for 1.2 BG of storage.

The analysis of the reservoir's ability to provide water for municipal use is based on simulating the natural inflow to the reservoir for a 50 year period of monthly flows and determining the probability of failing to meet various amounts of diversion. The inflow to the reservoir is determined by applying a drainage area ratio to the flow records at the USGS gage on the Whippany River at Morristown, No. 138150.



Note: Probability based on 50 years of monthly stream flow.

FIGURE 3C-8

PROBABILITY OF SHORTAGE FOR VARYING DEMANDS

ALTERNATIVE PROJECTS No. 40 and 41,
TWO BRIDGES-RAMAPO DIVERSION PROJECT
AND MONKSVILLE RESERVOIR
WITH RAMAPO PUMPING

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

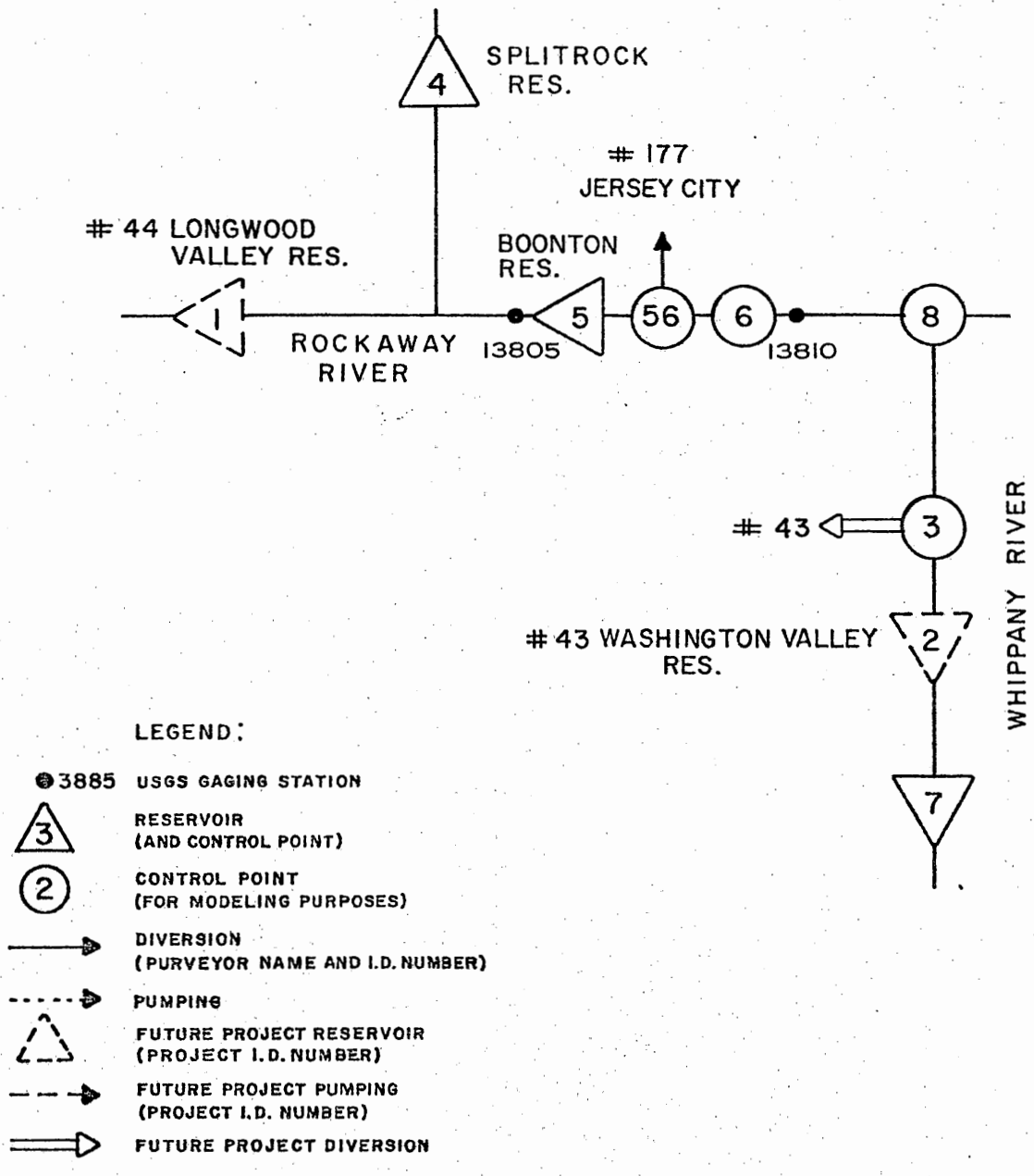


FIGURE 3C-9

SYSTEM NETWORK FOR FUTURE PROJECTS
IN ROCKAWAY AND WHIPPANY RIVER BASINS

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

The reservoir elevation, storage and area relationships developed from available data for model application are the following:

ELEVATION (FT/MSL)	STORAGE (BG)	AREA (ACRES)
310	0.00	0
320	0.39	100
330	0.65	200
325	1.20	245

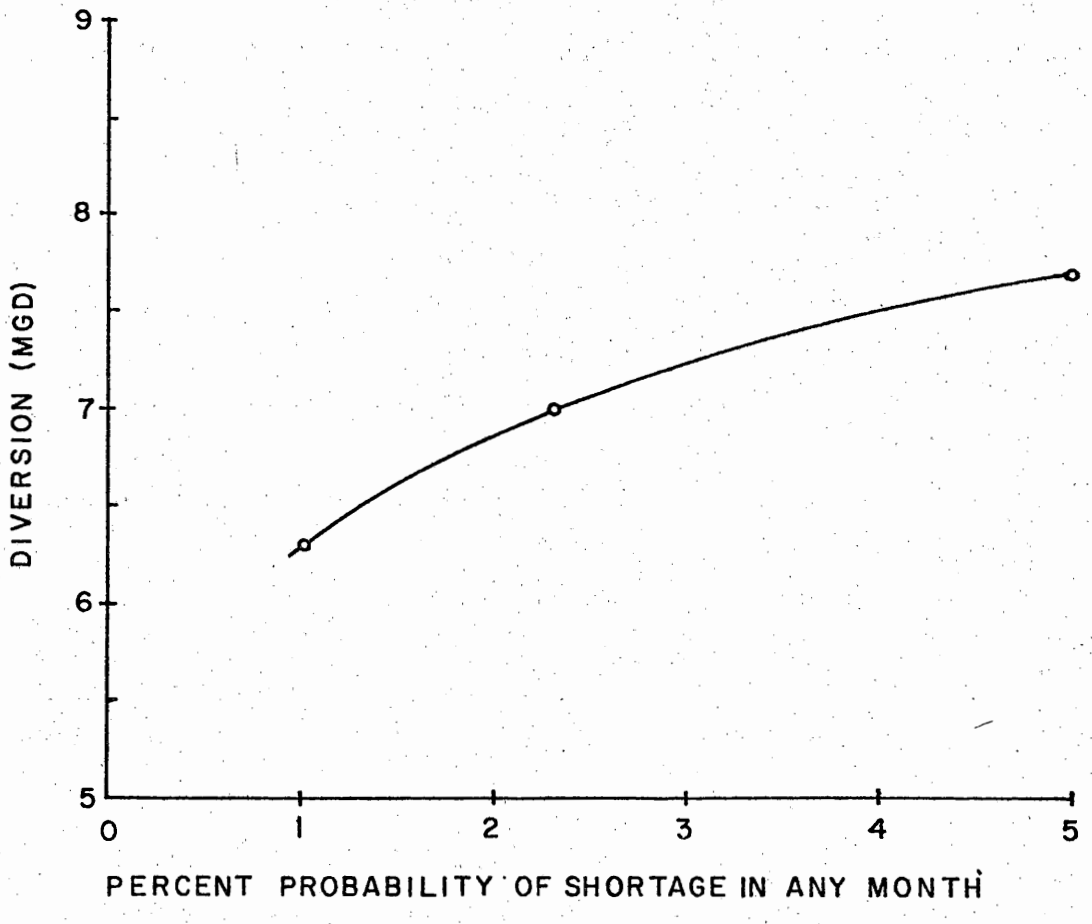
The reservoir is modeled retaining 10 percent of the storage. Therefore the total available storage for diversion is 1.08 BG. A minimum flow release from the reservoir is set equal to 2.1 mgd which is the 7-day 10-year low flow at the reservoir site computed from equation (1).

The percent probability of shortages for various diversion flows is given in Figure 3C-10. The simulation results show that a two percent probability of failure occurs at a diversion flow of 6.9 mgd and that extending the curve gives no shortages in any month for a flow of approximately 5.7 mgd.

ALTERNATIVE PROJECT NO. 44, LONGWOOD VALLEY RESERVOIR

The proposed location of the Longwood Reservoir is at the headwaters of the Rockaway River in Jefferson Township as shown in Figure 3C-9. The reservoir which would regulate 23 square miles, has a storage capacity of 5.2 BG and a surface area of 670 acres at the spillway elevation of 750 ft/msl.

The reservoir is modeled as part of the Jersey City Water supply system which presently uses Boonton Reservoir as the point of diversion and Splitrock Reservoir for storage and release to Boonton. Longwood Valley Reservoir is added to the system and is used for storage and release to Boonton. The 50 years of monthly flow to Longwood Valley are calculated based on drainage area ratio to the USGS gage 138050, Rockaway River above



Note: Probability based on 50 years of monthly stream flow.

FIGURE 3C-10

PROBABILITY OF SHORTAGE FOR VARYING DEMANDS

ALTERNATIVE PROJECT NO. 43,
WASHINGTON VALLEY RESERVOIR

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

Reservoir, at Boonton. The total storage capacity of Longwood Valley is 5.2 BG of which 0.7 is dead storage. Ten percent of the useable storage is retained and unavailable to supply the diversion as in the case for all reservoirs investigated in the modeling. The reservoir elevation, storage and area relationships for Boonton, Splitrock and Longwood Valley reservoirs are given in Table 3C-3.

Various percentages of diversions at Boonton are simulated with additional storage provided from Longwood Valley. The results are shown in Figure 3C-11. The dashed curve represents the percent probability of shortage as a function of varying demands for the existing system of Boonton and Splitrock reservoirs. The solid line presents the same relationship with the additional storage available from Longwood Valley. A probability of failure at the two percent level for the existing system occurs at 70.2 mgd, which is 108 percent of the present demand. With the additional storage, the system can deliver 81.3 mgd (which is 125 percent of the present demand at a two percent probability of shortage. No shortages occur in any month for a diversion of 64 mgd which is approximately 98 percent of the present demand.

ALTERNATIVE PROJECT NO. 76, UPPER AND LOWER MANASQUAN RESERVOIR

This project is a pumped storage system with two reservoirs and an interconnecting pipeline. The Lower Reservoir is a 0.1 BG impoundment on the main stem of the Manasquan River in Wall Township to serve as an intake for a proposed raw water treatment plant and later for pumping to storage at the Upper Reservoir. The Upper Reservoir which has a capacity of 5.0 BG is an off river storage reservoir in Howell Township to store water from peak Manasquan River flows and surplus water during periods of low demand. A 100 mgd capacity force main would convey water pumped from the Lower Reservoir to the Upper Reservoir. The pipeline would also convey released water to the Lower Reservoir for treatment and distribution.

TABLE 3C-3

BOONTON, SPLITROCK, LONGWOOD VALLEY
RESERVOIR DATA

BOONTON RESERVOIR

Spillway Elevation : 305 FT/MSL

Dead Storage Plus
10% Usable Storage: 0.762 BG

ELEVATION (FT/MSL)	STORAGE (BG)	AREA (Acres)
261	0.351	220
265	0.652	230
275	1.554	345
285	3.008	555
295	5.113	710
305	7.620	792

SPLITROCK RESERVOIR

Spillway Elevation : 835 FT/MSL

Dead Storage Plus
10% Usable Storage: 0.33 BG

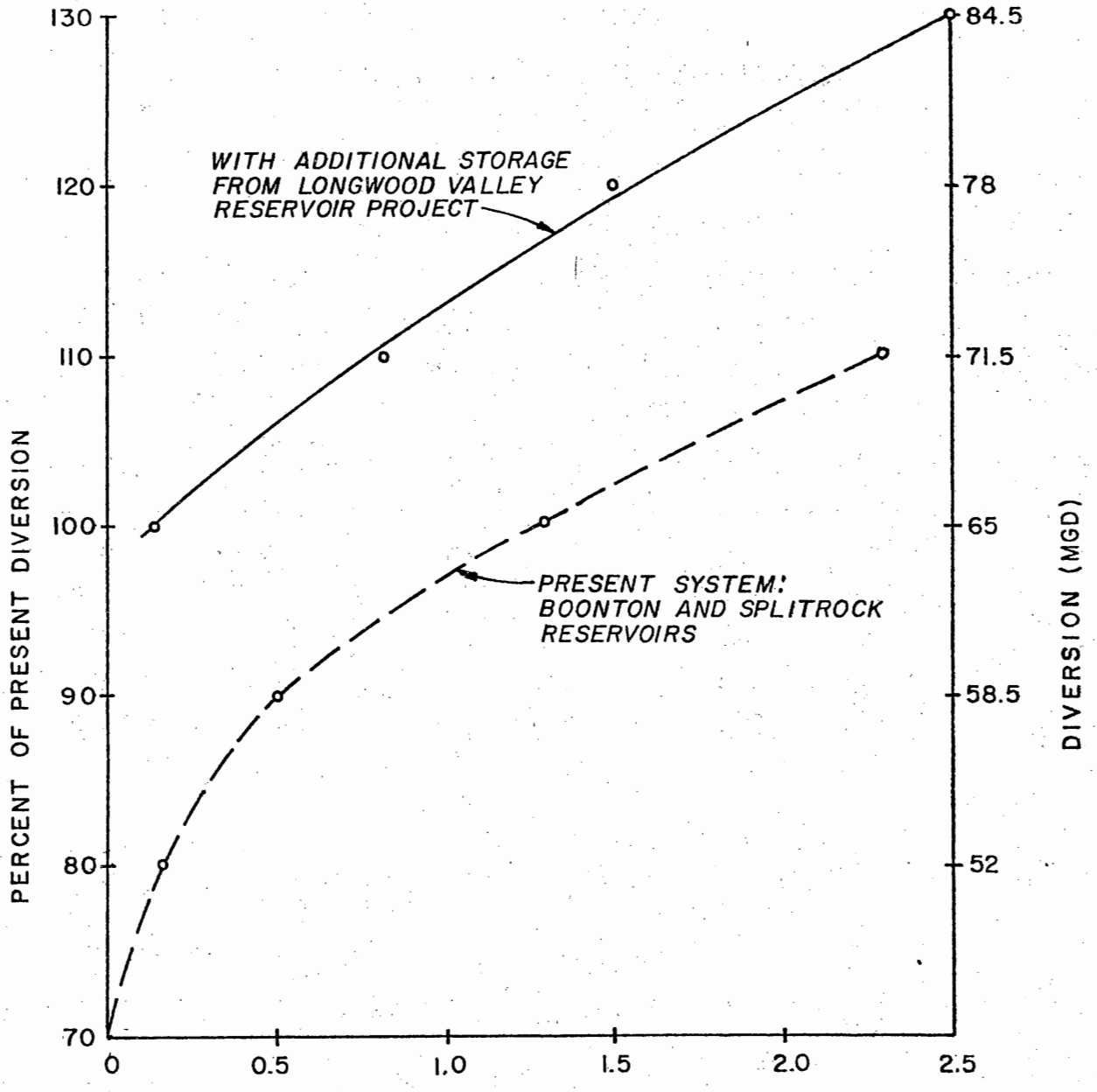
ELEVATION (FT/MSL)	STORAGE (BG)	AREA (Acres)
820	0.902	450
824	1.484	450
828	2.065	470
832	2.727	550
835	3.310	663

LONGWOOD VALLEY

Spillway Elevation : 750 FT/MSL

Dead Storage Plus
10% Usable Storage : 1.22 BG

ELEVATION (FT/MSL)	STORAGE (BG)	AREA (Acres)
725	1.3	330
730	1.9	400
735	2.6	450
740	3.3	500
745	4.2	580
750	5.2	670



Note: Probability based on 50 years of monthly stream flow.

FIGURE 3C-11

PROBABILITY OF SHORTAGE FOR VARYING DEMANDS

ALTERNATIVE PROJECT NO. 44,
LONGWOOD VALLEY RESERVOIR

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

The system configuration developed for model application is shown in Figure 3C-12. The USGS gage 140800, Manasquan River at Squankam, N.J. is assigned as control point 2 in the model. Flows at the gage are used to generate flows at other control points. Excess water is pumped, up to the maximum pump capacity of 100 mgd, from control point No. 3, the Lower Reservoir to the Upper Reservoir at control point No. 1. The Lower Reservoir is a small intake impoundment and its shortage is not modeled. The Upper Reservoir storage is released to control point No. 4, which is modeled as the point of diversion, when the natural river flow cannot meet the diversion demand and the minimum flow-by requirement. The minimum flow-by requirement is designated as the 7-day 10-year low flow, 6.2 mgd which is calculated based on drainage area at the point of diversion and equation (1). The elevation storage and area relationships for the Upper Reservoir developed from available data for modeling purposes are given below:

ELEVATION (FT/MSL)	STORAGE (BG)	AREA (ACRES)
60	0.0	0
70	0.7	200
80	1.6	400
90	3.3	500
100	5.0	700

Ten percent of this storage, 0.5 BG, is retained and is not available for release to the point of diversion. Various diversion rates are simulated to determine the percent probability of shortage in any one month of the 50 years of monthly flows. As shown in Figure 3C-13, no shortages are predicted for a diversion of approximately 33 mgd, and two percent probability of failure occurs for a diversion of 39 mgd.

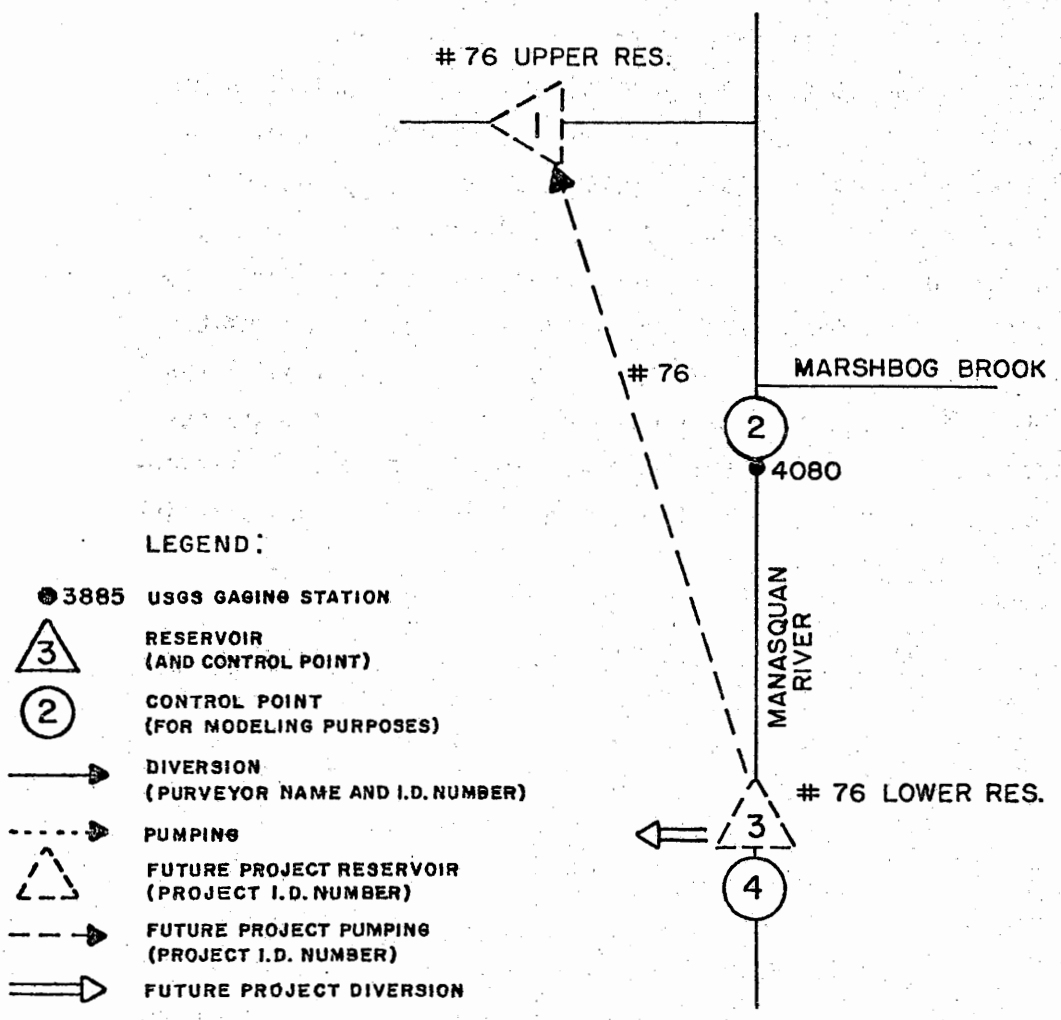
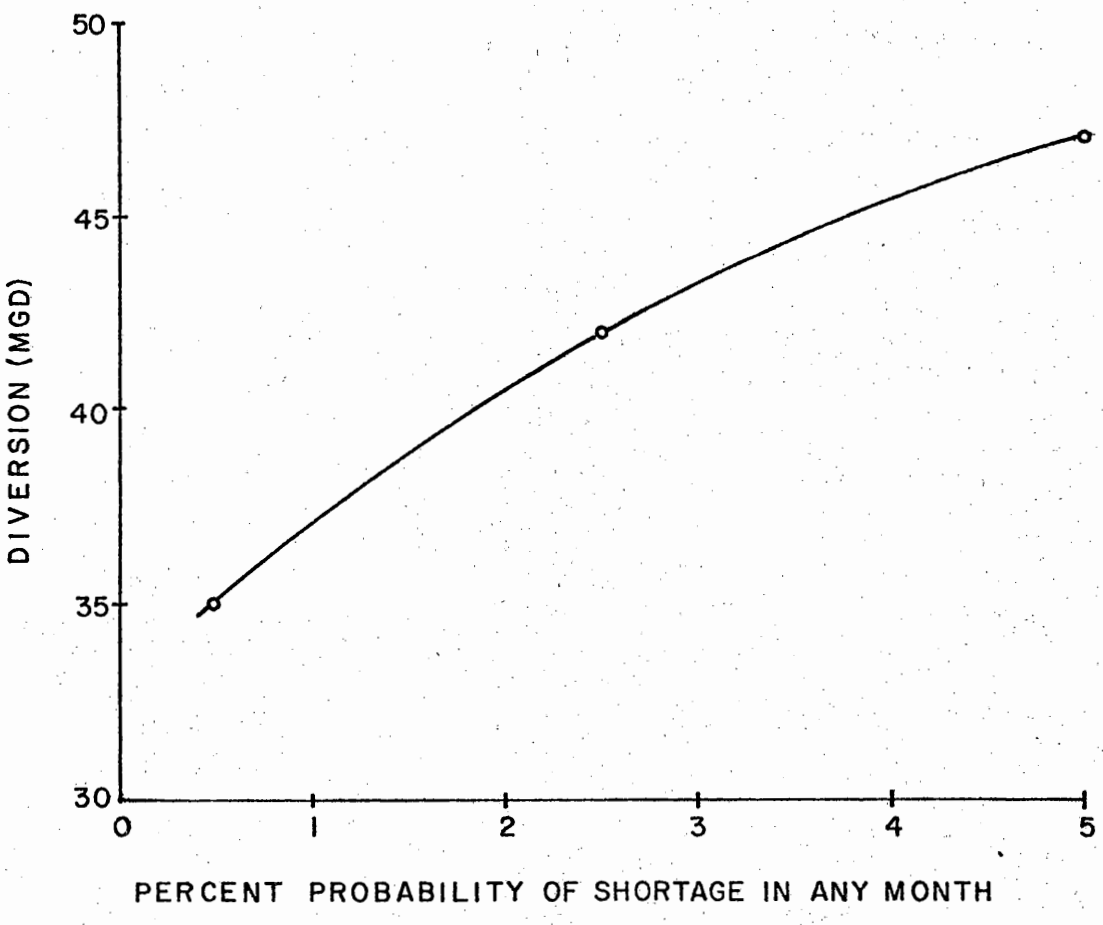


FIGURE 3C-12

FUTURE PROJECT SYSTEM NETWORK FOR
MANASQUAN RIVER BASIN

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN



Note: Probability based on 50 years of monthly stream flow.

FIGURE 3C-13

PROBABILITY OF SHORTAGE FOR VARYING DEMANDS

ALTERNATIVE PROJECT NO. 76,
UPPER AND LOWER MANASQUAN RESERVOIRS

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

GROUND WATER ALTERNATIVES

There were four ground water alternatives included among the final 24 alternatives proposed by the Association. After these alternatives were put forth, it was learned that one of the alternatives, Alamatong Well Field and Recharge Basin (No. 136), was being implemented by the Morris County MUA and is, therefore, no longer an alternative. The remaining three alternatives are the South River (Middlesex County) Ground Water Pumped Storage Diversion (No. 80) and the Well Fields in the Wharton Tract (Nos. 131 and 132).

The fundamental concept underlying each of the three alternatives is to induce recharge of the ground water reservoir from adjacent surface waters by installation of infiltration wells along the stream or river. This type of ground water use minimizes the impact of withdrawal from the aquifer because the major portion (if not all) of the pumped water is actually surface water.

The most important questions regarding these ground water alternatives are related to the ability of the stream to supply the induced recharge during low flow periods and the necessary hydraulic connection between the aquifer and the river. Because of this, many of the data items originally thought important for analysis of groundwater alternatives (such as ground water boundary conditions, underground storage, recharge areas, and pumpage effects) become less important than the two questions posed above. To the extent possible, these issues will be discussed for each alternative.

No. 80 South River (Middlesex County) Ground Water Pumped Storage Diversion

The South River simulation results were presented earlier in the discussion of surface water projects in the Raritan Basin. The results of the analysis indicate that average diversion over the 50 year simulation period was 39 mgd and the average monthly diversion for the driest year of the simulation period was 22 mgd. The minimum streamflow requirement was estimated to be 8.7 mgd from equation (1), page II-2.

The water would be diverted to ponds located in the outcrop area of the Old Bridge Sand. Based on similar water-supply developments in Middlesex

County, especially at Duhernal Lake, it does appear technically feasible to increase the yield of the Old Bridge Sand by diversion of excess surface water to the ponds. Silting of the bottom of the ponds must be prevented by periodic maintenance, however, for the recharge to take place. It should be noted that the industrialization in northern Middlesex County and subsequent contamination of surface and ground water may threaten the utility of this alternative.

No. 131 Well Field in Wharton Tract (Southwest New Jersey)

The infiltration wells in this alternative would be located along the Mullica and Batsto Rivers. The drainage area tributary to the Mullica River below the confluence with the Batsto River is approximately 200 sq. mi. The TAMS Report, "Survey of New Jersey Water Resources Development", estimated the average flow in the Mullica River below the Batsto River at 200 mgd and the average monthly flow during dry periods at 90 mgd. Data from USGS records for the gages in the Mullica River are summarized below:

River	Gage Number	Years of Record	Drainage Area (sq. mi.)	Average Flow (mgd)	(mgd/sq. mi.)
Mullica, nr. Boston	14094	1957-1975	46	72	1.6
Batsto River at Batsto	14095	1927-1975	70.5	81	1.1

The average flow in the Mullica Basin is 1.6 mgd/sq. mi. on the Mullica River near Batsto and 1.1 mgd/sq. mi. on the Batsto River at Batsto. Using the lower of the two figures to estimate the average flow downstream of the confluence of the Mullica and Batsto Rivers would given an average of 220 mgd. The 7-day 10-year low flow for the 200 sq. mi. drainage area would be 15 mgd using equation (1).

The purpose of this alternative is to induce ground water infiltration of surface water along the two rivers. The alternative is proposed to deliver 100 mgd. Thus the average flow of the Mullica River could be expected to decrease from 220 mgd to 120 mgd. During periods of low flow, almost the entire flow would

be infiltrated into the ground water system. The impact on river flows during low flow periods could be reduced by constructing additional wells in the aquifer at a distance from the rivers which would not cause infiltration beyond some desirable low flow. These additional wells would of course add to the cost of this alternative.

There is some question concerning the hydraulic connectivity between the aquifer and the river. A pumping test adjacent to the Mullica River revealed the presence of a thin, relatively impermeable bog iron deposit in the river bed which caused a poor hydraulic connection with the aquifer (1). Such deposits would have to be removed by dredging in order to improve the hydraulic connection. The costs for dredging would have to be added to the alternative costs.

The ground water quality in the Pine Barrens is reported to have low pH, high dissolved iron, and sometimes undesirable color (2). These conditions would necessitate water treatment prior to use and thus further increase the cost of this alternative.

No. 132 Well Field in Wharton Tract (Southeast New Jersey)

The proposed infiltration wells in this alternative would induce surface water from the Wading River and tributaries into the adjacent ground water reservoir. A total of 22 mgd is projected to be supplied in this alternative. The TAMS Report of 1955 indicated an average flow in the basin of 150 mgd and an average monthly flow during dry periods of 40 mgd. USGS data at station number 14100, Oswego River at Harrisville, indicate an average flow of 0.9 mgd/sq. mi. The drainage area of the Wading River just below Harrisville is about 150 sq. mi., which gives an average flow of 135 mgd. The 7-day, 10 year low flow would be 12 mgd using the equation (1).

As in the case of Alternative No. 131 the average stream flow in the Wading River would be reduced by an amount equal to the average pumpage. In order to reduce the impact on low stream flows, additional wells would have to be constructed at sufficient distances from the stream to insure no induced

infiltration during low flow periods.

Studies (3, 4) of the Mullica River Basin indicate that 118 mgd can be diverted without adverse environmental impact on the biological resources in the river and in Great Bay. Since Alternative Nos. 131 and 132 are in the Mullica Basin, one or both may have to be scaled downward by a total of 2 mgd to meet this constraint.

The same comments regarding the hydraulic connection between the river and aquifer and water quality are applicable to this alternative as well as to Alternative No. 131.

OTHER CONSIDERATIONS

This section of the 3C Output presents discussion regarding considerations such as flexibility under varying future demands, phased development potential, impact of land use changes, and projects reflecting major directions in decision making. To a large extent when any of these considerations were significant, they were highlighted in the description of alternatives presented in the Task 3ABC Output. For example, the transfer of water from Pennsylvania to Camden via a pipeline on the Betsy Ross Bridge (Alternative No. 139) reflects a new direction in decision making and this was pointed out in the Task 3ABC Output. Similarly, when water quality issues were important, such as Alternative Nos. 2 and 10, it was pointed out in the Task 3ABC Output.

The consideration of flexibility under varying future demands and phased development often go hand-in-hand. Projects which can be phased are ones which can be built in discrete steps, usually as water consumption increases. In some cases dams may be built in phases, but usually the types of public works projects which best lend themselves to phased development are large pipelines, pumping stations and well fields. Raw water pipelines (or treated water) can be phased by constructing two (or more) parallel pipelines with a combined capacity equal to that required under ultimate development. The first pipeline would be constructed to deliver half of the total design amount and at a later date the second pipeline would be constructed. The decision on phased development of pipelines is made by comparing the present worth cost of a single pipeline with

the present worth cost of the two parallel pipelines. The cheaper of the two alternatives would dictate which alternative would be selected. The decision is usually made in the predesign analysis of a project. All of the proposed surface water alternatives which have long water transmission lines associated with them should be analyzed for phased development. Such analysis is usually not performed in planning studies when large numbers of alternatives are being considered, because each alternative would have numerous phased development sub-alternatives. After a project is selected for implementation, it is appropriate to study the sub-alternatives in order to construct the near-optimum project.

Pumping stations and well fields are also well suited for phased development. Alternative Nos. 131 and 132 are groundwater alternatives having large well fields diverting 100 mgd and 20 mgd, respectively. The construction program could be phased to install wells each year as the demand increases. The water transmission line could also be phased. Determining which wells to install, the quantity of wells, and where to install them, is also a predesign analysis.

REFERENCES

1. Rhodehamel, E. C., 1973, Geology and Water Resources of the Wharton Tract and the Mullica River Basin in Southern New Jersey. New Jersey Department of Environmental Protection, Division of Water Resources, Special Report 36.

2. Rhodehamel, E. C., 1970, A Hydrologic Analysis of the New Jersey Pine Barrens Region. New Jersey Department of Environmental Protection, Division of Water Policy and Supply, Water Resources Circular 22.

3. Durand, J. B., M. L. Granstrom, and N. S. Rudolph, 1974 Water Resources Development in the Mullica River Basin. Water Resources Bulletin, Vol. 10, No. 2, pp. 272 - 282.

4. Granstrom, M. L., G. H. Nieswand, and R. Ahmed, 1973, Water Resources Development in the Mullica River Basin, Part II - Conjunctive Use of Surface and Groundwaters of the Mullica River Basin. New Jersey Water Resources Research Institute, Rutgers University, New Brunswick, New Jersey.

TASK 3.C

APPENDIX A

This appendix presents the naturalized monthly flows of the 50 year period developed for the analysis of future projects. The flows are contained in the computer printout input data listings which also give the control cards for the basin model.

A general explanation of the control cards is given in the following section labeled Control Card Description. The card description is taken directly from Exhibit 7 of the HEC-5C Simulation of Flood Control and Conservation Systems, Users Manual prepared by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers.

The total naturalized monthly flows for control points are given on the IN cards (12 monthly flows per card) of the input data listings. The first number following the "IN" is the control point number (one or two digits) which is followed by a two digit number indicating the water years 28, 29, 30, etc. At the beginning of each computer listing an explanation is given of which control points have IN cards and for which control points the flows are calculated as a factor of the flows on the IN cards of other control points.

The computer input data listings of the alternative project models contained in this appendix include the following:

1. Raritan River Basin for combined Projects No. 3, Confluence Reservoir Pump Station and Force Main; and No. 14, Round Valley Reservoir Expansion,

2. South River Basin for Project No. 80, South River Groundwater Pumped Storage Diversion,

3. Passaic River Basin for Project No. 40, Two Bridges-Ramapo Diversion Project

4. Passaic River Basin for Combined Projects No. 40, Two Bridges-Ramapo Diversion Project; and No. 41, Monksville Reservoir with Ramapo Pump Station,

5. Rockaway and Whippany River Basins for Projects No. 43, Washington Valley Reservoir; and No. 44, Longwood Valley Reservoir, and

6. Manasquan River Basin for Project No. 76, Upper and Lower Manasquan Reservoirs.

CONTROL CARD DESCRIPTION

T1-T2-T3

J1

A. TITLE CARDS

** T1, T2, T3 Cards

Job title cards. Three cards required. Both alphabetic and numeric information may be placed on these cards. Information on these cards will be printed out as job title on the first page of the output.

B. JOB CARDS (general data applying to entire computer run)

** J1 Card - First Job Card - all integers

Field	Variable	Value	Description
1	(1) NPER	+	Number of values on each set of flow data cards (cards IN, NQ, QA, etc.) for Flood 1 (between the ED card and the first EJ card).
2	IPER	+	Time interval (Δt) in hours between flows and on which all computations for all floods are based, unless changed by 7th field of BF card. Use 720 for monthly routing.
3	NL	+	Number of index levels used in apportioning reservoir releases among reservoirs. Minimum of 2; maximum of 7. Normally 5 levels are used.
4	NL1	+	Index level on RL cards (Index L of array STORL(M,L,K)) corresponding to the top of the conservation pool for all reservoirs. Normally = 3.
5	NLM	+	Index level on RL cards corresponding to the top of the flood pool for all reservoirs. Normally = 4.

**Required cards

(1) If NPER exceeds the dimension limits of KPER (and EPER is not used) the routing will be automatically divided into several periods (called floods), however the output will still appear as one flood.

Current dimension limits are printed out at the top of computer run. For the UNIVAC 1108, the limits are for 50 time periods (KPER), 15 control points (KNCPT), 10 reservoirs (KRES), 11 diversions (KDIV), and 9 power plants (KPWR).

J1 Card - Continued

Field	Variable	Value	Description
6	EPER	0	NPER (J1.1) periods of routing will be made.
		+	Last computation period will be EPER. This option is used to limit operation to a fewer number of periods than on the flow cards without changing the flow data. Use (KPER-1) or less (49 on UNIVAC 1108).
7	NLBUF	0	Index level = 1.
		+	Index level on RL cards corresponding to the top of buffer pool. Above this level, minimum desired flows will be made; and below this level, minimum required flows will be made (see text for definitions). Normally = 2.
8	ILOCAL	1 or 0	Local flows specified on IN cards are incremental; that is, they represent local flow between adjacent control points.
		10(1)	Compute incremental local flows from observed gages (IN cards) and observed reservoir releases (QA cards) and STOP (do not operate system). Reservoirs used in data must correspond to reservoirs in operation during flood. Output for this computation will be printed only if code 64 is requested by field 6 of J2 card.
		15(1)	Same as 10 except operate system also.
		20(1)	Incremental local flows are calculated from natural flows, on IN cards, and then the system is operated.
		25(1)	Same as 20 except do not operate the system.

(1) A negative value for ILOCAL will provide punched card output for the computed local flows. Computing local flows from observed gages or natural flows is limited to the number of dimensioned time periods.

J1 Card - Continued

Field	Variable	Value	Description
9	INFLOW	0	Input flow data is average for the period. Normally used.
		1	Input flow data is end-of-period on cards IN and NQ. QA and MR cards are always average values.
10	IOPMD	0	Reservoir releases will be made equal to inflow above top flood control pool up to outlet capacity.
		1	Same as above except that prereleases equal to channel capacity at the dam site will be made as soon as it can be determined that the reservoir will exceed the flood control storage using IFCAST(J2.3).
		2	Same as 1 except prereleases can be larger or smaller than channel capacity. Constant releases are determined for future periods so that the top of the flood control pool will be just reached within the forecast period, IFCAST (J2.3 or RL.3).

** J2 Card - Second Job Card

Field	Variable	Value	Description
1	CNSTI	0	Factor is assumed = 1.0.
		+	Factor which is multiplied times all inflows and local flows (Card IN). When several ratios of the given flows (IN cards) are to be computed the constants on the BF or FC card will be used.
2	CFLOD	0-1	Constant is assumed = 1.0.
		>1	Coefficient greater than or equal to 1 by which local flows are multiplied as a contingency allowance in the determination of upstream flood control releases. If this value is 1.2 a 20 percent forecasting error is assumed for IFCAST periods. This 20% error will be used for both flood control and conservation.

**Required Card

J2 Card - Continued

Field	Variable	Value	Description
3	IFCAST	0	A foresight equal to, 24/IPER, on all inflows and local flows will be used in system operation.
		+	IFCAST periods of foresight on inflows and local flows will be used in system operation for all reservoirs unless a different value is specified on the RL Card (RL.3). If both long and short time interval operations are made, IFCAST is only applied to the short time interval operation (daily or less).
4	RATCHG	0	The maximum rate of change, during IPER (J1.2), of reservoir release will be assumed as .5 times the designated channel capacity (CP.2).
		+	The maximum rate of change of reservoir release during IPER(J1.2), expressed as a ratio of the channel capacity (CP.2).
5	NFLRD	0	Flow data for only one flood will be read.
		+	NFLRD sets of flow data will be read on Cards IN, etc. Multiple ratios (FC card) can be used for each flood read. A series of "floods" (NPER items of IPER duration for a given flood) can be used to simulate a period of record by using monthly periods for some or all of the "floods" with short period routings as necessary.

J2 Card - Continued

Field	Variable	Value	Description
6	PRINT	0-511	The sum of the codes representing the desired output is used for PRINT. More than one copy can be obtained by specifying a number up to 9 to the right of the decimal (i.e., 38.2 would provide 2 copies of output coded 2, 4, and 32). Input cards T1-ED are always printed for batch jobs.

Code	Option
0	All output listed below.
1	Summary of maximum events for each flood and a summary of averages for reservoirs and nonreservoirs.
2	Summary of maximum and minimum values for each event and for all events. Also summary of monthly operations.
4	Output error check.
8	Normal sequential output by control point, by variable, by time period.
16	Reservoir data by period (all floods).
32	Reservoir releases and control point regulated flows by time period (all floods).
64	Computation of incremental local flows from natural or observed conditions.
128	Flow cards.
256	Hydrologic efficiencies (must also ask for code 2).

J2 Card - Continued

Field	Variable	Value	Description
7	FLONAT	0	Natural or unregulated flows, flows that would have existed if no reservoirs were upstream, will not be computed. However, they can be read on NQ cards. If ILOCAL = 20(J1.8) natural flows will be printed from the IN card data.
		-1	Natural flows will be calculated and printed (omit NQ cards). If ILOCAL = 20, natural flows printed out will be based on adjusted computed local flows (no negative locals).
8	NOROUT	0	Indicator is assumed equal to 24 hours.
		+	Indicator used to differentiate between short interval operation that would use routing and forecasting, and long interval conservation operation in which no routing and forecasting would be used. Channel routing and forecasting will not be made if IPER(J1.2 or BF.7) is greater than NOROUT.
9	NCPTR	0	All control points will be used in the system.
		+	Identification number of last control point to be used in this run of the system. Option is used to operate a subsystem when data is coded for a large system. The total number of control points can exceed the dimension limits (KNCPT) as long as subsystem specified does not. The first RL card should be for the upstream starting point. NCPTR must be a nonreservoir.

J2

J2 Card - Continued

Field	Variable	Value	Description
10	TRACE(1)	0	Trace level is assumed = 15 if TC or TP card is used.
		1	Very small volume of trace showing how reservoir releases were determined.
		11	Trace of release computation (see TC and TP Cards).
		15	Comprehensive trace (see TC and TP cards).
		17	Same as 15 except additional trace for diversions and routing coefficients.
		20	Comprehensive trace including Modified Puls trace.

(1) No trace will be provided unless a TC or TP card is also used.

* J3 Card - Third Job Card

Field	Variable	Value	Description
1	METRIC	0	Input and output are in English units.
		1	Input and output are in metric units.
2	ECFCT	0	No damage data will be used (cards DA-DC omitted) or factor "ECFCT" will be assumed = 1.
		+	Factor to be multiplied times all damage data on the DC cards.
3	FLDAT	0	No date will be printed out.
		+	Date of beginning of time period for first flow on IN cards. The eight digit code is for the year, month, day and hour. December 31, 1933, at 10 a.m., is 33123110. The month shown will be used for the starting month of evaporation (J6), diversion data (QD)and reservoir levels (additional RL cards) unless specified on J4.1.
4	BCRFAC	0	Capital recovery factor, if used, will be specified on the CP card.
		+	Capital recovery factor, used when data is omitted from 9th field of CP card, which is multiplied by the present worth of reservoir or control point costs to obtain the annual cost of the capital investment based on desired interest rate.
5	COSFAC	0	Any cost data will be multiplied by 1.0.
		+	Cost data on cards R$ and C$ will be multiplied by COSFAC.
6	IPRECN	0	All types of economic output will be printed including frequency plot.
		-1	All economic output except frequency plot.
		1	Economic summary table (only) will be printed.
		2	Economic summary and summary by category (only) will be printed.

*Optional Card

J3 Card - Continued

Field	Variable	Value	Description
7	IANDAM	0	No flood damages will be computed.
		-1	Flood damages for all floods operated by the system will be determined (expected annual damages will not be estimated).
		1	Expected Annual Damages will be calculated for natural conditions, for uncontrolled local flows, and for regulated conditions. The probability for each regulated flood will be assumed equal to the probability of the natural event.
		2-100	Expected Annual Damages will be calculated for the same three conditions as above. Probabilities for regulated conditions will be based on rearranging the flood events at each control point in the order of magnitude and assigning plotting positions based on IANDAM years of record. This option should be used when both monthly and short-interval routings are made.
8	ISCHED	0	Do not use scheduling.
		1	Use scheduling. No releases will be made from a reservoir unless all higher priority reservoirs in parallel are also releasing. The sum of the releases from all upstream reservoirs during any time period is not allowed to exceed damaging channel capacity at any downstream control point.

J3 Card - Continued

Field	Variable	Value	Description
9	IPRIO	0-15	The sum of the codes representing the desired priorities in the operation is used for IPRIO.
		Code(1)	
		0	Normal priorities will be made as indicated below by criteria in parenthesis.
		1	When flooding is occurring at a downstream location, primary power releases will still be made at upstream reservoirs (instead of curtailing the power releases).
		2	Primary power releases will be made as long as the reservoir storage level is above level 1 (in lieu of top of buffer level).
		4	All specified diversions from reservoirs will be made as long as the reservoir is above level 1 (instead of top of buffer pool) except where diversions are a function of reservoir storage.
		8	When flooding is occurring at a downstream location, minimum desired flow releases will be made contributing to the flooding (instead of making no releases).

(1) If any of the codes (1-8) are not selected, operational priority for that item will be based on normal priority as shown in parenthesis.

J3 Card - Continued

Field	Variable	Value	Description
10	IPLOTJ	0	Hydrographs will not be plotted unless requested for a given control point by IPLOT(ID.9).
		1-4	IPLOTJ (up to 4) hydrographs will be plotted (printer plot) for all control points (unless specified on ID.9) based on the value of IPLOTJ as follows: (1) Regulated hydrograph only. (2) Natural and regulated hydrographs. (3) Natural, regulated and uncontrolled local hydrographs. (4) Natural, regulated and uncontrolled local and inflow hydrographs.
		5-8	The four hydrographs listed above will be plotted as well as (IPLOTJ-4) hydrographs for computed incremental local flows. (ILOCAL ≥ 10 on J1.8.) Additional plotted hydrographs based on value of IPLOTJ are: (5) Routed hydrograph (6) Observed hydrograph (7) Computed local flow (8) Inflow hydrograph
		>10	Vertical scale for plots can be set for all plots by coding the discharge scale (flow units/inch) plus the plot level desired. A 2007 value will use 2000 cfs or CUMECS per inch scale and plot the 4 control point hydrographs plus three local flow hydrographs.

* J4 Card - Fourth Job Card

Field	Variable	Value	Description
1	ISTMO	0	Starting month for all monthly data is based on FLODAT (J3.3 or BF.5).
		+	Starting month (1 = January) for all monthly data, such as evaporation (J6 card), diversions (QD card), power demands (PR card), and storage levels (RL cards). With this input, flow data does not have to start with the same month as the monthly data set.
2-10			Not used.

*Optional Card

J5
J6

* J5 Card - Reservoirs Deleted - Fifth Job

Field	Variable	Value	Description
1	NRDEL	+	Number of reservoir identification numbers to be read on J5 card starting in field 2. Maximum of 29.
2+	RESDEL(I)	+	Reservoir identification number (same as field 1 of RL card) of all reservoirs which are to be operated with outflows equal to inflow instead of using the criteria shown on cards RL-RQ. The computer will automatically change the storages on the RL card to zero, will eliminate the downstream control points the reservoir was to have operated for on RO card and will change the outlet capacities on RQ card to 1,000,000 cfs. RO card must be manually changed if an upstream reservoir operates for the deleted reservoir (see RO.2) or cards RL-RQ must be removed.

* J6 Card - Basin Evaporation Data - Sixth Job Card (normally two cards)

Field	Variable	Value	Description
1	NEVAT	+	Number of evaporation rates on J6 cards. Maximum of KEVAP (currently 12). Normally = 12.
2	EVDUR	+	Duration, in days, for each evaporation rate on these cards (3-14). Normally 30 days.
3-14	EVRAT(K)	+	Net evaporation minus precipitation rate in inches (millimeters) per month over the reservoir area for NEVAT periods. The first "EVDUR" of the routing will use EVRAT(1), etc. Therefore, if all flow cards (IN, etc.) start in October (for 1st flood), EVRAT(1) must be for October. Variable ISTMO(J4.1) can be used to differentiate the starting month for this data from the date used for the routing of flows.

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*Optional Card

J7
J8

* J7 Card - To be used later.

* J8 Card - User Determined Output Format (0-5 cards)

Optional card to design format of additional output. Each card used will specify output variables to be printed for up to 10 columns.

Data by Period (first field is positive)

Each field of the card used should contain the control point location (to the left of the decimal) and variable code (to the right of the decimal). For example, a 10.10, 15.10, 10.12, 15.12, 10.13, 15.13 in fields 1-6 would print six vertical columns for each period of the routing showing in order: the outflows for reservoirs 10 and 15 (code 10 = outflow), cases (code =12) for reservoirs 10 and 15 and levels (code =13) for reservoirs 10 and 15.

Summary Data by Control Point (first field is negative)

Each field of the card used should contain the code for the type of summary (to the left of the decimal) and variable code (to the right of the decimal). Codes for the summary data are: 1=SUM, 2=Maximum, 3=Minimum, 4=Period of Maximum, and 5=Average. The first card requesting summary data (first field is negative) will provide data for reservoirs and if a second summary card is used, the data would be for nonreservoir control points. A maximum of two sets of cards (4 cards) can be used in this manner with cards 1 and 3 for reservoir data and 2 and 4 for nonreservoir data. For example, a -1.02, 2.02, 5.02 in the first three fields would provide the sum, maximum, and average of the natural flows for all reservoirs. If the next J8 card also requested summary data (negative value in the first field) the summary data would be for nonreservoir control points.

Variable codes to be used are:

.01 Cumulative Local Flow	.09 Reservoir Inflow	.17 Channel Capacity
.02 Natural Flow	.10 Reservoir Outflow	.18 Q Space
.03 Diversion	.11 Reservoir EOP Storage	.19 U.S. Res/Div. Flow
.04 Regulated Flow (nonreservoir)	.12 Reservoir Case	.20 Flooding by Reservoir
.05 Min. Desired Flow	.13 Reservoir Level	.21 Evaporation
.06 Min. Desired Flow Shortage	.14 Reservoir Eq. Level	.22 Elevation
.07 Min. Required Flow	.15 Required Power Demand	.23 Power Shortage
.08 Min. Required Flow Shortage	.16 Generated Power	.24 Incremental Local Flow

*Optional Card

TC

TP

* TC Card - Trace Card - Control Points

All control points will be traced if this card is omitted, and if a TP card is used.

Field	Variable	Value	Description
1	NTRAMX	+	Number of values of MXTRA(I) on TC card.
2-10	MXTRA(I)	+	Identification numbers of selected control points to be traced for periods shown on TP card with level of trace from J2.10.

* TP Card - Trace Card - Time Periods

All time periods will be traced if this card is omitted and a TC card is used.

Field	Variable	Value	Description
1	NTRACE	+	Number of values of ITRAP(I) on TP cards.
2		0	If NTRACE = 1, a general trace before and after operation by period will be generated, but no trace will be generated from system operation.
2-10	ITRAP(I)	+	Selected time period numbers for trace specified on J2.10. If it is desired to trace period 10 of flood 2, use 10.02. These values can exceed the dimension limit KPER.

Note

If both TC and TP cards are omitted trace will not be printed for any time period or control point regardless of value of TRACE (J2.10).

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*Optional Card

C. Reservoir Cards (2) - Cards RL, RO, RS, and RQ are required for all reservoirs, omit for nonreservoirs. The most upstream control point on each tributary must be a reservoir.

RL Card - Reservoir Target Levels

Field	Variable	Value	Description
1	MM	+	Integer identification number for the control point (user number). The computer will generate the subscript M for internal identification (computer I.D. number).
2	STOR1	+	Initial storage of reservoir MM in acre-feet or 1000 cubic meters.
3	IFCST(M)	0	The foresight shown on J2 card (field 3) for inflows and local flows will be used for reservoir MM when short interval routings are made (when IPER (J1.2 or BF.7) is less than or equal to NOROUT (J2.8)).
		+	IFCST(M) periods of foresight for inflows and local flows will be used for reservoir MM when IPER is less than or equal to NOROUT.
4-10	STORL(M,L)	+	Reservoir capacities for control point MM in acre-feet or 1000 cubic meters for each of NL levels (J1.3) starting with level 1. Level NLBUF(J1.7) is the top of buffer pool. Level NL1(J1.4) is the top of conservation pool. Level NLM(J1.5) is the top of flood control pool.

##Required cards for reservoirs

(2) Cards RL-DC are repeated for each control point (reservoir or damage center) in turn in downstream order until all control points have been specified. The maximum number of control points depends on computer used but is = KCPT, including reservoirs. The maximum number of reservoirs is KRES. If a control point is not a reservoir, cards RL-R3 and P1-PE are omitted, and only control point cards CP-DC are used. If a reservoir is not a power plant, omit cards P1-PE. All control points above each confluence must be specified before the confluence control point.

*Additional RL Cards

Additional RL cards can be used when reservoir levels change during the year. These cards will be read after the first RL card (storage data will be ignored on first card if more than one card is read). NL(J1.3) groups (one or two cards each) of additional RL cards will be read in increasing order of level.

Field	Variable	Value	Description
1(1)	L	+	Level Number (1-7).
2(1)	M	+	Control point identification number.
3	IRPT	0	Storages will be read for all 12 months. Two RL cards are required for this level.
		-1	Storage in field 5 will be used for all months. Second RL card for this level will be omitted.
4	FACTR	0	All storages are read in acre-feet or thousands of cubic meters.
		+	Storage on fields 5-10 will be multiplied by FACTR.
5-10	STORL	+	Reservoir storage for each month for level L. The first six values of storage appear on the first card in fields 5-10 and the remaining six values (if used) must be in fields 5-10 of the second card (fields 1-4 are omitted). The first monthly value must be for the starting month of the flow data unless variable ISTMO(J4.1) is used. More than one acre-foot of flood control storage should be shown for the first month if downstream CUMULATIVE LOCAL FLOW should not include local flows above this reservoir.

*Optional Cards

(1) Fields 1 and 2 are not read by HEC-5C, but are read by HEC-3. (Both programs can use same RL cards if prepared as described above.)

RO Card - Reservoir Operation Points

Field	Variable	Value	Description
1	NSERV	+	Number of downstream control points for which reservoir MM is operated to prevent flooding or to provide low flows. If MM has flood control storage, this value should be equal to one or more. An unlimited number of points may be used, however, each additional point increases computer time.
2+	ISERV(M,K)	+	Control point numbers for which reservoir MM is operated. NSERV values in any order. None of these control points can be reservoirs without flood storage. If MM is an upstream tandem reservoir, it should be operated for the downstream reservoir, but not for any control points below that.

RS Card - Storage Capacities

Field	Variable	Value	Description
1	NK	+	Number of values of STOR(M,K) and QCAP(M,K).
		-	Number of values of STOR as above (negative). Also values of STOR(M,K) are in 1000's of units on input cards and will be multiplied by 1000 by the computer.
2-10	STOR(M,K)	+	Reservoir capacity in acre-feet or 1000 cubic meters for control point MM, corresponding to RQ card values. NK values. Dimension limit for K, for cards RS, RQ, RA, RE, RD, and R$ is KNCAPT (currently = 18). First storage value should be zero and two successive values should not be equal.

##Required cards for reservoirs

RQ
RA
RE

RQ Card - Outlet Capacities

Field	Variable	Value	Description
1	NK	+	Number of values of STOR(M,K) and QCAP(M,K).
2-10	QCAP(M,K)	+	Outlet capacity for control point MM in cfs or cubic meters per second. NK values. First value should be equal or greater than the minimum outflow desired.
		-1	Unlimited outlet capacity at STOR(M,K). This option sets the outflow equal to the inflow when reservoir reaches the value of STOR which corresponds to a QCAP which is negative.

* RA Card - Reservoir Areas

Field	Variable	Value	Description
1	NK	+	Number of values of AREA(M,K) on this card and STOR(M,K) on RS card.
2-10	AREA(M,K)	+	Reservoir areas in acres or thousands of square meters for control point MM corresponding to RS card storages. NK values.

* RE Card - Reservoir Elevations

Field	Variable	Value	Description
1	NK	+	Number of values of EL(M,K) on this card and STOR(M,K) on RS card.
2-10	EL(M,K)	+	Reservoir elevations for control point MM corresponding to RS card storages. NK values.

##Required cards for reservoir

*Optional Card

* RD Card - Reservoir Storages vs Diversions or Minimum Releases

Field	Variable	Value	Description
1	DVEXC	0,+	All diversions are made based on reservoir storage.
		-1	Diversions are equal to the excess flood waters above the top of conservation up to the outlet capacity of the diversion pipe (FDQ). The second value on this card must be greater than 0.0.
		-10	Minimum reservoir releases are shown for FDQ values as functions of reservoir storages (RS card). Induced surcharge envelope curve values (minimum reservoir releases during emergency conditions) can be shown on RD and RS cards and maximum reservoir releases vs reservoir storages on RQ and RS cards. For this option (DVEXC = -10) only do not use DR cards since reservoir releases determined from this option will not appear as diversions.
2-10	FDQ(M,K)	+	Diversion discharges from reservoir M corresponding to values of STOR(M,K) on RS card. If field 1 is -1, field 2 must be greater than zero (use .01 or greater). NK values.

* R$ Card - Reservoir Costs

Field	Variable	Value	Description
1	NK	+	Number of reservoir costs on this card and storages on the RS card. Maximum of 18.
2-10	COEF	+	Reservoir capital costs (present worth) corresponding to the storages on the RS card. The storage at the top of flood control pool (RL card storage corresponding to level NLM from the 5th field of the J1 card) will be used as the reference level for storage in determining the cost of the project from the RS and R$ cards. Values should be in the same units as damages (i.e., $, $1,000, etc.).

*Optional Card

R1
R2

* R1 Card - Starting Storages

Field	Variable	Value	Description
1	NSTOR1	+	Number of starting storages on R1 card.
2-10	TSTOR1(K)	+	NSTOR1 values of starting storages for multiple flood runs. Used only if NFLRD(J2.5) or NFLCON(J4) is positive and the starting storage is changed.

* R2 Card - Additional Reservoir Data

Field	Variable	Value	Description
1	RTCHGR	0	The rate of change on J2 card is used.
		+	The allowable rate of change of release during IPER(J1.2), in cfs or cubic meters per second, when the release from reservoir MM increases from the previous period.
2	RTCHGF	0	The rate of change on J2 card is used.
		+	The allowable rate of change of release during IPER(J1.2), in cfs or cubic meters per second, when the release from reservoir MM decreases from the previous period.
3	EVRTO	0,+	If greater than zero, factor is multiplied times the evaporation rates on EV or J6 cards.
4-10			Not used.

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*Optional Card

* R3 Card - Reservoir Evaporation

Optional data for varying the evaporation for reservoir M only on a monthly basis instead of using the basin evaporation on card J6. Evaporation which varies from year to year must be read on an EV card.

Field	Variable	Value	Description
1	NEVRAM(M)	12	Number of evaporation rates on this card. Enter the number 12.
2	EVDURM	30	Duration for each evaporation rate on these cards. Duration must equal EVDUR (J6 card) which is expressed in days. Use 30 days.
3-14	EVRATM(K,M)	+	Net evaporation minus precipitation rates in inches (mm) over the reservoir area for 12 monthly periods. The first month of the routing will use the first evaporation value unless modified by ISTMO(J4.1).

*Optional Card

P1

D. Power Reservoir Data (cards P1-PE)

P1 Card - First Power Card

This card specified physical characteristics of a powerplant located at this control point. Omit cards P1-PE if no powerplant exists at this control point; next card will be CP card for this control point.

Field	Variable	Value	Description
1	OVLOD	+	Overload ratio for the power installation. Usually 1.15 in the United States. If left blank, program assumes 1.15.
2	PWRMX	+	Installed powerplant nameplate capacity in kilowatts. Station service units are usually excluded.
3	TLWEL	0	Zero or blank indicates that a tailwater vs reservoir release relationship will be read on the PQ and PT cards.
		+	Tailwater elevation plus hydraulic loss in feet (or meters). For hydroelectric projects providing "peaking" power, this should be a "block-loading" or average "on-line" tailwater elevation that would be expected normally during periods of power generation.
4	IDPR	0	Zero or blank indicates that there is no downstream reservoir whose elevation affects tailwater elevation at this powerplant.
		+	Control point number of downstream reservoir whose elevation affects tailwater elevation at this powerplant. Program adds 2.0 feet (.6 meters) for hydraulic loss to elevation of downstream reservoir to obtain tailwater elevation and uses that or TLWEL (field 3) depending on which is highest for computing power head.

#Required card for all reservoirs with powerplants

P1 Card - Continued

Field	Variable	Value	Description
5	IPOW	0	Zero or blank specified that power peaking capability function will not be used. This, in effect, means that the only limitation of power output will be the powerplant nameplate capacity.
		1	Value of 1 indicated that a peaking capability vs reservoir storage relationship will be read in on cards PP and PS and used to calculate the turbine-generator capability as a function of reservoir storage. This option is used when head fluctuations are primarily dependent on headwater fluctuations.
		2	Value of 2 indicated that a peaking capability vs reservoir release relationship will be read in on cards PP and PS and used to calculate the turbine-generator capability as a function of reservoir release. This option is used when the head fluctuations are primarily dependent on changes in tailwater.
6	EFFCY	0	Standard ratio of .86 is used.
		+	Powerplant efficiency at this installation expressed as a ratio. Specification of a positive value implies that efficiency is constant throughout the range of operating heads anticipated.
		-1	If -1 is specified, powerplant efficiency vs reservoir storage relationship is specified on PE card.
		-2	If -2 is specified, KW/CFS (or KW/m^3/sec) coefficient vs reservoir storage relationship is specified on PE card.
7	QLKG(M)	0,+	Leakage through or under dam or powerhouse in cfs or cubic meters per second. Used to specify water which continuously passes the dam but cannot be used for power generation.
8-10			Not used.

PR

PD

PH

PR Card - Power Requirements - Monthly

This card specifies the monthly at-site power requirements for this project for each year. Two cards are required.

Field	Variable	Value	Description
1-10	POWRM	+	Monthly at-site power requirement in thousand kwh. Specify 12 values in successive order, one value per field. The first month for this data must be the same as the first evaporation period (J6 or R3 card). See ISTMO(J4.1).
		-	At-site power requirement as plant factor ratio times -1.0. Specify 12 values as above.

* PD Card - Power Requirements - Daily

This optional card specifies percentages (expressed as ratios) of the total weekly power requirements for each day of the week (7 values required).

Field	Variable	Value	Description
1-7	POWRD	+	Daily ratios of at-site power requirements. Sum of the 7 values must equal 1.0. The first value is for Sunday. The starting day of the week for each flood is assumed as Sunday unless specified on the BF card (8th field).

* PH Card - Power Requirements - Multihourly

This optional card specified percentages (expressed as ratios) of the total daily power requirements for each time interval (IPER) within a day.

Field	Variable	Value	Description
1	N	+	Number of ratios to be read starting in field 2. Number of values = 24/IPER (short interval routing period), i.e., for a six hour routing interval, 4 values would be required.
2+	POWRH	+	Ratios of the daily power requirements for each time period (IPER) within the day. First value represents the period from midnight to IPER past midnight. Sum of the values should equal 1.0.

#Required for each powerplant

*Optional Card

* PQ Card - Power Releases[1]

Field	Variable	Value	Description
1-10	QT	+	Reservoir outflow in cfs (or m^3/sec). Begin with lowest value in field 1 and specify values in increasing order. Values should cover the range of discharges expected. Program uses linear interpolation between points, so values should be selected so that linear interpolation is reasonably accurate. If less than ten values are needed, the unneeded fields should be left blank.

* PT Card - Power Tailwater

The number of values on this card must be the same as the number of values on the PQ card.

Field	Variable	Value	Description
1-10	TL	+	Tailwater elevation in feet (or meters) corresponding to reservoir outflow in same fields on the PQ card.

* PP Card - Power Peaking Capability[2]

Field	Variable	Value	Description
1-10	PKPWR	+	Maximum peaking capability in kilowatts. The capability must correspond to the specified values on the PS card. Program uses linear interpolation in this table so values should be selected so that linear interpolation is reasonably accurate.

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*Optional Card

(1) Cards PQ and PT are used to specify the tailwater-discharge relationship at this powerplant instead of using TLWEL (P1 card, field 3). Up to ten values can be used to define the relationship.

(2) Cards PP and PS define the relationship between peaking capability and either reservoir storage or reservoir outflow. P1 card, field 5 must be equal to 1 or 2 to determine type of data being read. Up to ten values can be used to define the relationship.

PS

PE

* PS Card - Power Storages (or Releases)

The data on this card can be either reservoir releases or reservoir storages. Reservoir storages are specified if IPOW (P1 card, field 5) is 1, and reservoir releases are specified if IPOW is 2. The number of values on this card must be the same as the number of the PP card. The largest should be larger than the highest storage or largest release anticipated and the smallest value should be smaller than the lowest storage or smallest release anticipated.

Field	Variable	Value	Description
1-10	CQOEL	+	Reservoir storage in acre-feet (or thousand cubic meters) if IPOW (P1 card, field 5) is 1, or reservoir release in cfs (or m^3/sec) if IPOW is 2. Begin with smallest value in the first field and specify values in increasing order. Values must correspond to peaking capabilities in same field on the PP card.

* PE Card - Power Efficiencies vs Storage

This card is used to specify the relationship between reservoir storage and either plant efficiency ratio or KW/CFS coefficient instead of using a fixed efficiency of EFFCY (P1 card, field 6). If EFFCY is specified at -1, plant efficiency ratios are specified on this card. If EFFCY is specified as -2, KW/CFS (or KW/m^3/sec) coefficients are specified. The number of values on this card must be the same as the number of values on the RS card.

Field	Variable	Value	Description
1-10	EFCY	+	Plant efficiency ratio if EFFCY (P1 card, field 6) is -1 or KW/CFS (or KW/m^3/sec) coefficient if IFFCY is -2. Values must correspond to storage capacities in same field on the RS card.

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*Optional Card

E. Control Point Cards (Cards CP-DC) - Cards CP, ID, and RT are required for all control points including reservoirs.

** CP Card - Control Point Card

Field	Variable	Value	Description
1	MM	+	Any integer indentification number. Must be equal to MM of the RL card if this control point is a reservoir.
2	QMX(M)	+	Maximum flow in cfs or cubic meters per second desired at control point MM (nondamaging capacity).
3	LQCP(M)	0	Flows for MM are read from card IN.
		+	IN cards do not have to be read for control point MM; instead, flows for MM can be based on values on card IN for the same or another control point LQCP(M) which is in system. Factor RTLQ(M) is multiplied times the flows on the IN cards and lagged by QLAG(M).
4	RTLQ(M)	0	Flows for MM are read as card IN.
		+	Ratio which is multiplied by flows at LQCP(M) to obtain flows at location MM.
5	QLAG(M)	0	No lag.
		+ or -	Number of periods local flows are to be lagged forward in time (+) or backward (-) expressed in IPER(J1.2) units.
6	CFLD(M)	0	Factor CFLOD(J2.2) will be used for contingency factor.
		+	Contingency factor (equal to one or more) for forecasting cumulative local flows at control point M.

**Required Card

CP Card - Continued

Field	Variable	Value	Description
7	QMIND(M)	+	Minimum desired flow at control point M for NPER periods. MR card for this control point will override this flow if it is used. Minimum desired flows will be made as long as upstream reservoirs are above level NLBUF(J1.7).
8	QMINR(M)	+	Minimum required flows at control point M for all periods. The target flows will be reduced from the desired flows to the required flows when upstream reservoirs fall below level NLBUF(J1.7). No releases will be made below level 1.
9	CRFAC	0	Capital recovery factor from J3 card (field 4) will be used for this control point.
		+	Capital recovery factor for this control point or reservoir to convert present worth cost (R$ or C$ cards) to an annual figure.
10	OMPER	0	No operation and maintenance costs.
		+	Proportion of capital cost, expressed as a percentage, that will be required for annual operation, maintenance and replacement of the facilities (reservoir or local protection works).

** ID Cards - Identification Card for Control Point

Field	Variable	Value	Description
1-4	CPT(M,1-10)	+	Title (alphanumeric) of control point in columns 3-32. Columns 3-32 will be printed in the summary.
5-8			Not used.
9	IPLOT	0	No hydrographs will be plotted for this control point, unless J3.10 is positive.
		1-8	IPLOT hydrographs will be plotted for this control point. (See J3.10 for priority of plots.)
10			Not used.

** RT Cards - Routing Card

Field	Variable	Value	Description
1	RTFR(M)	+	Control point number of upstream end of routing reach. Equal to MM of RL and CP card.
2	RTTO(M)	+	Control point number of downstream end of routing reach MM. Equal to MM of the RL and CP card for the next downstream control point. May be left blank for last control point in system.
3	RTMD(M)	+	Number of subreaches (to left of decimal) and ratios for method of routing for reach MM (.1 for straddle-stagger, .2 for Muskingum, .3 for Modified Puls and .4 for Working R&D). A 3.2 indicates three subreaches will be used in the Muskingum method.

**Required Card

RT Cards - Continued

Field	Variable	Value	Description
4	X(1)	+	Muskingum routing coefficient "X" for each subreach of reach MM. For the Muskingum and Working R&D methods, use the desired value of X between 0 and .5. Use 0 for Modified Puls. Enter the number of ordinates to be straddled and staggered (such as 3.1 for 3/1 straddle-stagger). For routing by the Tatum (successive Average-Lag) method, enter a 2.1 and make RTMD(RT.3) equal to $2K/\Delta t$.
5	K	0	For Modified Puls, R&D, and straddle-stagger. If no routing is desired use Muskingum with X = .5 and K = 0.
		+	Travel time (Muskingum K) in hours for Muskingum subreach. To avoid negative coefficients, K, for the subreach, should be approximately = Δt (IPER of J1.2); in no case should K be less than $\Delta t/[2\cdot(1-X)]$ or greater than $\Delta t/2X$.
6	LAG(1)	0	No lag in addition to routing.
		±	In addition to routing specified by Methods 1-4, lag outflow by the number of periods shown in this field (RT.6) (+ or -).
7-10			Not used.

(1) Do not use routing criteria that specifies that outflows are a function of future period inflows. (e.g., Straddle-Stagger of 3/0 or in some cases where a negative LAG is greater than or equal to the routing time.) The 3/0 straddle-stagger would have outflow for the present period equal to 1/3 the inflow for the previous, present, and future periods.

* DR Card - Diversion Data for Control Point

Dimension limit for number of diversions is KDIV (currently = 11).

Field	Variable	Value	Description
1	DRTFR(NDIV)	+	Control point identification number (same as MM on CP card) where diversion is made.
2	DRTTO(NDIV)	0,+	Control point number where diversion returns to system. Diversion flows will be routed from MM to DRTTO(NDIV). Can be zero if there is no return flow.
3	DRTMD(NDIV)	+	Routing method for diversion. See RTMD of RT card (field 3). Only linear methods are allowed.
4	DRTCOF(NDIV)	+	Routing coefficient "X" for diversion. See RTCOF of RT card (field 4).
5	DMUSK(NDIV)	+	Routing coefficient "K" for diversion. See XMUSK of RT card (field 5).
6	DCON(NDIV)	+	Percentage of flow (expressed as a ratio) diverted at MM which returns at DRTTO(NDIV). A .2 indicates 20% of diversion returns.
7	KDTY(NDIV)	0	Diversion flow is constant and equal to DFLOW(NDIV) on 8th field (QD card not needed).
		+	Each diversion flow from card QD is constant for KDTY periods and then the next flow on the QD card is used. For monthly operations, if KDTY = 1, 12 flow values on the QD card would provide monthly diversions that would cycle through for each years operation. The first diversion value must correspond to the starting time of the first flow value (IN card) unless ISTMO(J4.1) is used. For this option, diversions should not be made both from and to the same control point.

---

*Optional Card

DR Card - Continued

Field	Variable	Value	Description
		-1	Diversion quantity is a function of the inflows at control point MM according to the tables of CHQ (QS card) and FDQ (QD card).
		-2	Diversion quantity is a function of the reservoir storage for MM according to the tables of STOR (RS card) and FDQ (RD card).
8	DFLOW(NDIV)	0	Diversion flow is not constant.
		+	Diversion flow is constant and equal to DFLOW. Field 7 must be = 0.
9-10			Not used.

* QS Cards - River Discharges

Cards QS and SQ are read following RT cards when storage outflow data is required for Modified Puls or Working R&D routing (RTMD of RT card = .3 or .4).

Field	Variable	Value	Description
1	NPTSQ	+	Number of outflows on QS card and number of storages on SQ card. Maximum number = 18.
2-10	CHQ(M,N)	+	A table of river outflows in cfs or cubic meters per second at the downstream end of reach MM corresponding to the storages given on the SQ cards for use in non-linear flood routing from control point MM. NPTSQ values. Each value should be unique.

* SQ Card - Channel Storages

Field	Variable	Value	Description
1	NPTSQ	+	Number of outflows on QS card. Must correspond to the number of storages on SQ card.
2-10	CHSTG(M,N)	+	A table of channel storages in acre-feet or 1000 cubic meters corresponding to the outflows given on the QS cards. Storage represents total volume between control point MM and control point RTTO(M). NPTSQ Values.

---

*Optional Card

* QD Card - Diversion Flows

Field	Variable	Value	Description
1	X	+	Number of DQ(I,M) values on QD cards for control point.
2-10	FDQ(M,N)	+	When KDTY (field 7) of DR card = -1, fields 2-10 are the diversion flows corresponding to values of channel flow, CHQ(M,N), on the QS card. Maximum number = 18.
or			
2-10	DQ(I,M)	+	When KDTY (field 7) of DR card = 1 or more, DQ represents the diversion flow in cfs or cms for time periods composed of KDTY periods of IPER(J1.2 or BF.7). Maximum number = KPER.

---

*Optional Card

EL
C$

* EL Card - Elevation or stage for damage center at MM (Nonreservoir)

Field	Variable	Value	Description
1	X	+	Number of outflows on QS card.
2-10	EL(M,N)	+	Elevation or stage in feet (or meters).

* C$ Card - Control point (local project) Cost Data

Field	Variable	Value	Description
1	DESQ	0	Damages for the modified channel are reflected in the second set of DC cards.
		+	Design discharge for the local project below which there are no damages. Damages described on the DC cards will be eliminated below this discharge if only one damage condition is provided. The channel capacity of field 2 of the CP card should be modified accordingly, but it can be different if desired.
2-19	COEF(N)	+	Capital (present worth) cost of the local project (channel modification, levee, floodwall, etc.) corresponding to the flows on the QS card. The design discharge (DESQ) will be used as the reference level for discharge in determining the cost of the project from the QS and C$ cards.

*Optional Card

CC

QM

* CC Card - Channel Capacities for Control Point

Optional card for varying the operational channel capacity with inflows at a control point. When this card is omitted, QMX (card CP.2) is used for the channel capacity.

Field	Variable	Value	Description
1	NK	+	Number of channel capacity values shown on this card up to 9 values (only 1 card can presently be read).
2-10	CHCAPT(K)	+	Channel capacity values at MM corresponding to the regulated flow (inflow) at MM on the QS cards. The table interpolation value of the channel capacity is used as the hydrograph progresses except that the channel capacity is never decreased from the previous period value. Thus, once the maximum channel capacity is reached, it is maintained throughout the remainder of the hydrograph.

* QM Card - Minimum desired flow which vary monthly(1)

Field	Variable	Value	Description
1	J	+	Number of minimum flows on QM cards for control point MM. Normally = 12. Maximum = 18.
2	FLDUR	+	Duration in days, for each minimum flow. Normally = 30.
3-14	COEF(I)	+	Minimum desired flow values for control point MM for J periods, each representing a duration of FLDUR. The first monthly value must be for the starting month of the flow data unless variable ISTMO(J4.1) is used.

---

*Optional Card

(1) QM Cards are assumed applicable to all floods. MR cards are not required for short interval flood periods if flows still vary monthly; but if they are used for any flood, they will override the monthly QM card data for that flood only.

*F. Damage Data (Cards DA-DC)

Evaluation can be made of the damages that would result from a single flood, a series of floods, or the expected value of annual damages (average annual damages). The evaluation is made for base conditions, modified conditions (regulated) and for conditions resulting from uncontrolled local flows below the reservoirs. Damages are assumed to be a unique function of peak flow rate and are computed at each damage center and for the basin as a whole. Total damage for a single flood or a series of floods can be evaluated by using only those floods. However, when computing the expected value of annual damages, at least 6 floods representing the full range of expected discharges should be processed. The J2 card controls the number of floods to be processed and the J3 card, field 7, provides the damage computation option. The DA, DF, DQ, and DC cards describe the flow frequency damage data required for each control point (nonreservoir).

If damages are not to be evaluated all cards DA-DC are omitted.

(1) DA Card - Damages (expected-annual) for base (normally natural) conditions.

Field	Variable	Value	Description
1	J	+	Number of damage categories to be read on this card. Must also equal the number of sets of DC cards to be read. Maximum of 9.
2-10	COEF(I)	0	Expected annual damages for base conditions are not given. The damages for base conditions will be computed from the input flow-damage-frequency functions and used in adjusting the integration procedure for the modified conditions as discussed below.
		+	Expected annual damage for base conditions for each of (J) damage categories.

---

*Optional Cards

(1) When DA card is read, all other damage cards (except DB) are required.

DB

DF

* DB Card - Base Damage Card for Existing System (card will follow the DA card if used)

The DB card may be used to input the expected annual damage for each damage category for an existing reservoir system. These expected damages are then substituted for natural (base) conditions expected damages so that the incremental reduction due to additions to the existing system can be displayed.

Field	Variable	Value	Description
1	J	+	Number of damage categories on the DA and DB cards.
2-10	COEF	+	Expected annual damages for each damage category in turn for this control point for existing reservoirs and other developments (base conditions) for which costs are not furnished.

(1) DF Card - Damage Frequencies

Field	Variable	Value	Description
1	K	+	Number of values of exceedance probabilities on this DF card, of discharges on the DQ card and damages on each DC card. Maximum of 19 values.
2-10	COEF(I)	+	Exceedance probabilities read (in order of decreasing magnitude, i.e., .99, .95, etc.) from a frequency curve for each value of discharge on the DQ card. Values can be annual series or partial duration.

---

*Optional Card

(1) When DA card is read, all other damage cards (except DB) are required.

(1) DQ Card - Damage Discharge

Field	Variable	Value	Description
1	K	+	See field 1 of DF card.
2-10	COEF(I)	+	Discharges (K values) corresponding to the exceedance probabilities on the DF card. These discharges must be in increasing order of magnitude. Discharge values should be average values for the time interval used (IPER).

(1) DC Card

Base condition damages for each of J(DA.1) categories (one set for each damage category). (J sets of additional DC cards may be used if one represents base conditions and the second represents modified conditions from channel improvement or land purchase, etc.)

Field	Variable	Value	Description
1	N	+	Reserved for damage category identificaton (integer). Not used by program.
2-10	COEF(I)	+	Damage in dollars or multiples thereof corresponding to the same fields of the DF and DQ cards and for damage category N. All damages on these cards will be multiplied by ECFCT (field 2 of J3 card) to obtain the damages in dollars. (K(DQ.1) values on each set of cards. J(DA.1) sets of DC cards are used for base conditions and J additional sets may be used for modified conditions. Input for the J additional sets would follow the complete input for the base condition.

**Required Card

(1) When DA card is read, all other damage cards (except DB) are required.

ED

G. End of Control Point Data

** ED Card - Required card at end of last set of RL-DC cards and just before IN card of first control point (or BF card).

Field	Variable	Value	Description
1	IDB	0	A BF card will not be read next.
		1	A BF card will be read next. All flow sets (IN cards, etc.) will start with a BF card and end with a EJ card.
2-10			Not used.

**Required Card

H. Flow Data (1)

* BF Card

Begin Flow Data Set (omit card unless field 1 of ED card is positive).

Field	Variable	Value	Description
1	FLOFMT	0	All flow data (Cards IN-EV) will be read using standard format of 10 fields per card. (First 2 fields of first card are used for identification and date.)
		1	All flow data (Cards IN-EV) will be read using control point identification (Columns 3-6), date (alphanumeric columns 7-8) and 12 flow fields per card (6 digits each - columns 9-14, 15-20, etc.). Same format as HEC-3.
		2	All flow data (Cards IN-EV) will be read using the standard format of 10 fields per card so that MM and DATE are read on the first card and the flows are read starting with the first field of the second card.

---

(1) Data after ED card represents flow data (except for BF and FC cards and monthly evaporation data). Data for each flood read (consult text for multiflood definition) is separated by an EJ card. For any set of flow data for a "flood" (could be NPER monthly periods) the set can be preceded by a single BF card and possibly by a single FC card (both are optional) followed by a set of IN cards (NPER values on each set) for each control point in the system (those omitted will be assumed as zero unless computed by a ratio of another station (see CP.3)), and followed, if desired, by sets of QA or NQ or MR or EV (NPER values on each set) for any or all of the control points or reservoirs, followed by an EJ card. The order of these cards is not important. Cards should be set up in order described above if convenient, however they could be set up in any order (NPER values of NQ for control point 5, NPER values of IN for control 10, etc.).

*Optional Card

BF Card - Continued

Field	Variable	Value	Description
2	NPER(1)	+	The number of periods of flow data on next set of cards (IN-EV). The value on J1 Card is ignored.
3	NPSTO	0	Reservoir storages are not transferred from one series of routings (called floods) to the next.
		+	The time period of the routing of the following flows, where the reservoir storages will be transferred to the subsequent routing. This is normally set equal to NPER less IFCAST(J2.3). When a monthly operation follows the current short interval flooding, NPSTO must equal NPER.
4	CNSTI(1)	+	Factor which is multiplied times all inflows and local flows on the next IN Cards. Value in first field of J2 card is ignored.
5	FLDAT(1)	+	Date corresponding to the first flow on the next IN Card. The data is an 8 digit number (2 digits each for year, month, day, hour) such as 54120223 for December 2, 1954 at 11 p.m. Date on J3.3 will not be used.
6	EPER(1)	+	Last computation period, if different from NPER. Field 6 of the J1 Card is ignored. Use (KPER -1) or less (49 on UNIVAC 1108).

(1) These values are not read unless greater than zero, thus the previous values of these variables are used from the BF or J1 or J2 Cards.

BF Card - Continued

Field	Variable	Value	Description
7	IPER(1)	+	Time interval (Δt) in hours between flows on next IN Cards. Field 2 of J1 Card will be ignored.
8	NDAYWK	0	Starting day will be assumed equal to Sunday.
		+	Day of week corresponds to the first flow on the next IN Cards (1 = Sunday). Used in hydropower computations for power demand distributions less than or equal to a day.
9			Not used.
10	NFLCON(1)	+	Number of flood constants to be read on next card (FC Card must follow showing constants in field 1-9). CNSTI on BF card (4th field)is ignored. Maximum of 9.

* FC Card - Read only if NFLCON on BF card (BF.10) is positive.

Field	Variable	Value	Description
1-9	CNSTI	+	Ratios to multiply next set of flows read (IN cards) by to obtain additional system operations. NFLCON (BF.10) values are read.

(1) These values are not read unless greater than zero, thus the previous values of these variables are used from the J1 or J2 Cards or a previous BF card.

*Optional Card

IN

QA

** Card IN - Inflows or local flows for NPER(J1.1 or BF.2) periods. See BF.1 for card format for all flow data (IN, QA - PV).

Field	Variable	Value	Description
1	MM	+	Control point number. Equal to MM for RL and CP cards.
2	DATE	+	Starting date of flow in field 3 for identification only. Alphanumeric data such as: 6 June.
3	QII(I,M)	+	If ILOCAL(J1.8) is equal to 1, incremental local flows between M and the next upstream control points are read. If ILOCAL is equal to 10 or 15 observed gages are read and if = 20 or 25, natural flows are read.

Repeat IN cards for each control point in turn. IN cards for points not in system are ignored. Where IN cards are not read for a control point, flows are assumed = 0.

* QA Card - Specified reservoir releases for NPER(J1.1 or BF.2) periods for one or more reservoirs. Same format as IN cards.

Field	Variable	Value	Description
1	MM	+	Control point number.
2	DATE	+	Identification data (alphanumeric).
3+	QA(I,M)	0	Reservoir outflows for period I will be determined by computer.
		+	Reservoir outflows, in cfs or cubic meters per second for period I, specified by a positive number will be used instead of the computer-determined release. If a release of zero is desired, use .01. If specified release exceeds outlet capacity shown on RQ cards for corresponding storages on RS cards, release will be restricted to the appropriate maximum outlet capacity.

---

*Optional Card

**Required Card

* NQ Card - Base condition flows (normally natural flows but can be for an existing system) for NPER(J1.1 or BF.2) periods. Natural flows will be computed and printed, if these cards are omitted, and if FLONAT(J2.7) is set to -1.

Field	Variable	Value	Description
1	MM	+	Control point number.
2	DATE	+	Identification data (alphanumeric).
3-10	QPREP(I,M)	+	Base condition flows in cfs or cubic meters per second used for printout purposes and for expected annual damage base flows.

* MR Card - Minimum desired reservoir releases for NPER(J1.1 or BF.2) periods.

Field	Variable	Value	Description
1	MM	+	Control point number.
2	DATE	+	Identification data (alphanumeric).
3-10	QMIN(I,M)	+	Minimum desired reservoir release in cfs or cubic meters per second for reservoir MM, period I. Computer-determined releases will not be less than QMIN unless the reservoir is below level NLBUF(J1.7).

---

*Optional Card

EV
PV
EJ

* EV Card - Evaporation rates for reservoir MM only for NPER(J1.1 or BF.2) periods. Each rate will be multiplied by EVRTO(R2.3) if EVRTO is greater than zero.

Field	Variable	Value	Description
1	MM	+	Reservoir identification number.
2	DATE	+	Date of start of flood.
3-10	EVRATM(K,M)	+	Net evaporation minus precipitation rate in inches (or mm)/period over the reservoir area for each of NPER periods.

* PV Card - Power Requirements - By Period for Reservoir MM.

Field	Variable	Value	Description
1	MM	+	Reservoir identification number.
2	DATE	+	Identification date (alphanumeric)
3-10	POWR(I,M)	+	At-site power requirements in thousands kwh for each of NPER time periods. These values will override any values on PR, PD, or PH cards for this reservoir.

** EJ Card - Card read after last flow data.

Field	Variable	Value	Description
1-10			Not used.

I. Begin with T1 card for next job or use four blank cards after last job or if NFLRD(J2.5) is positive, enter next set of flow data, cards IN-EJ, (or BF-EJ card, if ED.1 is positive).

---

*Optional Card

**Required Card

CONTROL POINTS AND FLOW DATA

FOR

Raritan River Basin, Combined Projects
No. 3, Confluence Reservoir Pump Station
and Force Main; and No. 14, Round Valley
Reservoir Expansion

Control Point	Flow Data
1	IN Card
3	IN Card
2	IN Card
5	IN Card
6	126% of Control Point 5
7	IN Card
9	IN Card
10	IN Card
11	IN Card
12	100% of Control Point 13
4	1% of Control Point 9
13	IN Card
14	IN Card
15	IN Card
16	0.8% of Control Point 15
17	3% of Control Point 15
18	14% of Control Point 15
19	14% of Control Point 15
20	IN Card
21	IN Card
22	IN Card

CONTROL POINTS AND FLOW DATA

FOR

South River Basin for Project No. 80,
South River Ground Water Pumped
Storage Diversion

Control Point	Flow Data
20	IN Card
1	118% of Control Point 20
2	275% of Control Point 20
3	275% of Control Point 20
4	275% of Control Point 20

CONTROL POINTS AND FLOW DATA

FOR

Passaic River Basin for Project No. 40,
Two Bridges-Ramapo Diversion Project

Control Point	Flow Data
1	IN Card
2	IN Card
30[1]	None
8[2]	None
3	IN Card
4	IN Card
5	IN Card
56	100% of Control Point 5
6	IN Card
7	IN Card
11	IN Card
12	IN Card
13	IN Card
15	IN Card
14	IN Card
18	IN Card
22	IN Card
24	100% of Control Point 23
23	IN Card
19	IN Card
20	IN Card
21	IN Card
27	IN Card
28	IN Card
100[2]	None
150[2]	None
200[2]	None
210[2]	None
29	IN Card

[1]Canoe Brook Reservoir: Off Channel Reservoir system, negligible inflow.

[2]Dummy Control Point: Does not affect the flow regime but is needed in addition to regulate control points to model complicated systems.

CONTROL POINTS AND FLOW DATA

FOR

Passaic River Basin for Combined Projects No. 40, Two Bridges-Ramapo Diversion Project; amd No. 41, Monksville Reservoir with Ramapo Pump Station

Control Point	Flow Data
1	IN Card
2	IN Card
30[1]	None
8[2]	None
3	IN Card
4	IN Card
5	IN Card
56	100% of Control Point 5
6	IN Card
7	IN Card
11	IN Card
12	IN Card
13	IN Card
15	IN Card
14	IN Card
18	IN Card
22	IN Card
24	100% of Control Point 23
23	IN Card
19	IN Card
20	IN Card
21	IN Card
27	IN Card
28	IN Card
100[2]	None
150[2]	None
200[2]	None
210[2]	None
29	IN Card

[1]Canoe Brook Reservoir: Off Channel Reservoir system, negligible inflow.

[2]Dummy Control Point: Does not affect the flow regime but is needed in addition to regulate control points to model complicated systems.

CONTROL POINTS AND FLOW DATA

FOR

Rockaway and Whippany River Basins
for Projects No. 43, Washington Valley
Reservoir; and No. 44, Longwood Valley Reservoir

Control Point	Flow Data
1	19% of Control Point 5
4	IN Card
5	IN Card
56	100% of Control Point 5
6	IN Card
7	IN Card
2	691% of Control Point 7
3	691% of Control Point 7
8	150% of Control Point 5

CONTROL POINTS AND FLOW DATA

FOR

Manasquan River Basin for Project No. 76,
Upper and Lower Manasquan Reservoirs

Control Point	Flow Data
2	IN Card
3	144% of Control Point 2
1	7% of Control Point 2
4	144% of Control Point 2

NEW JERSEY

STATEWIDE WATER SUPPLY MASTER PLAN

TASK 3

WATER SUPPLY DEVELOPMENT STUDIES

SUBTASK 3D

ANALYSIS AND EVALUATION OF ALTERNATIVE PROJECTS

NEW JERSEY
STATEWIDE WATER SUPPLY MASTER PLAN

HAVENS AND EMERSON, INC.
PARSONS, BRINCKERHOFF, QUADE & DOUGLAS, INC.
WESTWATER, GASTON & DUNKA
WATER RESOURCES ENGINEERS, INC.
GERAGHTY & MILLER, INC.
— In Association —

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3-1188-03-1

November 1979

Letter of Transmittal

This report is our draft submission of Subtask 3D - Analysis and Evaluation of Alternative Projects. This report represents the second step of the three step evaluation process delineated in Subtask 3G - Recommended Plan Selection Methodology. Projects screened as realistic in the Subtask 3ABC output are subjected to more detailed analyses to select a set of preferred projects to be used in the water supply development programs of Subtasks 3E and 3F.

To orient the reader to the consultant's responsibilities, the following excerpt from the Scope of Work represents the contractual responsibilities for Subtask 3D.

TASK 3.D.

The Consultant will, on a region by region basis, analyze and evaluate alternative projects within each region taking great care to specify the positive and negative characteristics of each project; i.e. the monetary costs, technical conditions, environmental effects, social indications, and institutional and financial feasibility. (This analysis will provide a basic framework and data base for future detailed investment decisions.)

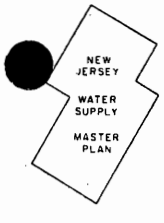
1. Special attention shall be paid (but not be limited to) the following review considerations and characteristics in the evaluation of individual projects:

   a. flexibility of projects to meet a variety of future conditions;

   b. evaluation of the phased development potential for individual projects;

   c. the potential for land development to impact upon the quality or quantity of water supply from a given project;

   d. the identification of projects which reflect major directions in decision-making;



2. The evaluations of this work item shall also address the following specific policy oriented questions:

   a. Re-analyze past decisions to acquire reservoir sites. Ascertain if these decisions are still applicable, and if additional sites should be proposed as additions to the State acquisition program.

   b. Conduct a detailed exploration of the degree and manner in which reuse of wastewater will influence or impact upon existing and future sources of water supply. In particular, study the advisability of continuing or revising the current State policy of transmitting raw water supplies in-channel, with particular focus on the impact to the quality of the water, emergency situations and conservation needs, and long term treatment costs.

   c. Evaluate the opportunities available to encourage the use of the Delaware and Raritan Canal for base load purposes in order to raise annual average use of this facility. Examine how pricing policies, substitution of supply, or conjunctive management opportunities of the various users could facilitate the achievement of this objective.

SUBTASK 3D

ANALYSIS AND EVALUATION OF ALTERNATIVE PROJECTS

SUMMARY

This Subtask 3D report provides for the transition between the data compilations of Subtasks 3ABC and the recommended programs of water supply development in subsequent Task 3 outputs. The pool of alternative, "realistic" water supply projects established in Subtask 3C is subjected to further analysis and evaluation in this output in terms of a variety of criteria, including technical feasibility, monetary costs, environmental and socio-economic impacts, implementation issues, and need. The merits of individual water supply projects are analyzed from the following perspectives:

1. The specific characteristics of the project itself, including its positive and negative factors, in terms of the evaluation criteria.
2. The "health" of the planning region, including existing resources, projected future demand, and the need for additional water supply development.
3. The comparative benefits of alternative projects and/or other water supply plans.
4. The policy issues which impact water supply decision-making.

Logically, those projects which are technically feasible, environmentally and socially acceptable, least difficult to implement, compatible with water policy directions, are appropriate to need, and represent the best alternative for satisfying needs are those projects which should be developed in an overall water supply program.

This Subtask 3D report addresses alternative water supply projects to the above evaluation criteria and perspectives, establishing the foundation for Subtask 3E program development. Projects are evaluated individually, with issues and decision-making perspectives discussed in terms of their overall influence. Based on these data and considerations, a selection of "preferred" projects is made for each of the six water supply planning regions in the State.

> IT IS EMPHASIZED, HOWEVER, THAT SELECTION OF A PROJECT AS PREFERRED DOES NOT RESULT IN REJECTION OF OTHER APPLICABLE PROJECTS. NEEDS, ECONOMICS, ENVIRONMENTAL POLICIES AND PHILOSOPHIES, INSTITUTIONAL FACTORS, SOCIAL ISSUES, POLITICAL DIRECTIONS, AND OTHER SUCH CONSIDERATIONS ARE PLANNING COMPONENTS WHICH DO NOT REMAIN STATIC AND UNCHANGING. PROJECTS DEEMED REALISTIC AND VIABLE IN SUBTASK 3C, BUT NOT SELECTED AS PREFERRED IN THIS OUTPUT, FORM AN ESSENTIAL RESERVE POOL OF "DEFERRED" PROJECTS AVAILABLE TO MEET NEW OR CHANGING WATER SUPPLY PROBLEMS AND NEEDS IN THE FUTURE.

In addition, projects are judged primarily in terms of their water supply benefits. Deferred projects may be viable for other primary uses (recreation, low flow augmentation, flood control, etc.); however, it is not the intent of this output to judge the suitability of projects for these other uses.

Water supply need represents a key factor in project planning. To provide for future water supply stability throughout the State, resources must be at least equal to and preferably greater than demands and distribution/transmission systems must be available to transfer those resources to the demand centers. In areas where existing resources are of ample capacity to meet future needs, additional supply development is unnecessary; in areas where additional water is required, but economics preclude transfers from major supply projects, development of small, localized resources may be the better alternative. Evaluation of projects therefore requires an analysis and

identification of need centers in the State. Since the need for water is influenced by a variety of factors (dissipation of existing resources, such as through contamination; augmentation of available resources, such as through conservation programs or wastewater reuse), it is necessary to establish base water needs as a starting point for evaluation and selection of water supply projects and programs.

Base water needs are developed from Task 2 demand projections as amended by the State. These needs are defined as the total of:

1. THE PROJECTED INCREASE IN DEMAND OVER 1975ACTUAL DEMAND PLUS
2. AN ESTIMATE OF UNACCOUNTED-FOR WATER QUANTITIES PLUS
3. EXISTING SHORTFALL QUANTITIES (THE AMOUNT OF WATER PRESENTLY CONSUMED IN EXCESS OF DESIGN SAFE YIELDS OF EXISTING RESOURCES; THESE QUANTITIES APPLICABLE TO REGION 1 AREAS ONLY, ARE CONSIDERED AS EXISTING NEEDS).

Table S-1 summarizes base water supply needs on a regional and county basis. Project (and program) selections are directed at satisfying these needs, which represent the quantities of water that must be made available to demand centers (counties) in order to ensure water supply stability. How needs may be satisfied requires analysis of two basic approaches: (1) reduce demands and (2) increase supplies. Although this output focuses on the latter, parallel consideration must be given to the former in ultimate plan development.

Lead time associated with the construction of a water supply project is estimated at 5-10 years. As such, it is assumed that projected needs up to the year 1990 will not be satisfied by any of the alternative projects. Rather, these "immediate" needs must be managed with alternate strategies (such as extended use of interconnected supplies, conservation efforts, system rehabilitation programs, etc.). Projects are therefore evaluated based on their

TABLE S-1

New Jersey Statewide
Water Supply Master Plan

PROJECTIONS OF BASE WATER NEEDS (MGD)*

Region	County	Base Water Needs - MGD				
		1980	1990	2000	2010	2020
1	Bergen	12.9	25.6	35.9	43.2	45.8
	Essex	27.7	26.4	28.0	34.1	36.3
	Hudson	12.6	12.6	13.6	16.5	17.7
	Hunterdon	0.1	0.6	1.3	1.7	2.1
	Mercer	1.1	2.7	4.3	5.2	5.5
	Middlesex	2.4	18.1	28.9	34.0	36.9
	Monmouth	0.5	1.2	1.8	2.1	2.2
	Morris	1.9	8.8	14.8	18.1	20.7
	Passaic	1.0	4.1	10.1	13.3	15.1
	Somerset	0.1	4.8	9.0	11.8	13.5
	Sussex	0.2	0.4	0.5	0.7	0.9
	Union	2.0	2.0	2.6	5.1	5.9
2	Monmouth	4.8	11.6	17.3	20.4	21.7
	Ocean	7.7	18.2	20.3	23.4	28.3
3	Atlantic	2.7	10.7	11.9	14.3	16.3
	Cape May	1.9	4.9	5.1	5.6	5.9
4	Cumberland	0.0	1.7	3.9	5.3	6.3
	Salem	0.0	0.3	1.1	1.9	2.3
5	Burlington	3.1	7.0	10.8	12.9	14.0
	Camden	0.9	4.5	9.5	12.3	13.3
	Gloucester	1.1	3.1	5.5	7.4	9.0
6	Hunterdon	0.2	0.8	1.7	2.3	2.8
	Mercer	1.8	4.3	7.0	8.4	8.9
	Morris	0.2	1.0	1.8	2.2	2.5
	Passaic	0.0	0.2	0.5	0.7	0.8
	Sussex	1.5	3.6	4.8	6.5	8.4
	Warren	0.2	1.2	2.0	2.9	3.5
Totals						
Region 1		62.5	107.3	150.8	185.8	202.6
Region 2		12.5	29.8	37.6	43.8	50.0
Region 3		4.6	15.6	17.0	19.9	22.2
Region 4		0.0	2.0	5.0	7.2	8.6
Region 5		5.1	14.6	25.8	32.6	36.3
Region 6		3.9	11.1	17.8	23.0	26.9
State		88.6	180.4	254.0	312.3	346.6

*Gross Needs

capabilities for satisfying short-term needs, or those needs represented by the year 2000 (10 year design) and "long-range" needs, to the year 2020.

Another key factor in project evaluation is water supply management strategy. The overall concern for New Jersey in this regard is threefold: Delaware River development; Hudson River development; and intrastate development. Evaluation of these alternative (but not mutually exclusive) "directions" for water supply decision-making involves critical institutional questions. In general, it is a finding of this report that intrastate resources offer the best approach for satisfying the State's needs in the near future, with Hudson River and new Delaware River options reserved for needs in the distant future.

Appendices to this Subtask 3D report provide specific evaluative data on each of the project alternatives listed as realistic in Subtask 3C. Water supply needs are established and policy issues and alternative water management schemes are discussed. These "perspectives" are combined in individual discussions of the six planning regions in order to select a set of preferred projects which directly addresses needs and issues appropriate to each region.

Summary conclusions and listings of preferred projects recommended for use in developing subsequent regional plans (Subtask 3E) are presented below:

REGION 1 (Northeastern New Jersey)

1. Existing water supply shortfalls represent current needs for Region 1. Purveyors presently overstressing their safe system yields must adopt supplementary supply measures or, in some cases, be prepared to curtail peak demand deliveries until major additional projects are developed.
2. Existing surplus resources in the Region are available to alleviate a portion of the Region's immediate (1990) needs.

3. The potential use of groundwater is limited to small, local development of this resource.
4. Table S-2 lists the major alternative projects to be considered in development of water supply programs for Region 1. The combined yield of these projects represents over 150% of the long-term needs in the region, providing flexibility in program development. Sufficient resources exist within the region without resorting to inter-region or inter-state transfer schemes.

REGION 2 (Monmouth, Ocean Counties)

1. Project development in Region 2 is measured only for Monmouth County and the upper portion of Ocean County. Remaining areas exhibit sufficient existing resources for meeting future needs, with some supplementary local groundwater development required.
2. The supply situation in Monmouth County is becoming critical, with additional supplies required for short-term and long-range needs. Anticipated groundwater problems (salt water intrusion and contamination) minimize future dependence upon this resource. The preferred project for this area is #76, the Upper and Lower Manasquan Reservoirs (estimated yield of 10 mgd for the Lower Reservoir, 25 mgd additional for the Upper Reservoir).

REGION 3 (Atlantic, Cape May Counties)

The need for regional or major water supply projects is not anticipated for this region. Future water supply stability is a function of prudent management of existing groundwater reserves and potential development of Wharton Tract reserves.

TABLE S-2

NEW JERSEY STATEWIDE
WATER SUPPLY MASTER PLAN

ALTERNATIVE WATER SUPPLY PROJECTS
REGION 1

ALTERNATIVE WATER SUPPLY PROJECT			NEED CENTERS POTENTIALLY SATISFIED BY PROJECT
Project Number	Project Name	Estimated Yield	Counties[a]
2	Raritan-Passaic Pipeline	80 mgd[b]	Essex, Hudson, Middlesex, Union
3	Confluence Reservoir, Pump Station and Force Main	50 mgd	Somerset, Union, Middlesex
7, 8	D&R Canal Improvements and Six Mile Run Reservoir	63 mgd	Mercer, Middlesex, Hunterdon, Somerset
14	Round Valley Reservoir Expansion	27 mgd	Somerset, Union, Middlesex
39, 40	Two-Bridges/Ramapo Diversion and Wanaque-Oradell Pipeline	79 mgd	Passaic, Essex, Bergen, Hudson
41	Monksville Reservoir and Ramapo Pump Station	25 mgd[c]	Essex, Hudson
43	Washington Valley Reservoir	7 mgd	Morris
44	Longwood Valley Reservoir	11 mgd	Hudson
77	Hackensack River Optimization	15 mgd	Bergen, Hudson
80	South River Groundwater Pumped Storage Diversion	15 mgd	Middlesex, Monmouth

(a) additional counties as transfer schemes permit.

(b) existing Round Valley Surplus

(c) Yield may be impacted by operation of Two Bridges/Ramapo Diversion

REGION 4 (Cumberland, Salem Counties)

Projected needs are low in this region and, like Region 3, groundwater resources are adequate to meet water supply requirements of the area.

REGION 5 (Burlington, Camden, Gloucester Counties)

1. Groundwater contamination, overdrafting and potential loss of existing resources in the Camden area have resulted in a critical water supply condition there and a solution should be implemented at the earliest possible date.
2. The alternative projects which have been identified as potential solutions to the problems in Region 5 are as follow:
   a) Development of the Wharton Tract (Project 131A). Anticipated yield is 25 mgd.
   b) Interstate transfer of water supplies via an interconnection to the Philadelphia, PA system (Project 139).
   c) Construction of an intake on the Delaware River (Project 140)
3. In view of the long lead time required for approval, planning, design and construction of the above projects, emergency measures should be used to protect existing groundwater resources and plans made to provide for alternate supplies that may be required.
4. Areas outside the Camden area are generally capable of meeting future needs from existing local resources and no major project development is anticipated.

REGION 6 (Northwestern New Jersey)

1. The needs of the southern portion of this region (Mercer, Hunterdon Counties) require no major project development, with existing access to the Delaware River providing sufficient resources for meeting future needs, complemented by local groundwater supplies.

2. The northern counties of Region 6 exhibit moderate needs for additional water supply development in the immediate and long-range future. Since the population of the Region is scattered along a narrow strip of the Delaware River Basin in New Jersey, selection of projects requires an optimization analysis of transmission schemes. The projects considered for Task 3E program development are as follow:

   a) Direct diversion of Delaware River supplies by individual purveyors (no storage)

   b) Ross Corner Reservoir (Project #60); 20 mgd yield

   c) Hackettstown Reservoir (Project #56); 40 mgd yield

   d) Shades of Death Reservoir (Project #65)

   e) Petersburg Reservoir (Project #66)

   f) Franklin Reservoir (Project #72); 14 mgd yield

   g) Beaver Run Reservoir (Project #73); 28 mgd yield

   h) Sussex North Reservoir (Project #74); 52 mgd yield

GENERAL

The evaluations and selections of preferred projects in this output match centers of need with potential centers of supply. The mechanics of bridging these two factors in terms of who will own, operate, and distribute the water derived from new resources is left, in part, to the subsequent Task 3 outputs and, in part, to future policy decisions of State agencies, individual water purveyors, and public interests. It is emphasized, however, that the intent of these analyses is to provide sufficient quantities of water to consumers. Although focus in this and other outputs may seem by the reader to be directed toward the needs of major water purveyors, many of the other purveyors will also benefit from the projects considered here. Local water supply development, not specified in this report, will be needed in many cases.

Development of major water supply projects must be accomplished in conjunction with other projects and will require coordination of other water related efforts (local supply development, conservation, rehabilitation programs, interconnection of supplies, etc.) and cooperation among a multitude of interests.

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SUBTASK 3D

ANALYSIS AND EVALUATION OF ALTERNATIVE PROJECTS

3D-1 INTRODUCTION

Efforts in Task 3 are directed at three primary objectives: (1) an inventory of water supply projects potentially available to satisfy water supply needs in New Jersey; (2) development of a methodology which can be used to evaluate the viability and effectiveness of proposed projects both currently and in the future and provide decision-makers with a mechanism for allocating capital expenditures for water supply development; and (3) use of this methodology by selecting alternative projects and recommending programs which are suitable for meeting immediate and anticipated water supply needs throughout the State.

The analyses conducted in this Subtask 3D phase of Task 3 comprise the transition between the pool of available water supply alternatives in the Subtask 3C inventory and the specific water supply programs recommended in Subtask 3E. In order to maintain a clear perspective on the role of these analyses in the overall Task 3 selection and evaluation process, capsule summaries of the components of this process are provided below.

3D-1.1 Project Inventory

The complete inventory of available water supply projects, including a detailed data file for each, is developed and presented in Subtasks 3A, 3B and 3C. The project list developed in Subtask 3A includes all known water supply alternative projects proposed in the past to meet either local or regional needs. The listing represents a wide range of projects designed for past, present and future water supply conditions. Beyond these alternatives,

other possible surface and groundwater projects were investigated and identified in Subtask 3B. Subtask 3C efforts concentrated on the development of a detailed data file for each of the projects in the inventory. Data in Subtask 3C are presented in two forms: (a) project description forms which summarize pertinent project characteristics and (b) a reference list citing sources of additional information available for detailed project evaluations. The project inventory is considered to comprise a complete listing of potentially developable water supply resources which are available to meet anticipated statewide water supply needs.

3D-1.2 Preliminary Project Screening

The wide range of projects presented in the inventory includes projects proposed for a variety of purposes and projects in varying stages of conception. Changes in water supply characteristics and directions in the State over the past thirty years or so make the design considerations of many of these projects inappropriate to existing and projected future conditions in New Jersey. In addition, many projects generally address small, localized supply needs and, although appropriate for such use, they are not major regional elements for this master plan study. It was determined in Subtask 3C, therefore, that a preliminary screening of the project inventory was necessary to eliminate from further consideration those projects which, because of obvious factors, are inappropriate in light of current and projected water supply issues in the State. Projects which manifest irreversible adverse environmental impacts, are redundant to an approved, developed project, are technically unfeasible, and/or are simply unnecessary in view of water supply need are screened out of the evaluation process. Almost half of the projects in the inventory are, in this regard, considered unrealistic. It is to be emphasized, however, that categorizing a particular project as unrealistic in many cases

does not eliminate the project from the inventory of alternatives. Just as changes in water supply issues over the past thirty years have caused these projects to be inappropriate at present, unforeseen changes in the next thirty years or so may necessitate their reconsideration.

3D-1.3 Evaluation Methodology

The evaluation methodology developed in Subtask 3G provides for the assessment of proposed water supply projects and programs in terms of monetary costs, technical considerations, environmental and socioeconomic impacts, and implementation. This methodology is intended to enable State decision makers to indicate the basis for determining and selecting worthwhile projects, while also evaluating the potential consequences of those decisions. The overall evaluation process employs a three-step procedure. The first step, project screening, as described in 3D-1.2 involved preliminary analysis of about 120 projects to result in about 60 realistic ones. The second step (Subtask 3D), involves evaluation of these projects against established criteria with more refined data than used in 3C, to result in approximately 20 regional projects. Step 3 (Subtask 3E) analyzes regional scenarios (combinations of projects) and utilizes the evaluations of step 2 to subject the projects to detailed analysis including refinement of calculated yield using a computer program to develop an overall water supply program. The plan selection methodology and evaluative criteria are summarized in Figure 3D-1 and Table 3D-1, respectively.

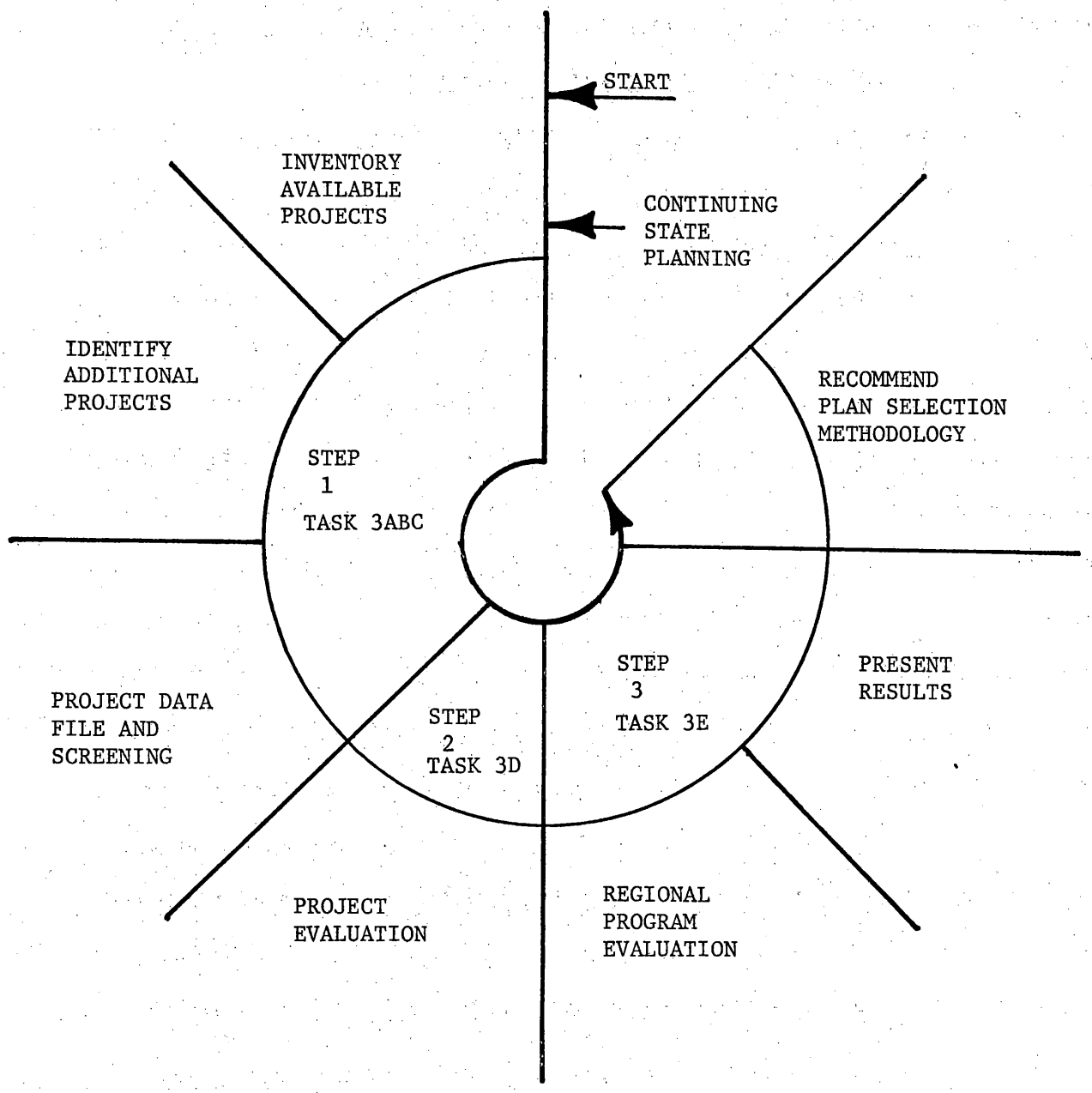


Figure 3D-1

INITIAL PLAN SELECTION METHODOLOGY

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

TABLE 3D-1

New Jersey Statewide
Water Supply Master Plan

SCREENING AND EVALUATION CRITERIA

CRITERIA	SCREENING (STEP 1) (TASK3C)	PROJECT EVALUATION (STEP 2) (TASK 3D)	REGIONAL EVALUATION (STEP 3) (TASK 3E)
I MONETARY COST			
1. Construction Cost		x	x
2. Operation and Maintenance Cost		x	x
II TECHNICAL CONSIDERATIONS	x		
3. Safe Yield		x	x
4. Capacity to Meet Needs		x	x
5. Flexibility		x	x
6. Ease of O&M		x	x
7. Reuse Potential		x	x
III ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS	x		
8. Ground Water Quality & Quantity		x	x
9. Surface Water Quality & Quantity		x	x
10. Ecology		x	x
11. Natural Resources		x	x
12. Resources Commitment		x	x
13. Cultural Resources		x	x
14. Induced Growth Effects		x	x
15. Displacement of Communities and Facilities		x	x
16. Recreation Potential		x	x
17. Employment		x	x
IV IMPLEMENTATION	x		
18. Major Direction in Decision Making		x	x
19. Institutional Arrangements		x	x
20. Financial Feasibility		x	x
21. Legal Constraints		x	x
22. Public Acceptability		x	x

3D-1.4 Subtask 3D Analyses

Analyses in this Subtask 3D report illustrate the application of Step 2 of the evaluation methodology to the pool of viable water supply alternative projects listed as "realistic" in Subtask 3C. Positive and negative characteristics of each project are identified in terms of monetary costs, technical conditions, environmental impacts, social effects and institutional feasibility. Other factors considered in this evaluation include project flexibility, potential for phased development, anticipated impacts of land development on water supply quality and quantity for given projects, and identification of projects which reflect major water policy direction and decision-making.

The additional evaluative information developed for each project is used conjunctively with specific regional water supply needs in the State to select a set of preferred projects (and alternates) with which regional water supply programs can be developed. Projects selected in this manner are considered to comprise the basic pool of alternative projects available to meet New Jersey's water supply needs for the next forty years. Where available, additional detail on these projects are developed for use in evaluating the coordinated water supply programs in Subtask 3E.

3D-1.5 Other Subtask 3D Evaluations

Providing for the water supply needs of the State requires consideration of the potential water resources available. New water supply projects such as reservoirs, wells, river diversion schemes, etc., are major alternative sources, consideration of which is a prime objective of this output. Potential for more effective use of water supplies also exists through such mechanisms as the distribution of current supply surpluses through interconnections, implementation of conservation programs, rehabilitation of distribution systems to reduce leakage, upgrading of existing supply

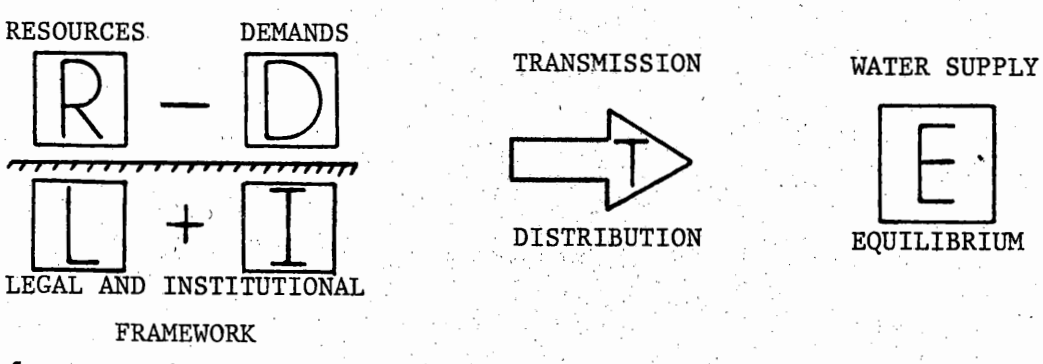
sources and impacts of wastewater reuse on existing and future supplies. These factors are addressed in this output and in Subtask 3E. In addition, state policies on acquisition of reservoir sites and major directions in decision making are discussed.

3D-2 WATER SUPPLY NEEDS

Evaluation of water supply projects and development of specific water supply programs are directly related to the need for water in the State. Subtask 3C presents a brief discussion of water supply needs in New Jersey; however, elaboration of the factors which influence those needs and a more detailed description of needs are presented in this output.

3D-2.1 Resources and Demands

Equilibrium in water supply can be attained through the proper balance of resources and demand, integrated by legal and institutional factors:



This, of course, is not a direct mathematical equation, but a means of illustrating that the equilibrium (E) or stability of the supply/demand relationship for water is a function of available water resources (R) compared to demand for water (D), as modified by the legal (L) and institutional (I) requirements. The transmission and distribution (T) of water between the resources available and the areas of demand is also a significant factor. In general, for water supply equilibrium to exist, resources must be

at least equal and preferably greater than demand and adequate distribution systems must be available to transfer resources to areas of demand. Satisfying demand is therefore a matter of ensuring adequate local supplies and/or of making available distant supplies through transfer networks.

The significance of applying water resources to areas of demand cannot be underestimated. To illustrate this point, total resources and demands in 1976 for purveyor supplied water in New Jersey (as reported in purveyor questionnaires) amounted to, on a regional basis, the following:

	Resources (MGD)	Demands
Region 1	890	760
Region 2	120	80
Region 3	75	30
Region 4	60	20
Region 5	220	105
Region 6	100	55

At this general level of analysis, it appears that New Jersey is in an enviable water supply position, with surplus supplies throughout the entire State. Similar analyses show that adequate resources are available to meet projected increases in demand in Regions 1 and 2 for the next 25 years and for the next 45 years in Regions 3, 4, 5 and 6.

More detailed analysis shows, however, that this is simply not the case. The surplus of 130 mgd in Region 1, for instance, is actually a combination of purveyor operating surpluses* of some 179 mgd and purveyor shortfalls of 55 mgd. Thus in Region 1, 55 mgd of demand was met not with

*See Section 3D-2.3.2, Page 17

surplus resources, but through utilization of some resources over available "safe yields." Whether or not surplus resources of some purveyors could be transferred readily to satisfy shortfall needs of other purveyors is not a simple determination and, in fact, an adequate transfer network of mains and interconnections may not be available. Therefore, supply surpluses in the various planning regions of the State must be considered in the context of local conditions and where increases in demand will occur in the future. In many instances, reported surpluses reflect supplies available for seasonal and peak demand periods, a condition particularly applicable to groundwater systems.

3D-2.2 Base Water Supply Needs

It is important to recognize that both resources and demands are not static factors in the equilibrium equation. Resources available may be modified by drought or other emergency conditions, contamination, overdrafting, and other influences. Demand, though predominantly a function of population and development in an area, may fluctuate because of conservation programs, seasonal factors and precipitation patterns. In order to establish a frame of reference for evaluating the State's future water supply requirements, however, it is necessary that several working assumptions be made and that base water supply needs be established as a starting point for evaluation. These assumptions are:

1. Existing water supply resources will continue to be available through the year 2020.*
2. Existing water supply surpluses are not generally available to meet increases in demand.[(a)]
3. Existing water supply shortfalls reported by purveyors are immediate needs which must be satisfied.

*Task 7C indicates that existing groundwater sources may be diminished in some areas, necessitating replacement from evaluated projects.

[(a)]Round Valley/Spruce Run and Trenton excepted from general rule.

4. Existing distribution system losses (unaccounted for water) represent immediate additional water supply requirements.

The impacts of the various potential influences on base water supply needs are discussed, for each region, as appropriate, under the various specific evaluations of this output and in Subtask 3E.

Estimates of 1975 freshwater demands and projected (medium range) increased demands for ten year intervals from 1980 to 2020 were proposed by the State using procedures developed in Subtask 2A for purveyor supplied water. Table 3D-2 summarizes these data by county. Base water supply needs are determined by totaling the following components:

1. Absolute projected increased in purveyor demands
2. "Unaccounted For" water estimates, and
3. Existing water supply shortfalls. (Overdrafts)

Projected increases in demand over the plan period are shown in Table 3D-2. Water supply shortfalls are determined from individual purveyor questionnaires and interviews with the major purveyors in the State. In general, purveyors which exhibited shortfalls serve several counties, requiring that the shortfall be apportioned to each county according to the percentage of the purveyors total supply to each county. Shortfalls were registered by purveyors in Region 1 only with 55.1 mgd apportioned as follows:

Bergen County	12.9 mgd
Essex County	26.4 mgd
Hudson County	12.6 mgd
Morris County	0.1 mgd
Passaic County	1.0 mgd
Somerset County	0.1 mgd
Union County	2.0 mgd

TABLE 3D-2

New Jersey Statewide
Water Supply Master Plan

Purveyor Demands - Fresh Water Intake (MGD)

COUNTY	1975	1980	1990	2000	2010	2020
Atlantic	15.6	17.6	23.6	24.5	26.3	27.8
Bergen	99.5	99.1	108.4	115.6	120.7	122.5
Burlington	25.6	28.1	31.2	34.2	35.9	36.8
Camden	46.4	47.1	50.0	54.0	56.2	57.0
Cape May	5.5	6.9	9.2	9.3	9.7	9.9
Cumberland	10.4	10.4	11.6	13.1	14.1	14.8
Essex	111.6	112.5	108.8	112.7	117.0	118.5
Gloucester	13.7	14.6	16.2	18.1	19.6	20.9
*Hudson	64.5	63.6	63.0	65.2	67.2	68.1
Hunterdon	4.8	5.0	5.8	6.8	7.5	8.1
Mercer	30.8	32.7	35.5	38.4	39.9	40.4
Middlesex	63.7	65.4	76.4	83.9	87.5	89.5
Monmouth	38.4	41.9	46.8	50.9	53.1	54.1
Morris	30.2	31.6	37.0	41.6	44.2	46.2
Ocean	16.7	21.7	28.5	29.9	31.9	35.1
Passaic	57.2	56.6	59.5	63.9	66.3	67.6
Salem	4.3	4.1	4.5	5.1	5.6	5.9
Somerset	21.2	20.8	24.5	27.4	29.4	30.6
Sussex	4.5	5.6	7.1	8.0	9.2	10.6
Union	68.4	68.2	67.6	68.8	70.6	71.1
Warren	5.1	5.2	5.9	6.4	7.0	7.4
State	738.1	758.9	821.0	877.9	919.0	943.0

*Fresh water distribution

Estimates of unaccounted for water (treatment and distribution losses, leakage, fire fighting, municipal use, metering inaccuracies, etc.) were made based on purveyor questionnaires, interviews with major purveyors, and literature sources. Loss factors are established on a regional basis as presented below:

	% Losses
Region 1	30
Region 2	35
Region 3	25
Region 4	30
Region 5	20
Region 6	35

Table 3D-3 and Figure 3D-2 present by county and planning region the additional base needs (over 1975 levels) for water throughout the State for the ten year intervals between 1980 and 2020. These needs represent the starting point for selection of water supply programs. The indicated needs must, in one way or another, be satisfied to ensure water supply stability in the State over the next forty years (alternative supply projects, local utilization of existing surplus resources either directly or through the use of interconnections, conservation programs, distribution system rehabilitation, and so forth).

In order to facilitate subsequent analyses of these needs and development of programs to satisfy needs, the concept of immediate, short term, and long range requirements for water is introduced. Obviously, the development, approval, and construction of major water supply projects require considerable time and effort. Opinions vary as to the length of the planning through implementation for such projects. It is assumed in this analysis, however, that a five to ten year time span is required before a new project can provide water supply benefits.

TABLE 3D-3

New Jersey Statewide
Water Supply Master Plan

PROJECTIONS OF BASE WATER NEEDS (MGD)*

Region	County	Base Water Needs - MGD				
		1980	1990	2000	2010	2020
1	Bergen	12.9	25.6	35.9	43.2	45.8
	Essex	27.7	26.4	28.0	34.1	36.3
	Hudson	12.6	12.6	13.6	16.5	17.7
	Hunterdon	0.1	0.6	1.3	1.7	2.1
	Mercer	1.1	2.7	4.3	5.2	5.5
	Middlesex	2.4	18.1	28.9	34.0	36.9
	Monmouth	0.5	1.2	1.8	2.1	2.2
	Morris	1.9	8.8	14.8	18.1	20.7
	Passaic	1.0	4.1	10.1	13.3	15.1
	Somerset	0.1	4.8	9.0	11.8	13.5
	Sussex	0.2	0.4	0.5	0.7	0.9
	Union	2.0	2.0	2.6	5.1	5.9
2	Monmouth	4.8	11.6	17.3	20.4	21.7
	Ocean	7.7	18.2	20.3	23.4	28.3
3	Atlantic	2.7	10.7	11.9	14.3	16.3
	Cape May	1.9	4.9	5.1	5.6	5.9
4	Cumberland	0.0	1.7	3.9	5.3	6.3
	Salem	0.0	0.3	1.1	1.9	2.3
5	Burlington	3.1	7.0	10.8	12.9	14.0
	Camden	0.9	4.5	9.5	12.3	13.3
	Gloucester	1.1	3.1	5.5	7.4	9.0
6	Hunterdon	0.2	0.8	1.7	2.3	2.8
	Mercer	1.8	4.3	7.0	8.4	8.9
	Morris	0.2	1.0	1.8	2.2	2.5
	Passaic	0.0	0.2	0.5	0.7	0.8
	Sussex	1.5	3.6	4.8	6.5	8.4
	Warren	0.2	1.2	2.0	2.9	3.5
Totals						
Region 1		62.5	107.3	150.8	185.8	202.6
Region 2		12.5	29.8	37.6	43.8	50.0
Region 3		4.6	15.6	17.0	19.9	22.2
Region 4		0.0	2.0	5.0	7.2	8.6
Region 5		5.1	14.6	25.8	32.6	36.3
Region 6		3.9	11.1	17.8	23.0	26.9
State		88.6	180.4	254.0	312.3	346.6

*Gross Needs

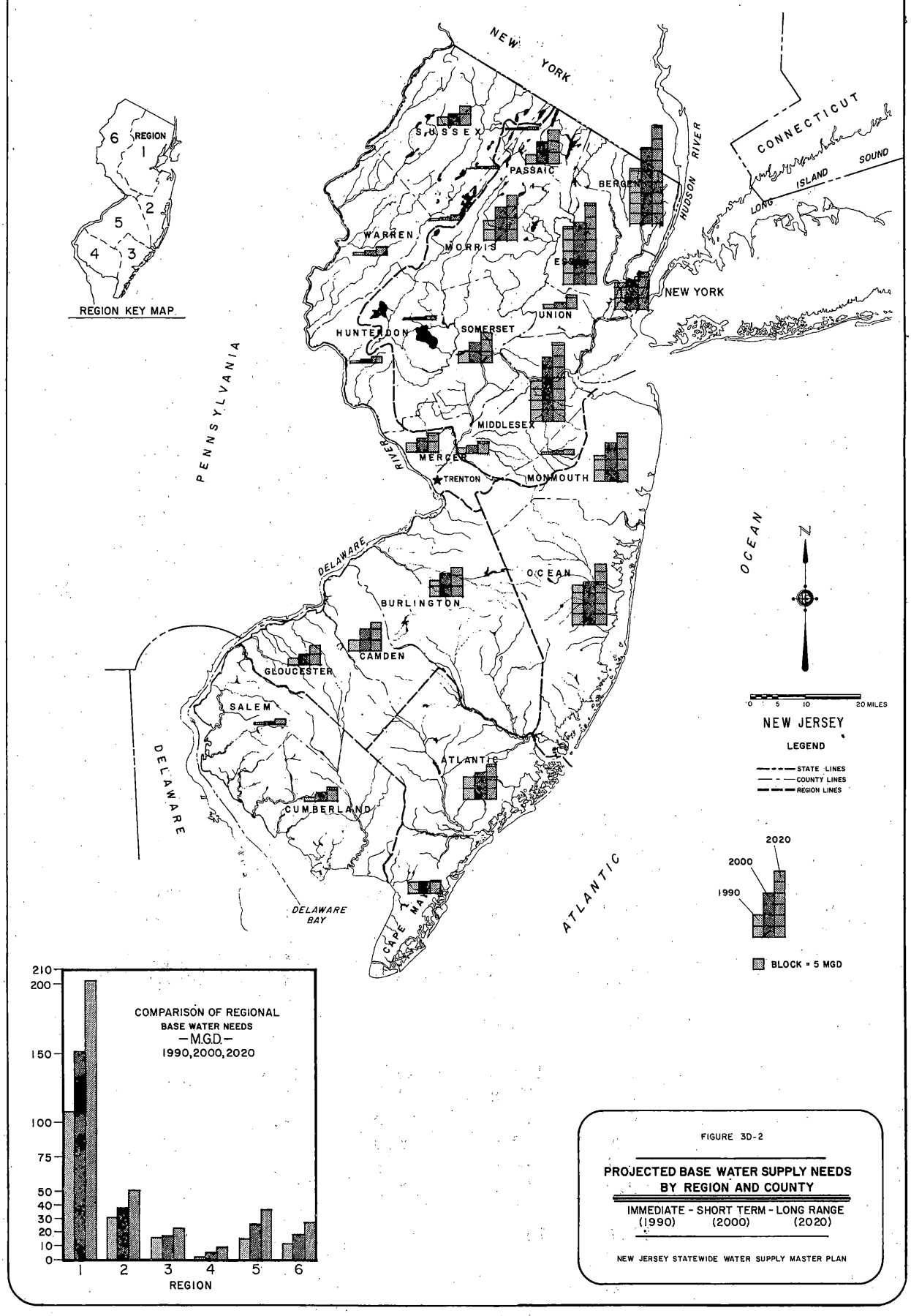


FIGURE 3D-2

PROJECTED BASE WATER SUPPLY NEEDS BY REGION AND COUNTY

IMMEDIATE - SHORT TERM - LONG RANGE
(1990) (2000) (2020)

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN

Immediate Needs

Assuming a lead time of 10 years for the planning, design and construction of a water supply project, it is seen that other measures will be required to provide for increased needs up to the year 1990.* These "immediate needs" are included in project evaluations only to the extent that they provide a perspective of the water supply conditions. Alternate supply plans for satisfying immediate needs are discussed in general in this output, with specific programs developed in Subtask 3E.

Short-Term and Long-Range Needs

A project which can begin to provide water in 1990 should be planned to satisfy needs in excess of that required for 1990. The limits of the plan, however, may vary widely from obsolescence (where the project capacity is surpassed by need after a short period of operation) to "overkill" (where the project capacity is much greater than the need for long periods of time). The former is a water supply disaster; the latter is an economic disaster. The criteria for project evaluation in this output involve the development of projects to meet the needs of an initial ten-year interval (1990-2000) and a subsequent interval to the year 2020. Design for the "short-term" is thus represented by year 2000 needs; and year 2020 needs represent "long-range" plan requirements. Phased development of a single project and combinations of short-term and long-range projects is an objective. Individual projects are evaluated based on their compatibility with either of these alternatives.

*The 1980's thus are critical years because the benefit of new projects cannot be realized immediately. Project development therefore cannot be viewed as a solution to New Jersey's immediate water needs. Interim contractual committments using existing limited surpluses and system interconnections or severe water use reductions must be employed until adequate new water supply sources, and system improvements where necessary, can be constructed and operated.

3D-2.3 Issues Affecting Needs

Section 3A-3 of this Task 3 report identifies a number of issues which influence resources and demands in the various planning regions of the State. In consideration of basic water supply needs, the two main categories of concern are:

(1) Those influences which result in the loss of existing water supply. The main issues in this category are water quality deterioration, disaster events and excessive drought conditions.

(2) Those influences which result in increases in available water, such as development of new resources, conservation programs, water reuse and utilization of existing but presently unused supply capacity.

3D-2.3.1 Loss of Water Supplies - Contamination of surface and ground water sources can have significant effect on the water supply balance in the State, although the magnitude of the potential problem is uncertain. Subtask 7C estimates for urbanized areas such as Essex and Bergen Counties and the City of Camden cite losses of between five and ten percent of all well capacity in the period of 1977 to 1990, primarily due to pollution and overdrafting. Issues surrounding emergency events and droughts are discussed in detail in Tasks 4 and 5. The importance of providing back-up supply capability as a safety factor for these conditions is critical to overall water supply programming. In general, however, these efforts require specific consideration of local vulnerabilities, preferably on an individual water purveyor basis. The role of transfer networks becomes increasingly significant in managing supplies during emergencies and droughts in excess of design and State activity in this area of water supply is necessary for the future (see Tasks 4E and 5C).

3D-2.3.2 Additional Water Supplies - a variety of alternatives exist for developing water supply resources. New water supply projects such as reservoirs, river diversion plans and groundwater development proposals directly augment supplies through development of "new water." Development of water supply projects is the main concern in this Subtask 3D report. Existing water supply surpluses, conservation programs, and reuse of wastewaters also offer potential for making additional supplies available to the resource pool either directly or through demand reduction.

Purveyor Surpluses

The term "surplus," as used in these Task 3 analyses, refers to the unused portion of a water purveyor's existing resources, based upon the safe yield of those resources. Reports of safe yield and water demand for 1976 were obtained from individual purveyors in the Task 1 questionnaires. Total average yearly demand (mgd) was subtracted from design yields of all supply sources to determine surpluses for each purveyor in the State. Where water is purchased wholesale by contract from another purveyor, this quantity is removed both from demand and yield data in order to analyze the surplus available in a purveyor's own resources.

Utilization of existing surpluses to meet increasing future water supply needs is limited by a number of considerations:

1. The system's requirements for meeting peak and seasonal loads. Surpluses based on average annual conditions do not reflect the hydraulic realities of a system operating over large demand fluctuations.
2. Transfer and distribution capabilities. To meet increasing demands, surplus supplies must be directly available to the location of those demands. Generally, needs which occur within the existing service area of a purveyor can be satisfied directly using surplus resources.

However, it is obvious that an existing surplus located in Passaic County is not likely available to meet a need in Mercer County. Transfer of surpluses using interconnections is a potentially significant alternative; however, as discussed in Task 4, the overall lack of data and interconnection planning presently precludes dependence upon interconnections for such transfers.

3. Demand fluctuations. Annual average demand figures utilized in the calculation of surpluses represent usage during 1976. Fluctuations in rainfall patterns, changes in service areas and land use within the areas, varying contractual demands and seasonal conditions all can influence water demand from year to year.

Surpluses therefore cannot be viewed as absolute quantities of available water. Rather, they represent calculated values specific to conditions which occur in a specific time period, in this case 1976. Applying surpluses to future needs must be considered on an individual purveyor basis. Although not absolute, surpluses considered on this basis are useful indicators of the supply-demand balance for a given purveyor and general conclusions can be drawn as to the purveyor's need for additional supply development.

Conservation

The impact of water conservation programs for lessening demand stresses and thus increasing the availability of supply is detailed in Task 6. Estimates indicate that effective conservation programs could, in the long range, potentially result in about a twelve percent (12%) savings in water use. It is emphasized that conservation programs do not represent a substitute for a program of water development to meet future projected needs. Historically, conservation has been important

as a cushion between supply and demand during unusual periods of stress and its value under these conditions should not be underestimated. Over time, should the actual impact of conservation prove to be significant, it will serve to extend the useful life of existing water supply resources. For these Task 3 analyses, conservation is viewed in its "buffer" role rather than as a direct means of satisfying future needs. Public response to conservation is susceptible to the price of water, the availability of water at any given time, and to the personal costs involved in implementing the program, making predictions of actual savings suspect. In addition to the speculative nature of conservation impacts, removing conservation as a cushion for unusual stress periods - should they prove unavoidable - could remove a significant response tool from water supply management during those times.

Wastewater Reuse

A variety of wastewater reuse options exist that can affect both the quantity and quality of water supply in an area. Wastewater reuse can be classified into two categories: direct and indirect reuse. Direct reuse refers to the use of wastewater effluent directly from the discharger without passing through any intermediate receiving water body. Examples of direct reuse include reuse of municipal effluent by an industrial facility for part of its production process or by a farm for irrigation. Indirect reuse refers to the use of wastewater effluent after it has been discharged into a receiving surface water or groundwater body. Examples of indirect reuse include use of surface waters containing upstream wastewater discharges or withdrawal of groundwater that has been replenished in some way by wastewater.

Direct Reuse

The potential for direct reuse of wastewater effluent in industry or agriculture depends on the availability, cost, reliability, and quality (absolute or relative), of supply. Direct reuse becomes feasible when wastewater is available in sufficient amounts, at a cost below that for obtaining water from natural or public water supplies, and at a reliable quantity and quality of supply. The demand for a given quantity and the cost of procurement and pretreatment of wastewater as well as the degree of pretreatment needed depend on the requirements of the user.

Industrial Reuse

Water quality requirements vary considerably among industries and even within different processes of the same industry. For example, higher quality water and, hence, greater degrees of pretreatment are generally required for boiler feedwater and process water than for cooling water. The feasibility of reuse must be examined, therefore, on a case by case basis.

Additional direct reuse of wastewater for industrial purposes is anticipated as water supplies become more scarce and expensive, and as wastewater quality improves (such as by actions of the Federal Water Pollution Control Amendments Act PL 92-500). For greater reuse of wastewater by industries, a competitive situation in which one of three conditions are satisfied must occur. These conditions are:

(1) Existing water supplies are limited or expensive;

(2) Significant expenditures are required to develop new sources of supply; or

(3) Wastewater effluent is treated to a higher quality than at present.

If one or more of these conditions exists, detailed investigations of the potential of direct wastewater reuse would be warranted.

In New Jersey, two areas appear to warrant further investigation of the feasibility of direct wastewater reuse: northeastern New Jersey and industrial areas along the Delaware. In northeastern New Jersey, many industries are located on saline water bodies thus limiting the availability of fresh water supplies. In instances where large volumes of wastewater are available from municipal treatment plants, some of the industries that obtain their water from public supplies might reuse the municipal wastewater effluent resulting in a net reduction of fresh water withdrawals. In some areas along the Delaware River, regional treatment plants will provide large volumes of high quality effluent. In instances where this effluent can replace industrial supplies currently coming from public sources, the time frame of availability of existing fresh water supplies will be extended.

Land disposal

Land disposal, which includes land application, recharge ponds and injection, can reduce the demand for public water supply or maintain groundwater quality. If a wastewater effluent from a treatment plant is spray irrigated on agricultural lands previously irrigated by publicly supplied water, a reduction in public water withdrawals will occur. In instances where wastewater effluent is injected into groundwater to prevent salt water intrusion, for example, groundwater quality can be maintained for public supply.

The costs associated with land application systems include land acquisition or leasing and the transport of the treated wastewater. Land application becomes economically feasible when the point of discharge is located close to the disposal site. Other considerations, such as the potential health hazards and public opposition associated with this method, however, require that each case be examined to determine the overall feasibility of land application.

In the case of deep well injection, treated effluent is injected directly into the groundwater aquifer. This method is often used to prevent salt water intrusion in coastal areas and to quickly recharge depleted groundwater levels. Because few, if any, pollutants are removed in the soil by deep well injection, the possibility of accumulating nitrates, phosphates, and other constituents in the groundwater should be assessed on a case by case basis before deep well injection is implemented. Monitoring quality during and after injection is a necessity.

Deep well injection of secondary treated wastewater has been performed in emergency situations in Long Island and California. In the densely populated regions of the New Jersey coast, deep well injection may serve as a potential, long range guard against salt water intrusion if geological conditions are appropriate. Injection of treated wastewater under current practices, however, is not economically or environmentally practical for long term use although it may be appropriate under emergency conditions.

Domestic Reuse

Reuse of treated wastewater for domestic purposes represents a potential saving of fresh water supply withdrawals. Types of domestic reuse include dual water supplies, direct potable reuse, and indirect wastewater reuse.

Dual water supply refers to a process whereby two sets of water distribution systems are provided. One set is used for high quality potable water, which accounts for approximately 5 to 10 percent of municipal water demand, while a second set is used for nonpotable supplies. Because of problems associated with the dual water systems, including health hazards in cases of

cross-connections, the large capital investment for distribution, and citizens opposition, dual water supply systems do not appear feasible under present conditions in New Jersey.

The implementation of direct potable reuse of wastewater also appears unlikely for New Jersey. This method has been used only twice--both under conditions of severe shortage--and has since been terminated. The acceptance of direct wastewater reuse for potable purposes in New Jersey seems unlikely, at least under present conditions.

Indirect Wastewater Reuse

Indirect wastewater reuse has been an ongoing practice in New Jersey for sometime. The major factors that determine the feasibility of this method are the quantity of wastewater in relation to the receiving waters, the quality of treated waste being discharged, the receiving water assimilative capacity and the subsequent water treatment costs. Highly treated wastewater can, under certain conditions, increase the flow of good quality surface waters and provide additional water for public supply.

The water quality factors of the effluent that determine its suitability to augment public water supply are the type and concentrations of pollutants. Effluent containing pollutants such as suspended solids that can be removed by water treatment plants may be suitable to augment public supply while wastewater containing nitrates, heavy metals, and other pollutants that are difficult to remove by treatment plants are typically not well suited as an addition to public water supply.

The effect of wastewater discharges on river quality depends on the original source of the water supply--surface waters from within the basin or subbasin, groundwater from within the basin, and interbasin transfers of water--each would have a different effect on river quality when the wastewater is subsequently discharged. Determining the impact of increases in wastewater discharge would require a case by case identification of the location of water supply sources, an account of the associated wastewater discharge points, and an analysis of the surface water--groundwater interactions within a particular basin.

Instream Transmission

Reuse and the use of instream transmission of raw water supplies are companion considerations. These concepts are already integral aspects of two major intrastate water supply systems on the Raritan and Passaic watersheds. In the Raritan Basin, releases from Round Valley and Spruce Run Reservoirs are transmitted downstream to Elizabethtown Water Company's intake at Bound Brook. At Little Falls, Passaic Valley Water Commission treats water containing discharges from wastewater treatment plants on the Passaic River.

Maximizing reuse in these two basins and at the same time using instream transmission may have related benefits which extend beyond water supply considerations. At the heart of this concept is a realization that wastewater treatment plants on the Passaic River must provide a high degree of treatment in order to maintain low-flow water quality standards in the River. The incremental cost of advanced wastewater treatment for the entire Passaic Basin must be considered along with the benefits of bringing additional freshwater supplies into the Passaic Basin from the Raritan system where a relative excess exists. Such an arrangement might benefit water quality to the extent that AWT requirements might be reduced and at the same time provide additional water supplies to several major northeast purveyors.

Simultaneous consideration of water quality and water supply benefits could represent a major direction in decision-making, and could cause an alteration in the ranking or priority of projects as benefits are adjusted over a broader range of users.

3D-2.3.3 Impact of Issues Affecting Needs - The various issues surrounding water supply needs in New Jersey complicate a direct quantitative projection of "actual need." The base needs shown in Table 3D-2 represent the best estimate to date of projected needs developed from a limited set of variables. Satisfying these needs is required if water supply balance is to be achieved throughout the State. However, it is necessary to recognize that these needs are highly variable depending upon decisions made in other aspects of water resource management (conservation, enforcement of water quality standards, reuse, etc.). Coordination of ultimate water supply management efforts will likely require some adjustments to these needs as other planning programs progress. Analyses of needs in terms of project development in this output include some adjustments where appropriate information is available. However, in general, alternative projects are evaluated based on their capacity to meet the needs presented in Table 3D-2. Projected water supply requirements have been determined in this and other task outputs and the function of Subtask 3D evaluations is to judge the ability of the alternative projects to meet these estimated supply requirements.

The variability of needs may also be influenced by one policy issue which is mentioned here to maintain perspective on the overall planning process. This issue can be summarized by the question "How much water should be made available to the State's population?" Obviously, there can be a wide gap between meeting needs and providing "All the water you want without waste, and on repayment of all costs." In general, individual purveyors

have established their own answers to this question. However, as the State's activities in water supply management may increase in the future, this question will need to be confronted by State decision makers.

3D-3 PROJECT EVALUATIONS

Where several alternative acceptable water supply projects have been identified in a region, a systematic evaluation of these alternatives is required to make selections from among them. Many standards are non-quantifiable, making much of the process judgmental and subjective. To reduce the possible influence of personal bias during the analysis, a standard set of criteria are evaluated and weighted to aid in arriving at project decisions.

Because the state is divided into six water supply regions, each with different requirements, it is necessary to be flexible in evaluation, but all criteria factors should be considered in every evaluation. Results are relative one to another. A project may not be superior when compared with another in a different region but it may be the only feasible one available, and thus be required.

3D-3.1 Methodology

The methodology of evaluation is directed toward arriving at a balanced program of water supply. The various stages are shown in the Figure 3D-1 and criteria are listed in Table 3D-1. These individual steps in the process are further described along with certain caveats concerning indiscriminate reliance upon them. The evaluation process is a dynamic one which necessarily must be capable of being updated when conditions warrant. Procedures for such future evaluations will be found in the output for Task 3G.

3D-3.2 Criteria

The basic criteria for project evaluation are listed in Table 3D-1. The titles disclose the contents of the criteria in a general manner. Additional information, to further define the extent and dimension of the criteria is offered. Four basic areas of concern are identified:

1. Monetary Cost
2. Technical Considerations
3. Environmental and Socioeconomic Impacts
4. Implementation

These areas are broken down into sub-criteria for a more detailed examination. Additional elaboration of certain sub-criteria are provided where appropriate.

3D-3.2.1 Monetary Costs - The projects are evaluated on both capital and operating costs where available. The sub-sections of these categories should be broadly interpreted to encompass all associated costs whether or not specifically stated.

1. Capital Costs - Capital costs for projects consist of site acquisition costs, construction costs, design costs and associated legal, financial and administrative costs. These expenses are costs of building a project.
2. Operation and Maintenance Costs - These costs are also known as annual costs because of their recurring nature. The broad categories include amortization and interest payments on borrowed capital; taxes (where applicable); personnel cost such as salaries, wages, fringe benefits; and chemical supplies, repairs, materials and power costs.

3. Depreciation, return on investment and other costs are involved when investor-owned utilities participate, but were not used in the comparative cost analysis.

For evaluation purposes reported costs have been updated to current levels by application of appropriate indices or cost curves where available. Where information would be misleading, or cause undo reliance on insufficient data, this evaluation has been omitted or so noted.

3D-3.2.2 Technical Considerations - All projects must be evaluated on the basis of anticipated performance to provide satisfactory service. Five particular areas of investigation are: safe yield, capacity to meet needs, flexibility, ease of operation and maintenance, and reuse potential.

1. Safe Yield - The drought of record, generally 1960's drought period, is used to determine the safe-yield of the various projects although synthetic hydrology may be used to establish an alternate yield (See Task B). Limitations, such as competing water uses, existing demands and stream flow requirements are considered in arriving at the yield obtainable. Ground water yields are evaluated.
2. Capacity to meet needs - Water supply needs and safe yields are compared to determine whether needs are met and potential schedules for implementation of projects and alternates may be established. The needs have been determined on a regional and county-wide basis, without regard to existing surpluses within the regions.
3. Flexibility - Projects capable of staged construction and expansion to meet a wide range of future conditions are highly preferred.

4. Ease of Operation and Maintenance - Favorable consideration is given projects that are relatively simple to operate, that impound waters requiring little treatment compared to others, and that are compatible with existing facilities. Gravity operation and closeness of the facility to point of demand are important considerations.

5. Reuse Potential - Projects situated where indirect water reuse is feasible receive additional consideration in the evaluation process depending on the value of the potential.

3D-3.2.3 Environmental and Socioeconomic Impacts - The evaluation of environmental and socioeconomic effects of the water supply alternatives selected in Task 3C focuses on generic impacts. These impacts are given a broad type of analysis because of limited baseline data for almost all of the projects as well as the scant design information for many of the alternatives. Site specific data is employed where available, and most of the analyses of environmental and socioeconomic effects attempt to indicate in some manner the magnitude of the impacts. Nine impact categories are specified:

- construction - effects of construction activity such as increased erosion and sedimentation, air and noise pollution from construction equipment, etc. These are temporary in nature and are related to the duration of construction.
- displacement - displacement of families, businesses and facilities.
- economic development - the incremental supply or service area to be provided for and short and long term employment engendered by the project.
- uses/purposes - water supply, pumped storage, hydroelectric power, recreation, etc.
- transportation - disruption of traffic routes by relocation to avoid inundation, and due to laying of transmission lines, construction activity, etc., usually temporary in nature, except route relocation.
- visual quality - the improvement or deterioration of visual quality as a result of the project.

- terrestrial and aquatic life - effects on biota due to land clearance and vegetation removal; disruption of natural habitats, migration routes, and spawning areas, change in biotic activity, etc. These can be temporary (construction) or permanent in nature.

- water quantity and quality - changes such as increased surface water turbidity, temperature, or flow velocity, drainage realignment, etc. Impacts could be temporary or permanent.

- land use - extent of land requirements for transmission, treatment plants, impoundments, etc.

3D-3.2.4 Implementation - Criteria considered under this general category include financial feasibility, legal constraints, institutional arrangements, public acceptance, and major directions in decision-making. Not all of the projects under consideration are directly amenable to full analysis of these implementation variables. A number of projects are in the conceptual phase of development; others are well advanced.

3D-3.2.5 Major Directions in Decision Making

An important aspect of project evaluation involves those projects which require major directions in decision-making; i.e., focusing of or modifying water supply management policy. Major directions in decision-making can be most simply understood by reviewing the physical development options available for providing additional water supplies. From a strategic point of view, there are three major development assumptions which can be examined to assist in evaluating the feasibility of the alternative projects. The three major assumptions are: Delaware River development presumed; Hudson River development presumed; and only intrastate development presumed. Each of these broad options is examined below:

Delaware River Development

Projects for developing the mainstream of the Delaware involve either high-flow skimming or continuous withdrawal of upstream reservoir releases.

In light of the controversy surrounding the Tocks Island Lake Project, the possibility of onstream development is questionable within the foreseeable time frame of this plan. In order for high-flow skimming to be considered, low-flow releases would also have to be provided if the water was exported from the basin. Such releases might come from the letdown of reservoirs constructed in the northwest section of the State, where numerous sites have been identified. Projects proposed for these areas require both DRBC and WP&SC approval. Gaining these approvals in light of an identified negative public attitude toward reservoirs which exists in the northwest counties (particularly Warren) may represent a very substantial hurdle. Only Hackettstown Reservoir, which has been under acquisition for several years, is likely to be implemented in the near future when and if required.

In addition to providing the prospect of new water development, proposed reservoirs in northwest New Jersey may also be required to defend New Jersey's claim to 100 mgd under the 1954 Supreme Court Decree, presently being diverted in part through the Delaware and Raritan Canal. One of the provisions of that decree has to do with the need for New Jersey's claim to be supported by compensating releases.* The yield from the Tocks Island Project would meet this need, plus also produce additional yields of water for New Jersey, Pennsylvania, and New York.

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*It should be understood that this is a point of controversy. The Supreme Court intended that any party to the Delaware litigation was permitted to petition the Court to reopen the Decree. However, the execution of the Compact in 1961 included a bartering away of the right of any of the four States party to the agreement to go back to the Court on its own for the life of the Compact except for very limited purposes. According to some accounts, a party to the Compact may go back to the Court to enforce provisions of paragraph V.B. of the Decree, which deals with New Jersey's permitted diversion and requirements for construction of certain public works by New Jersey.

The Tocks Island Lake Project (though located in Region 6, TILP would provide substantial supply capability for Region 1) has undergone extensive review and debate. The Delaware River Basin Commission did not support appropriation of construction funds (July 1975) and the U.S. Army Corps of Engineers recommended that the project be deauthorized by Congress. It is not the intent of this task analysis to attempt resolution of the Tocks Island controversies, however, in view of available data it is concluded that:

1. The design yields of the Tocks Island Lake Project and similar alternate schemes are in excess of projected long-term (2020) needs in Region 6 and Region 1.
2. The needs of northern New Jersey (Region 1 in particular) can be met by other projects which appear to have less controversy and which more directly satisfy the needs in specific demand centers.
3. Development of several smaller (yield) projects to satisfy the needs in Region 1 provides flexibility in the management of New Jersey's water resources and also permits the opportunity for phased development of those resources.
4. The present controversies over Tocks Island Lake Project, the possibility of its deauthorization and interstate debates over allocation of Delaware River waters do not present the Project as a sound foundation for water supply management in New Jersey.

With the present status of the Tocks Project, New Jersey may have to find alternatives to meet its obligations under the Decree, should it be called upon to do so. If such a situation develops, projects proposed for the northwest counties would assume increased significance, since the prospect of obtaining water from Pennsylvania or New York is remote, and the continued diversion of Delaware water to the D&R Canal would be essential to meeting the water needs of several central Jersey users.

High flow skimming of Delaware water, in addition to requiring compensating releases for water exported from the basin also necessitates extensive intrastate expenditures for pumping, transmission and storage facilities. State approvals for these facilities would be limited to the Water Policy and Supply Council. The multifaceted nature of the entire project indicates that the State would be the logical sponsor.

In summary, the prospect of significant Delaware River development does not represent a likely prospect under present institutional conditions. The need for compensating releases, opposition in the northwest counties and other approval related factors contribute to this conclusion. The need for development in the northwest counties could shift if New Jersey were forced to support its withdrawal of up to 100 MGD for the Delaware and Raritan Canal. The one exception to this conclusion is the proposed Hackettstown Reservoir, with lands presently being acquired, based on legislative authorization.

Hudson River Development

The limited likelihood of a large project being developed on the Delaware for New Jersey raises the importance of the State maintaining a role in any future Hudson River project. The prospect of regional benefits, shared between

New York and New Jersey, broadens the basis of support needed by the likely project sponsor, the Corps of Engineers, to gain approval, authorization and eventual funding of very expensive project alternatives.

The importance of New Jersey maintaining a role in Hudson River development is underscored by the fact that such a project represents at present the only single substitute for the 300 MGD which New Jersey would derive from the Tocks Island Project. Strategically, a Hudson River project could also be used to substitute for present surface supplies impacted by declining water quality from growth and development. However, a decision not to participate in Hudson development would leave only intrastate sources for development in the future in response to needs which may or may not be anticipated.

The other factor worthy of consideration regarding Hudson development is that New Jersey cannot pursue this option on its own. New Federal legislation, an appropriate organizational entity and some form of approval would be required. Corps sponsorship eliminates this institutional restraint, while at the same time providing the possibility of significant Federal financial participation, an absolute necessity.

On a smaller scale, Hudson River development can be pursued through development of withdrawal and storage projects in the Wallkill Basin for use within the basin, or transmission to the urban areas. Rapid development in Sussex County, the formulation of an extensive sewerage project, and the presence of a county wide institutional entity for water management - the Sussex County Municipal Utilities Authority - suggest out-of-basin use will be heavily opposed if such an arrangement were advanced.

Maximizing Intrastate Development

In the absence of Hudson or Delaware River development projects, the third major option available for meeting New Jersey's needs for additional water would involve maximum development of intrastate sources. Of course under certain circumstances some localized projects would be implemented regardless of any interstate development.

Intrastate projects should be implemented with an eye toward meeting defined needs, preserving options for the future (especially those which might be identified with interstate water), and adding to the flexibility of New Jersey's water supply network to address an uncertain future. Such an approach deals with near future needs while maintaining an eye toward resolving long term demands which might require major new supplies.

Conclusions on Major Directions in Decision-Making

1) Intrastate pursued as the principal near term development strategy
2) Keep open Hudson option because of potential large supply benefit; and
3) Beware of the possible responsibility on the Delaware and the need to develop northwest water as a response to this consideration.

Evaluation of projects from an institutional and financial perspective considers compatibility with the several evaluation criteria concerning the major directions in water development decision-making discussed above. Compatibility with the general strategies for water development is a necessary condition for qualifying projects for a more detailed scrutiny of institutional and financial characteristics.

Another institutional consideration in project evaluation is whether or not the project has a sponsor (i.e., a government entity or a purveyor). Other aspects impacting institutional qualities of a project include

the present project status (stage of development), approvals that have been sought and/or required, and the support and opposition which have been identified for the project. Financial matters at present do not represent strong factors in the evaluation since, generally, if a project is not beyond the design stage, financial information is not available except on a general estimate basis (or from updating previous estimates to current levels using appropriate indices or cost curves). Financial considerations (in addition to cost estimates of Section 3D-3.2.1) include for this evaluation the sources of funds/financing, the status of funds/capital, and pay-back arrangements.

3D-3.3 Evaluation Constraints and Data Presentation

Certain data have been found to be incomplete, or non-existent. The inclusion in Tasks 3A and 3B of all manner of projects has illustrated this situation. Well-documented and well-defined projects co-exist with those that have little or no documentation.

Detailed environmental impact statements are required before construction begins but, unless currently available, these cannot be made a part of this evaluation. Environmental impact statements are typically exhaustive investigations of all environmental aspects of the project. Criteria developed for this evaluation are meant to provide an overview of possible environmental problems that are foreseeable. Approval and recommendation in the Master Plan does not necessarily mean that a project can be designed and built. Extensive future environmental studies are required which may indicate necessary reassessment of decisions.

Institutional and financing problems may prove more difficult and durable than preliminary analysis indicates. Changing requirements of construction engendered by conditions uncovered in engineering design or environmental impact studies could cause significant shifts in institutional and financial outlooks.

Evaluative data for the sixty-four projects in the Subtask 3C pool of "realistic" alternatives are provided in the first three appendices to this output. These appendices include data on costs, technical conditions, socio-economic factors, and institutional and financial considerations, presenting both positive and negative aspects for each.

Appendix 3D-I: the list of sixty-four projects is reproduced from Subtask 3C for reference. In addition, data entries are defined, as appropriate.

Appendix 3D-II: evaluative data for the surface water projects under consideration are presented.

Appendix 3D-III: evaluative data for the groundwater projects under consideration are presented.

3D-3.4 Regional Analyses of Realistic Projects

Preferred Projects

Water supply project alternatives available to satisfy the diverse regional needs in the State are described in Subtask 3C and in previous sections on this Subtask 3D report. The following analyses are intended to refine the listing of realistic projects from a total of 60 in order to select a set of preferred alternatives which best address the requirements for water in each region. It is reemphasized that all of the projects deemed realistic in earlier analyses are considered viable potential alternatives for water supply. That some of these are selected as preferred is a reflection of present understanding of the needs and issues involved in water supply planning in New Jersey. Needs, economics, environmental rules, regulations and philosophies, institutional factors, social issues, political directions and other such considerations, however, are planning components which do not remain static and unchanging. Selection of a project as preferred is not intended as rejection of other applicable projects. Rather, maintaining data on these "other" projects is considered essential if planning agencies are to be equipped with a viable reserve of alternatives which can be drawn upon to meet new water supply problems and changing needs.

In general, the selection of preferred projects is based on the specific water supply "equilibrium" of each planning region. This balance in a region is most visible when its projected need for water is compared to the availability of additional supply to satisfy this need. In some cases, regional needs are relatively small and they can be satisfied from existing supply resources without development of new major water supply projects. In other areas, development of new water supply projects is overdue and concentrated planning efforts are necessary to ensure adequate supplies in the near future.

Base water supply needs on a county level are presented in Section 3D-2.2 of this report. Although projections of need are based on county, the specific needs of water purveyors operating within the county must be considered in the project analyses. Development of projects concentrate on satisfying centers of need for the benefit of all purveyors, both large and small, operating within a county. Ultimately, regional perspectives are required. However, for ease of evaluation it is generally assumed that the supplies provided by new projects are most efficiently distributed by purveyors with the largest service areas to the benefit of the greatest portion of the population (in their own areas and in the service areas of smaller interconnected purveyors). It is also expected that a significant portion of water use increases will occur within or near existing demand centers, i.e., those areas served by the major purveyors in the region. A general analysis is therefore conducted to estimate the extent to which county needs represent the localized needs of the larger purveyors. Needs of isolated, small, independent water companies in many cases can best be satisfied through local development of resources, since distribution systems and interconnections simply do not exist to transfer waters from a project serving a major population center; and economics do not justify construction

of such transfer networks. Preliminary evaluations of alternative water supply projects are therefore carried out in terms of compatibility with the needs of the region's largest purveyors.

One particular advantage to the analysis of projects in terms of purveyor needs is that some water supply surpluses reported by purveyors can be applied as direct sources of additional supply; similarly, areas of reported deficits can be addressed with greater focus. The disadvantage of this approach is that estimates of purveyor needs can only be developed on a very general basis and therefore may not accurately reflect actual conditions. Although county needs are apportioned to individual purveyors based upon actual reports of municipalities served, they do not include the variety of considerations included in Task 2 demand projections (the basis of county need projections). Nor do they include other factors such as changes in service areas through franchising, contractual modifications, purveyor acquisitions, etc. Nevertheless, the degree of accuracy available is considered sufficient for these analyses.

The regional analyses presented in the following pages provide a foundation for establishing a set of preferred water supply projects to be used in detailed planning programs of Subtask 3E. It is to be recognized that, in many cases, details of the projects discussed are incomplete. Few of the alternatives have undergone extensive official reviews and environmental evaluations. All, however, are considered technically feasible and responsive to anticipated water supply needs.

Deferred Projects

In evaluating water supply projects, an important criteria is that the project satisfy an immediate or foreseeable need. If it does not do this, water derived from it will not be used, will not be sold, and represents a misdirected commitment of resources. Costs resulting from the project have to

be met from sources other than users, to the detriment of the general economy.

The future requirements, beyond 2020, are not easily defined. Experience over the last century would indicate a continuing growth in water demand. This prospective growth may be satisfied by those projects presently conceived but not required. Reservoir sites reported on in the 19th Century by C.C. Vermeule, not yet built upon, might not be required until the 21st Century.

The concept of deferred projects is one of husbanding a catalog of sites and options against the day of need. It is necessary to have a reasonable expectation that the project can ultimately be built. Further, the interim use of sites should be productive, useful and reasonably suitable for change. Sites definitely not needed should be put to the most productive use, subject to the requirements of society, and not held back.

Tocks Island Lake Project (TILP)

Tocks Island as conceived in the 1950's was heralded as a solution to New Jersey's water supply problems as well as a flood control measure power generating and recreational facility. The lake would be formed by construction of a 160 foot high dam at Tocks Island, five miles north of the Delaware Water Gap. The reservoir would stretch 37 miles up river to Port Jervis, New York. With flood control storage utilized, 275 billion gallons would be stored. Normal water supply would be 139 B.G. active storage with another 31 B.G. permanent. A water supply elevation of 410 above msl was projected.

The impoundment at Tocks Island would provide New Jersey with 300 mgd in addition to the presently authorized 100 mgd diversion. Also, the project would maintain 3000 cfs in the Delaware River at Trenton, which is believed to be necessary for salinity control of the tidal Delaware.

The total water supply needs for New Jersey in 2020 are seen as 346 mgd above 1975 levels. Of this, 203 mgd are in Region 1 which would receive the major amount of TILP water. Needs generated by Delaware Basin communities are generally nonconsumptive, returning large portions of water to the river. Other needs, along the South Jersey coast are beyond the economic service areas of purveyors who would receive Tocks Island water.

Future needs could amply be satisfied by this project. The recent naming of the Tocks Island area of the Delaware as a "Wild and Scenic River" may still permit the TILP or other major water supply projects on the Delaware in the future.

Deferring the Tocks Island Lake Project negates those projects directly dependent upon it. Each of them must be considered separately to see if it is an essential means of transferring TILP water to Region 1, but as transmission facilities, the precise mechanism and location are not as critical as the source of water.

Hudson River Projects

These projects are of similar magnitude to TILP as regards yields intended for New Jersey. The size of the projects makes activation of any one subject to cooperative efforts with New York City and State.

As most of the project construction is in New York, New Jersey does not have the same magnitude problem as with TILP. New Jersey needs to review its needs from time to time relative to the Hudson, most importantly when New York requires additional supplies or when other major decisions regarding supplies must be made.

Other Deferred Projects

The combined yields of alternative projects in each region are sufficient to meet projected future needs. Selection of projects for Subtask 3E plans will leave a residual of projects which are not required for the planning period. In addition, some projects are either/or alternatives; selection of one makes another unfeasible or redundant. Viable projects not selected in Subtask 3E should be retained in a pool of (deferred) potential projects as long as is reasonable. (See Section 3D.5 for reservoir site acquisition or reservation recommendations.)

3D-3.4.1 Analysis of Region 1 - Region 1, situated in the northeastern portion of the State within and adjacent to the Greater New York Metropolitan Area, is by far the most complex region of New Jersey. It includes the drainage areas of the Hackensack, Passaic and Raritan Rivers and parts of the Hudson River, Newark Bay and Arthur Kill.

Region 1 consists of all or parts of twelve of the State's twenty-one counties; all of Bergen, Essex, Hudson, Middlesex, Somerset, and Union Counties; most of Morris and Passaic Counties; and portions of Hunterdon, Mercer, Monmouth and Sussex Counties, and occupies a total area of some 2200 square miles. Over two-thirds of the major purveyors in the State, and a large number of smaller purveyors are located within the Region. Obviously, institutional considerations will have a significant impact on the management of resources in the area. Additional institutional issues involve rivers and streams which originate (and are being used for water supply) in New York State, and issues surrounding proposed uses of Delaware River and Hudson River waters for Region 1 supplies. Effective solutions to the water supply problems of Region 1 will require, of necessity, cooperative efforts of a multitude of interests.

The immediate needs (1990) for Region 1 are approximately 107 mgd, increasing to 203 mgd in 2020. These needs represent almost sixty percent of the needs for the entire State. Supply shortfalls in the Region in 1976 amount to 55 mgd, derived from analyses of questionnaire data and reports of major Region 1 purveyors:

Newark Water Department	28 mgd[(a)]
Hackensack Water Company	16 mgd
Jersey City Water Department	11 mgd[(b)]
	55 mgd

Purveyor reported surpluses in the Region amount to some 179 mgd. The systems contributing to these surplus supplies include the following:

Passaic Valley Water Commission	25 mgd
Elizabethtown Water Company	14 mgd
Middlesex Water Company	8 mgd
Commonwealth Water Company (CD)	7 mgd
New Brunswick Water Department	7 mgd
Others (over 50 smaller purveyors)	118 mgd
	179 mgd

It is emphasized that direct transfer of surplus supplies to some areas of supply shortfalls is not feasible.

Analyses conducted in Subtasks 3ABC indicate that a sufficient number of alternative water supply projects exist within Region 1 borders and among various Delaware and Raritan Canal schemes to satisfy projected long-term regional needs without tapping additional Delaware River or Hudson River supplies. Needs

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(a) Newark: Overdraft of Pequannock Supply (-21.5 mgd); unused Wanaque allotment (+3.5 mgd); purchase (-10.0 mgd)

(b) Jersey City: Overdraft of 3.5 mgd plus 7.5 mgd letdown requirement from Boonton Reservoir

beyond the year 2020 may require use of the Delaware and Hudson Rivers and future planning efforts should not exclude their consideration. However, for subsequent discussions, it is determined that it is better to meet the Region's needs from projects within the Region.

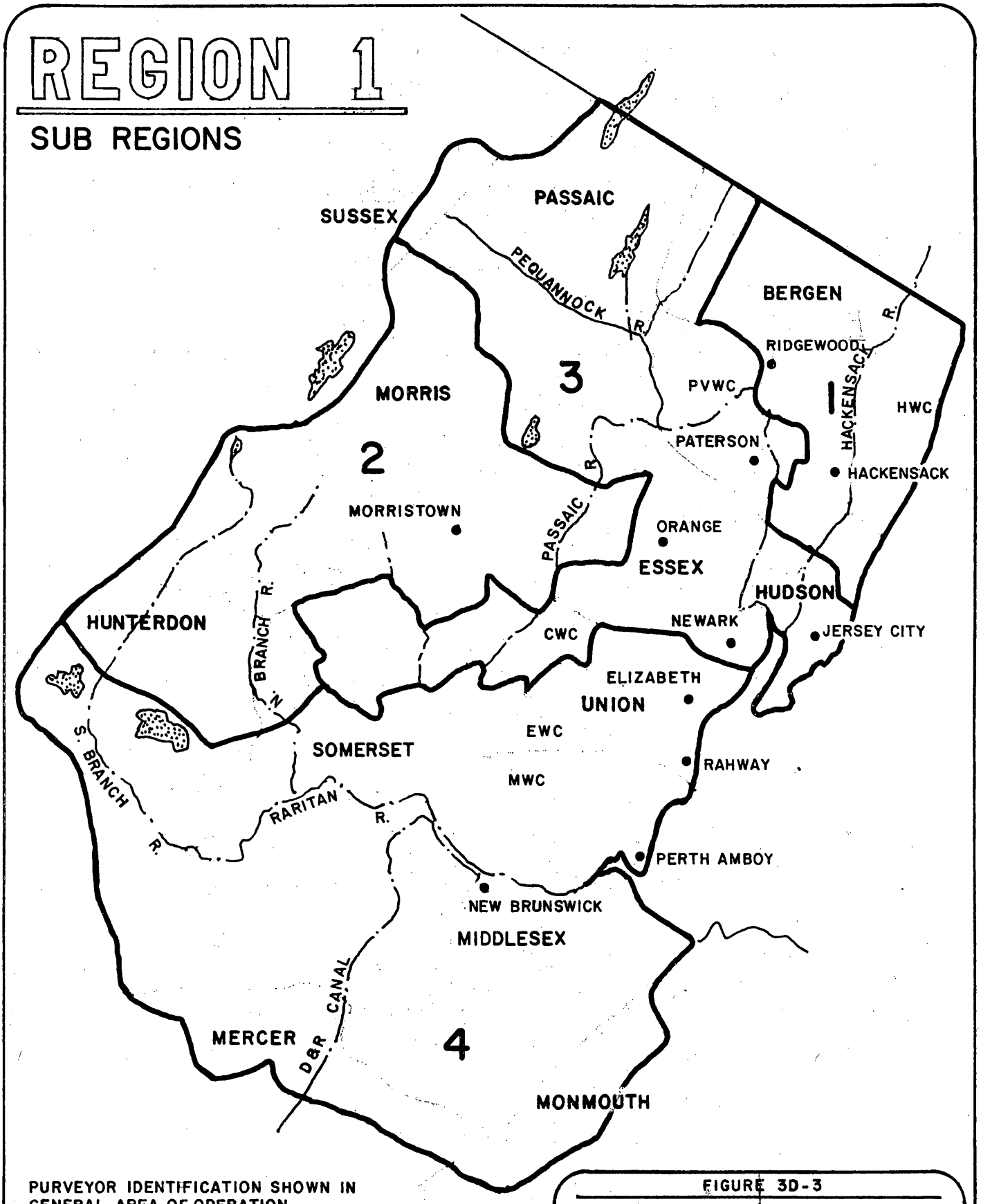
Due to the unique character of the Region, the uneven distribution of reported supply shortfalls and surpluses, and the potential for regional development, Region 1 has been divided into four sub-areas for analysis, generally shown on Figure 3D-3, and based principally on the service areas of the major purveyors and the smaller water utilities which locally supply those areas.

Sub-Region One includes most of Bergen County and a large portion of Hudson County. The Hackensack Water Company is the major purveyor supplying water in this area. Groundwater is rapidly reaching development limits and the smaller water utilities dependent on this resource, including the second largest purveyor, the Ridgewood Water Company, will have to depend on supplies from the major purveyors or additional surface development to meet their short-term (2000) and long term (2020) needs.

The Hackensack Water Company (HWC) has reported a 1975 safe yield of 81 mgd from its development of the Hackensack River, diversions from Saddle River and Sparkill Brook and groundwater extractions. In 1976 the Company diverted 97 mgd, a 16 mgd overdraft. As a participant in the Two Bridges-Ramapo Diversion Projects (#39 and #40), it appears that the 40 mgd interest, which HWC has in this facility, would be sufficient to meet its long term (2020) needs. However, in view of the long lead time required for the resolution of legal matters (acquisition of transmission main rights-of-way) and for the design and construction of the project, HWC must adopt alternate measures to supplement its safe system yield to alleviate immediate and short-term (2000) deficiencies.

REGION 1

SUB REGIONS



PURVEYOR IDENTIFICATION SHOWN IN GENERAL AREA OF OPERATION

FIGURE 3D-3

REGION ONE
SUB REGIONS

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

As much as 15 mgd could be supplied by the Hackensack River Optimization Project #77 by fully implementing the project. It has been investigated and partly developed by HWC. Additional requirements would have to be provided through interconnections with Pssaic Valley Water Commission and/or Raritan River transfers.

Sub-Region Two includes the lightly populated headwaters portions of the Passaic River and Raritan River basins not reserved by urban purveyors which includes much of Morris County and a portion of western Essex County. Major purveyors of the area are the Southeast Morris County MUA, the Parsippany-Troy Hills Water Company and the Morris County MUA. Except for a small reservoir operated by SMCMUA, all of the diversions were from groundwater sources.

Like most of northern New Jersey, additional groundwater development is limited except for the surplus and potential for further development of the Alamatong Well Field and Recharge Basin in western Morris County (which, however, is remote from the areas of need) and additional supplies considered to be available for local use in the western Essex and eastern Morris County portions of the sub-region.

Short and long term needs can be satisfied by local use of groundwater and by development of surface water projects. Alternates which may be considered include the Washington Valley Reservoir Project #3, and Longwood Valley Reservoir Project #44.

Sub-Region Three consists of the major portion of the Passaic River basin, including the service areas of the following major water utilities:

Newark Water Department

Jersey City Water Department

Passaic Valley Water Commission

Commonwealth Water Company

East Orange Water Department

Rahway Water Department

Orange Water Department

Hawthorne Water Department

Inasmuch as the local ground and surface water resources have been practically fully developed for local water supply needs in Sub-Regions 1, 2 and 3, the bulk of the immediate needs must be provided for by the interconnection of major purveyors of Sub-Region Three with adequate treatment and transmission facilities. While there is potential for development of additional major sources of water supply within the Passaic River Basin, the long lead time required for their construction requires that a "pool" of existing water supply capacity from EWC & PVWC and others be utilized by load transfer or interconnection to all areas of immediate need.

Preferred Passaic Basin projects, which should be considered to meet short and long-term needs and to supplement the utilization of the "pool" system and diversions from the Raritan River, include:

Two Bridges-Ramapo Diversion Project #40

Wanaque - Oradell Pipeline Project #39

Monksville Reservoir - Ramapo Pump Station Project #41

Sub-Region Four includes mainly the Raritan River drainage area which lies in portions of Hunterdon, Mercer, Middlesex and Monmouth Counties and includes the following major purveyors:

Elizabethtown Water Company

Middlesex Water Company

New Brunswick Water Department

Perth Amboy Municipal Utility

Fortunately, surplus water supply currently available in Sub-Region Four includes a balance of about 80 mgd from the State's Round Valley - Spruce Run Project, and 14 mgd and 8 mgd respectively from the Elizabethtown and Middlesex Water Companies' systems. In addition, the potential for the development of major surface water projects is more than adequate to assure that the short term (2000) and long term (2020) needs of Sub-Region Four can be met and that sufficient amounts of water can be made available for water-basin transfers of supply to Sub-Regions 1, 2 and 3.

The major water supply problem of Sub-Region Four concerns the ground water aquifers in the Sayreville area of Middlesex County where overpumping has resulted in the abandonment of wells due to salt water intrusion and contamination from surface sources. As the result of this situation, Perth Amboy is in danger of losing a major portion of its groundwater supply which is located in the Sayreville area. Implementation of the South River Ground Water Pumped Storage Diversion Project #80 is designed to protect and possibly increase the yield of the area's aquifers.

The amount of additional development of the available surface water resources of the Raritan River basin will depend on the adequacy of existing surpluses to meet the local needs of Sub-Region Four and inter-basin transfers to the Passaic River basin. Feasible Raritan River basin alternatives which may be required for development during the study period are:

Raritan-Passaic Pipeline Project #2

Confluence Reservoir Project #3

Delaware and Raritan Canal Improvements Project #7

Six Mile Run Reservoir Project #8

Round Valley Reservoir Expansion Project #14

Table 3D-4 summarizes the alternative projects which are considered to meet the Region's projected needs. Also included in the table are the need centers (represented by County) which are expected to be satisfied by each project. It is emphasized that, although the needs of major purveyors represent the majority of regional needs, the water supply requirements of smaller purveyors must also be considered in the distribution of new resources. Small purveyors, depending on location, may subscribe to outputs of projects directly or by purchase or exchange of water from other purveyors. Figure 3D-4 shows long term (2020) county needs in Region 1 and anticipated yields of the alternative projects.

The combined yield of the projects listed in Table 3D-4 amounts to over 150% of the long term needs (2020) in Region 1, indicating that sufficient resources exist within the Region. A significant portion of these resources is located in the Raritan River Basin, which offers the potential, through Elizabethtown Water Company and/or Middlesex Water Company, to provide for the needs of purveyors in shortfall areas as well as local needs.

Although it appears that all of the Region's needs can be satisfied with these projects, the economics of long distance transmission may be prohibitive for the less urbanized areas. Portions of Hunterdon, Morris, Passaic, Somerset and Sussex Counties in particular may require development of local resources. Areas heavily dependent upon groundwater sources (those portions of Middlesex County south of the Raritan River and Monmouth County) will likely find additional groundwater development preferable. However, should such sources prove inadequate, transfer of water from surface sources will be possible with relatively modest construction programs.

TABLE 3D-4

NEW JERSEY STATEWIDE
WATER SUPPLY MASTER PLAN

ALTERNATIVE WATER SUPPLY PROJECTS
REGION 1

ALTERNATIVE WATER SUPPLY PROJECT			NEED CENTERS POTENTIALLY SATISFIED BY PROJECT
Project Number	Project Name	Estimated Yield[a]	Counties[b]
2	Raritan-Passaic Pipeline	80 mgd[c]	Essex, Hudson, Middlesex, Union
3	Confluence Reservoir, Pump Station and Force Main	50 mgd	Somerset, Union, Middlesex
7, 8	D&R Canal Improvements and Six Mile Run Reservoir	63 mgd	Mercer, Middlesex, Hunterdon, Somerset
14	Round Valley Reservoir Expansion	27 mgd	Somerset, Union, Middlesex
39, 40	Two-Bridges/Ramapo Diversion and Wanaque-Oradell Pipeline	79 mgd	Passaic, Essex, Bergen, Hudson
41	Monksville Reservoir and Ramapo Pump Station	25 mgd[d]	Essex, Hudson
43	Washington Valley Reservoir	7 mgd	Morris
44	Longwood Valley Reservoir	11 mgd	Hudson
77	Hackensack River Optimization	15 mgd	Bergen, Hudson
80	South River Groundwater Pumped Storage Diversion	15 mgd	Middlesex, Monmouth

[a] As reported in Task 3ABC Output

[b] Additional counties as transfer schemes permit

[c] From existing Round Valley surplus

[d] Yield may be impacted by operation of Two Bridges/Ramapo Diversion

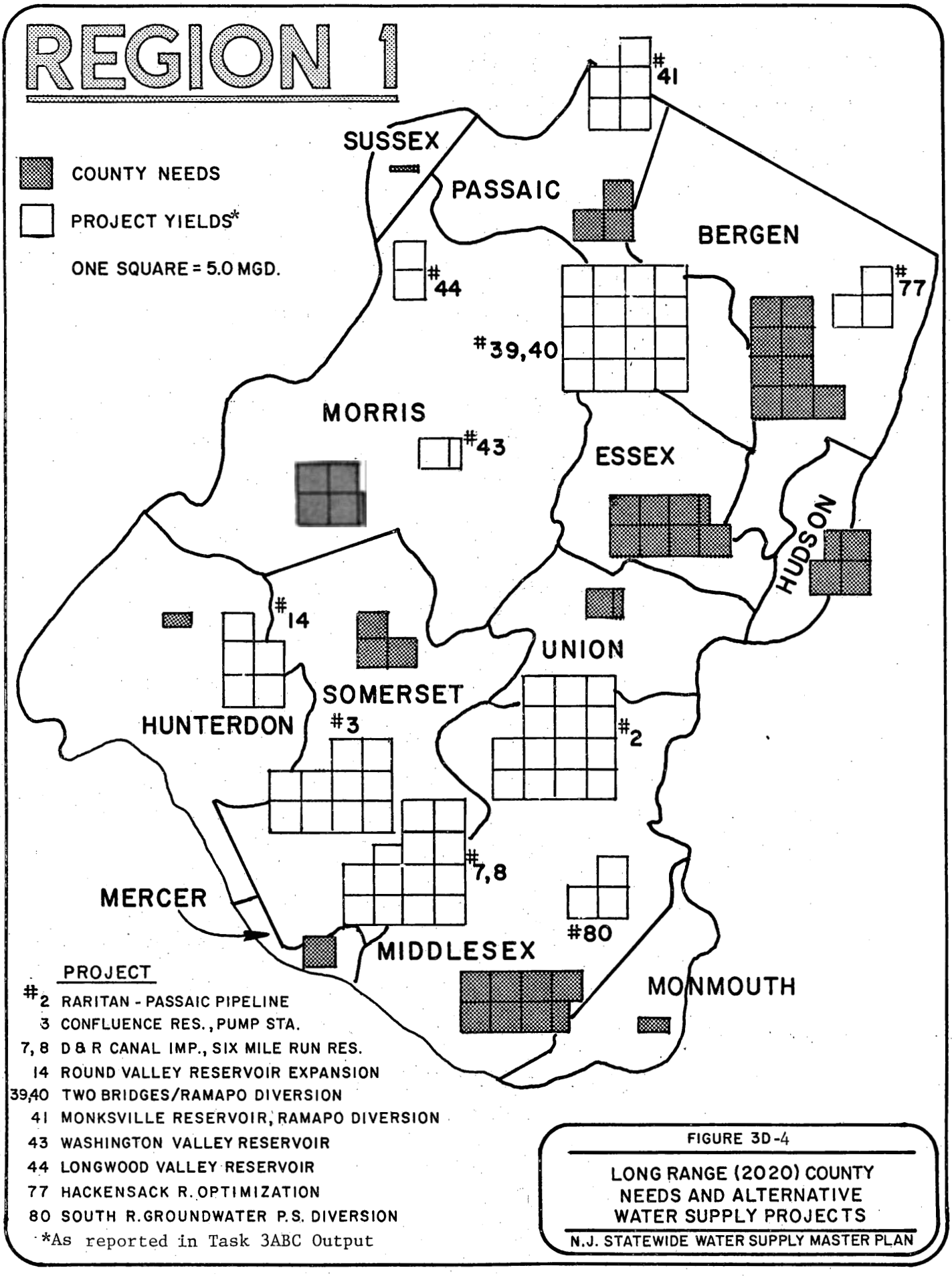


FIGURE 3D-4

LONG RANGE (2020) COUNTY NEEDS AND ALTERNATIVE WATER SUPPLY PROJECTS

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

3D-3.4.2 Analysis of Region 2 - As indicated in Table 3D-3, Region 2 comprising most of Monmouth County and all of Ocean County (see Figure 3D-2) has a 1990 need of some 30 mgd which is expected to increase to 50 mgd by 2020. An examination of the needs on a purveyor basis indicates that Monmouth Consolidated Water Co., Toms River Water Company and West Keansburg Water Company account for total needs estimated at 20, 25 and 33 mgd for the years 1990, 2000 and 2020 respectively. Compared to the 30, 38 and 50 mgd required for the entire region, these purveyors account for about two-thirds of the regional needs. The remainder is associated with scattered smaller purveyors.

Ocean County's public water supply demand is provided from groundwater sources by many public and private water supply systems, the largest of which is the Toms River Water Company which diverted some 6 mgd in 1976. As in the case of many New Jersey shore areas, peak summer demands have presented certain problems and serious ground contamination has been experienced locally in the Toms River area. However, except for possibly a northern portion of Ocean County which will experience problems similar to those of Monmouth County, local groundwater is considered adequate to meet the 18 mgd (1990) and 28 mgd (2020) needs of Ocean County.

On the other hand, a serious water supply situation has developed in the Monmouth County portion of Region Two and critical water shortages are imminent.

Analyzing the requirements of Monmouth Consolidated Water Co., reference to the questionnaire (Task 1) submitted by the Company shows an operating surplus of 7 mgd compared to an immediate need in 1990 of 9 mgd and a long-term need (2020) of 16 mgd, indicating that projected demands will exceed safe yield.

The West Keansburg Water Company has no substantial present surplus to apply against projected needs.

Overdrafting of groundwater resources has resulted in serious salt water intrusion problems which have led to restrictions on further groundwater extractions. While some surplus water is estimated to be available in the Monmouth Consolidated Water Company System, loss of groundwater supplies due to salt water intrusion and possible contamination must be taken into consideration. It is apparent that additional surface water development will be required to meet Monmouth County's demands of 12 mgd and 22 mgd for 1990 and 2020 respectively.

The Manasquan River Project #76 is well advanced in planning and land acquisition and can be constructed in increments to provide an initial supply of 10 mgd and later, as required, an additional 25 mgd. The project appears to be adequate to meet the needs of that portion of Monmouth County in Region Two and the upper part of Ocean County which also has limited groundwater resources. Moreover, in view of the size of the Monmouth Consolidated Water Company, most of the water developed by the Manasquan River Project can be treated and delivered through interconnections with that system to the areas of need.

As alternates to the preferred Manasquan River development, diversion of water through pumping stations and long pipelines from the Raritan River at Bound Brook or from developed groundwater supplies would have to be considered.

3D-3.4.3 Analysis of Region 3 - Region 3, comprising all of Atlantic and Cape May Counties, has 1990 and long term 2020 needs of some 16 mgd and 22 mgd respectively. Reported surpluses in the region currently total 48 mgd. However, much of this water is not true surplus but is committed to meet seasonal peaks in this shore resort area and is not available for year round average demands.

The major purveyors of Region 3 are the Atlantic City Water Department and the Atlantic County Division of the New Jersey Water Company. The areas

serviceable by these purveyors account for estimated total needs of 10, 11 and 15 mgd for the years 1990, 2000 and 2020 respectively, or almost two-thirds of all regional needs. The remainder of needs are distributed among various small purveyors in the region. Except for the development of a supplemental surface water supply by the Atlantic City Water Department, Region 3 depends entirely on groundwater as its source of water supply.

Water supply problems involve the high peak summer demands which are experienced in the shore communities and overpumping of groundwater aquifiers which has necessitated the abandonment of some wells due to salt water intrusion in Cape May County. However, ground water is generally abundant throughout Region 3 but prudent development of the resource including the proper spacing of wells, may require long transmission lines to reach the areas of demand. The need for regional water supply development is not anticipated during the study period.

Analyzing the requirements of the Atlantic City area, the questionnaire submitted by the City indicates a surplus of 16 mgd, compared with a need in 2020 of some 10 mgd additional. It appears that even with seasonal peak requirements, Atlantic City can cope with its future needs from existing surpluses, augmented by some additional groundwater development for peak summer usage. Similarly, areas serviced by NJWC - Atlantic Division show a need of 4 mgd in 2020, compared with a current surplus of 7.0 mgd, indicating that no additional major supply projects are necessary.

3D-3.4.4 Analysis of Region 4 - The 1990 needs for this region are very low at approximately 2 mgd; however, the need increases to 9 mgd in 2020. Surpluses reported by purveyors in the region currently total 16 mgd, some of which is committed to meeting peak demands.

The major purveyors of Region 4 are the Millville Water Department and the Vineland Water-Sewer Utility. Millville, which diverted 4 mgd from Union Lake in 1976, has abandoned this surface supply due to pollution problems of Union Lake and is now entirely dependent on a well system. Vineland took an average of 7 mgd from groundwater in 1976.

The City of Vineland and the City of Millville areas account for additional needs of 2, 4 and 6 mgd for the years 1990, 2000 and 2020 respectively, compared to the 2, 5 and 9 mgd required in the entire region.

No additional major water supply projects are necessary in Region 4. Groundwater is adequate in Region 4 to meet all needs during the study period.

3D-3.4.5 Analysis of Region 5 - Immediate needs (1990) for this region are moderate, approximately 15 mgd and the long range needs are projected to increase to 36 mgd in 2020. Surpluses reported by purveyors in the region currently total 58 mgd, however not all is available as some is reserved for peak demands.

An examination of purveyor needs indicates that areas serviceable by the City of Camden Water Department, NJWC-Haddon District, Merchantville-Pennsauken Water Commission and NJWC-Delaware Valley District account for estimated needs of 7, 13 and 18 mgd for the years 1990, 2000 and 2020 respectively, compared with 15, 26 and 36 mgd for the region, or approximately half of the region's needs. The remainder is associated with a large number of smaller purveyors.

The water supply situation in the City of Camden and the surrounding metropolitan area supplied by the major purveyors and the smaller public utilities is critical. Overdrafting of aquifers has greatly lowered water table levels. As a result of this, ground water movements that once recharged the Delaware River are reversed. It is now estimated that over fifty percent of the water extracted

from the aquifer is from Delaware River infiltration to the lowered aquifer. The ground water is therefore extremely vulnerable to river pollution and to salt water intrusion during periods of drought. Moreover, contamination from surface sources has led to the abandonment of many wells.

In view of these conditions, the State of New Jersey, in cooperation with the Delaware River Basin Commission has prohibited further diversions of ground water in the greater Camden area and has warned that reduction of current extractions are necessary. A task force under the direction of the U.S. Geological Survey has recently been established to study this problem.

In view of the seriousness of the situation, a regional solution to the water supply problems of the Camden area should be implemented at the earliest possible date.

Three viable regional alternatives to supplant the endangered water resources of the area or to supplement those supplies by conjunctive use are presented.

In view of the long lead time required for the approval, planning, design, and construction of a major water supply project, action on the initiation of a program to alleviate the water supply situation in the Camden area is needed at an early date. During the interim period required for development of an additional regional supply, emergency measures should be adopted to protect ground water from further contamination and overdrafting.

Development of Wharton Tract, Project #131

At the request of the State of New Jersey, the U.S. Corps of Engineers, in cooperation with the U.S. Geological Survey, currently is completing a modeling program of the 100,000 acre Wharton Tract which the State purchased in 1954 as a water preserve. The feasibility of conjunctive development of the surface and ground water of the area is being studied with primary consideration

being given to the protection of the ecosystem of the Tract. Considerations of water supply development, treatment and transmission to the greater Camden area are to be investigated in the Corps program.

Interstate Transfer - PA to Camden - Project #139

Institutional and political problems involved in inter-state transfer of water are appreciated. However, in view of the present vulnerability of Philadelphia's water supply system and the fact that the Delaware River provides a common source of water for both Philadelphia and the Camden area, it may prove to be of mutual benefit to both if Camden were to receive a dependable treated water supply from Philadelphia by participation in the cost for moving the City's intake to above head of tide at Morrisville and for the other treatment and modifications necessary for improvement of the system.

Delaware River Intake at Camden - Project #140

The feasibility, economics and political implications for construction of an intake with treatment facilities on the Delaware River (possibly as far upstream as Trenton to be above tidal influences), with transmission to the Camden area, should be investigated as a valid alternate.

Areas serviceable by NJWC-Haddon District, NJWC-Delaware Valley District and Merchantville-Pennsauken, show sufficient groundwater resources to provide for future needs. Protection and prudent management of these resources are primary considerations in the area.

3D-3.4.6 Analysis of Region 6 - Region 6 comprises all of the drainage area of the Delaware River in the State from the Burlington County line to the border of New York State and that portion of the Wallkill River watershed which lies in New Jersey. It includes portions of Mercer and Hunterdon Counties, all of Warren County, most of Sussex County, and small areas of Morris and Passaic Counties. The 1990 public water supply needs of 11 mgd for Region 6 are expected to increase to 27 mgd by 2020.

Areas serviced by four purveyors have been identified as accounting for about one-half of the region's projected needs. The City of Trenton Water Department, Garden State Water Company-Phillipsburg Division, Newton Water-Sewer Utility and Hackettstown Municipal Utilities Authority account for needs of 5, 9 and 13 mgd for the years 1990, 2000 and 2020 respectively, compared to the 11, 18 and 27 mgd needs for the region as a whole. The remaining needs are associated with smaller purveyors distributed throughout the region.

The southernmost portion of the Region is a narrow strip along the Delaware River which includes the greater Trenton Metropolitan Area in Mercer County and the semi-rural lands of Hunterdon County. Immediate (1990) needs and long term (2020) needs for these two counties of Region 6 are estimated to be some 5 mgd and 11 mgd respectively.

The major water purveyor of this portion of Region 6 is the Trenton Water Department which supplies the City of Trenton and several other communities in Mercer County from diversions from the Delaware River. In 1975 the Trenton Water Department extracted an average of 32 mgd for in-basin public water supply use. Except for the Town of Lambertville, which obtains a portion of its water supply from the State owned and operated Delaware and Raritan Canal, which parallels the Delaware River, the smaller water purveyors are entirely dependent on ground water.

Unfortunately, groundwater in this portion of Region 6 is rapidly approaching the limits of development and further extractions are restricted by the State of New Jersey and the Delaware River Basin Commission. Moreover, except for the Delaware River, surface water is not available for development. However, the Trenton Water Department has some 33 mgd excess plant capacity and its potential for increased diversion from the Delaware River is adequate to meet any anticipated future demands provided no out-of-basin transfers are involved. Expansion of its service area can be considered as one alternate for meeting the needs of the Mercer-Hunterdon County area.

In addition, water is available from either the Delaware River or, potentially, the Delaware and Raritan Canal, for diversion by individual pumping stations, treatment plants and transmission lines to the centers of need.

It is also recognized that surplus surface water is available in the Raritan River basin of Region 1 due to the State development of the Round Valley-Spruce Run Reservoir Project. Transmission of this water for use in Mercer and Hunterdon Counties is also considered a valid alternate.

In view of these options, which are available for meeting the local short and long term needs of this portion of Region 6, development of an additional new source of water supply is not warranted.

That portion of Region 6 lying north of Mercer and Hunterdon Counties has a 1990 need of some 6 mgd, which can be expected to increase to 15 mgd by 2020. The major purveyor in this portion of Region 6 is the Phillipsburg Water Company, which in 1976 diverted an average of 5 mgd from wells which are along and hydraulically connected with the Delaware River. Smaller water companies, including the Hackettstown M.U.A. and the Newton W.S. Utility, each with an average annual diversion of 1 mgd, developed from a combination of surface and ground water sources.

The Delaware River and tributary streams such as the Musconetcong River, Pequest River, Paulins Kill, Beaver Brook and the Hudson River Basin's Wallkill River, located in this part of Region 6, are available for local and regional water supply development. Several water supply projects have been identified as realistic in Task 3ABC, including the Tocks Island Lake Project and its alternate, the Flat Brook Reservoir, with and without continuous withdrawal.

The Tocks Island Lake Project alternatives, although considered as feasible and realistic for multi-regional water supply and for needs beyond 2020, are not preferred in the near future. The Delaware River is considered a viable source of supply on an individual purveyor basis.

In addition to direct diversions from the Delaware River which would not require the construction of storage facilities, several impoundments are considered feasible for water supply development and should be investigated further in the light of regional needs and transmission requirements.

Projects potentially beneficial to Region 6 directly include Ross Corner Reservoir (#60), Hackettstown Reservoir (#56), Shades of Death Reservoir (#65), Petersburg Reservoir (#66), Franklin Reservoir (#72), Beaver Run Reservoir (#73), and Sussex North Reservoir (#74). The latter three sites located in the Wallkill River Basin, with state projected yields of 97 mgd, far in excess of regional needs, offers potential benefits for water supply in Region 6, flow augmentation, and possible out-of-basin transfer of water to areas in Region 1.

The seven reservoir sites in Region 6 are in areas of relatively low population density in Sussex and Warren counties. If fully developed, these reservoirs could provide a total of about 200 mgd which is more than seven times the estimated 27 mgd Region 6 total needs by the year 2020. These sites are also relatively far from the large water demand centers in the northeast part of the State, which can be supplied by Region 1 projects for at least the next 40 years.

Therefore, Region 6 will need only partial development of reservoir sites in addition to the Delaware River and relatively small supplies from local surface and ground water development. The Hackettstown Reservoir is proposed by DRBC in their comprehensive development plan for local water supply or for flow augmentation primarily, and for recreation. The other three Delaware Basin reservoir sites in Region 6 are not in the DRBC Comprehensive Plan.

It is recommended that the Hackettstown Reservoir project of DRBC include on the order of 4 mgd dependable water supply capacity for use in the Hackettstown area before the year 2020. From Task 7B analysis of the Wallkill River watershed in Sussex County, needs in that area can be satisfied until 2020 by a relatively small Beaver Run Reservoir with a dependable water supply yield on the order of 5 mgd. The other four reservoir sites in Region 6 do not appear to require development until after year 2020, but local needs near those reservoir sites should be examined in detail to determine whether partial development of any of those sites would be required and justified in the next 40 years.

In any event, the six sites in Region 6 have tremendous potential for long-range water supply, possibly for transfer to Region 1 in addition to providing local needs. Therefore, preservation of the Region 6 reservoir sites is recommended for potential use after 2020 unless they are developed earlier.

3D-4 DELAWARE AND RARITAN CANAL

The canal is 60 miles long from the beginning of a 22-mile section of feeder canal which extends from Bull's Island on the Delaware River almost six miles north of Lambertville to Trenton. The main canal originally went from Bordentown, through Trenton and on to the Raritan River at New Brunswick. The canal was built in the 1830's by a railroad and canal company for barge transit between Bordentown and New Brunswick. The Bordentown-Trenton section of the canal no longer exists.

In 1934 the State acquired the canal. Refurbishing began in 1944 to make it a water supply conduit to municipalities and industries along the canal and in North Central Jersey. Legislation in 1949 allowed the State of NJ in 1950 to become the first in the nation in the water business. The canal flow averages about 47 mgd with peak flow water supply contracts totaling about 75 mgd, which is approximately the present delivery capacity of the canal. The State has a 100 mgd diversion right for transferring Delaware River water outside of its drainage basin. The canal is presently the only facility being used by the State for such Delaware basin transfer.

The Delaware and Raritan Canal Commission, a planning agency for canal protection and preservation, was created as a result of the Delaware and Raritan Canal State Park Law of 1974. The NJDEP administers the water supply operations, maintenance and water contracts and sales. Today there are five basic functions of the canal: a water supply source, a recreational site, an historic site, a buffer zone for water quality protection, vegetation and wildlife, and an urban improvement function at points of maximum accessibility and public exposure.

The NJDEP has been undertaking canal rehabilitation and water supply studies for greater water supply benefits. A Rutgers University study team will soon complete their four-part investigation for NJDEP: structural

integrity, institutional arrangements, water quality, and hydrology and hydraulics. Some of their preliminary conclusions on water quality, hydrology and hydraulics are in letter reports presented in Appendix 3D-IV.

Summarizing their findings to date, the canal capacity can be increased to 100 mgd by modification work such as dredging, weed cutting, and combinations of gate openings; and increased even more by raising some overflow spillways. Some additional work would be needed to protect the canal from floods.

Dissolved oxygen, heavy metals and eutrofication are the main problems identified by the study group although those problems are presently successfully overcome by purveyor treatment processes.

On January 1, 1980 Delaware and Raritan Canal Commission regulations became effective requiring minimum standards of stormwater management in streams flowing into the Canal or Canal Park. This includes provisions for the settlement of particulate pollution in runoff from new developments.

3D-5 REANALYSIS OF PAST DECISIONS TO ACQUIRE RESERVOIR SITES

3D-5.1 Authorization to obtain reservoir sites by State of New Jersey

The 1958 Water Supply and Water Bond Acts authorized and provided funds for the acquisition, design and construction of the Round Valley-Spruce Run Reservoir system, for special ground water studies and included $5 million for continued studies and surveys to develop ways and means of improving natural stream flows by stream flow regulation reservoirs, or other means deemed practicable to meet the water supply needs of the area or areas, and to acquire said new reservoir sites as and when specifically authorized by law after public hearing. In 1969, special legislation was enacted which directed the acquisition of sites for the South River Tidal Dam impoundment (Project #12) and for two reservoir sites on the Manasquan River (Project #76). Also the Water Conservation Act which was enacted in 1969 included $27 million for completion of the purchase of the South River and Manasquan River sites and for acquisition of the Raritan Confluence (Project #3), Six Mile Run (Project #8), Hackettstown (Project #56), and Two Bridges (Project #27) sites.

As discussed below, acquisition of lands, easements and rights-of-way for the Raritan Confluence, Six Mile Run and the two Manasquan River projects is substantially complete. Considerable acreage has also been purchased for the Hackettstown Reservoir site.

3D-5.2 Reservoir Sites

1. Confluence Reservoir, Project #3

The Raritan Confluence Reservoir, to be located at the junction of the North and South Branches of the Raritan River in Hunterdon and Somerset Counties, is a one billion gallon impoundment for the storage of excess flows from the North and South Branches and their transmission through a pumping station and force main

to the State owned and operated Round Valley Reservoir. Construction of the reservoir and transmission facilities will increase the yield of the Round Valley-Spruce Run system by 50 MGD. Acquisition of the reservoir site is practically complete and negotiation for easements and property required for the force main right-of-way is currently underway. Some 615 acres of lands and easements will be required for the project at a total estimated cost of over $2,630,000.

Whether construction of the project will be required prior to or subsequent to the year 2020 will depend upon the elements of the program developed in the master plan. The various options are considered in Subtask 3E. None the less, completion of acquisition of land, easements and rights-of-way for the project should be given high priority.

2. Six Mile Run Reservoir, Project #8

The Six Mile Run Reservoir will have a capacity of 5.9 billion gallons. It is located on a small tributary of the Millstone River in Somerset and Middlesex Counties adjacent to the Delaware and Raritan Canal. This impoundment will provide balancing storage to increase the present yield of the Delaware and Raritan Canal by 28 MGD and develop an additional 10 MGD yeild from the reservoir drainage area. Acquisition of the 2869 acres of property required for the project has been completed at a cost of about $11,500,000. It is recommended that the site be protected and retained in State ownership to assure its availability for development as a regional facility in the Somerset/Middlesex area.

3. Upper and Lower Manasquan Reservoirs, Project #76

The Upper and Lower Manasquan Reservoirs are sites located in Monmouth and Ocean Counties. The project consists of (1) a small downstream reservoir of 100,000 gallon capacity which will develop 10 MGD and (2) an upper reservoir of 5.0 billion gallons for storage of flows diverted from the lower reservoir through a

pumping station and force main which will produce an additional yield of 25 MGD. Acquisition of the 1233± acres required for lands, easements and rights-of-way will soon be completed at an estimated total cost of about $3,000,000. In view of the water supply problems of Monmouth and Ocean Counties, it is recommended that this land be held for the purpose of construction as required.

4. Hackettstown Reservoir, Project #56

The Hackettstown Reservoir project provides for the construction of a 9.9 billion gallon impoundment on the Musconetcong River in Warren, Sussex and Morris Counties which will develop a safe yield of 40 MGD at the dam site. Its construction will require major rail and highway relocations, the relocation or diking of the historic village of Waterloo and diking to protect residential development along Route No. 206. To date 762 acres have been purchased at a cost of $2,670,000 and some 447 additional acres will be required to complete the acquisition at an estimated cost of $3,000,000. Projections of water demands for the Musconetcong Valley indicate that construction of the project for local water supply purposes cannot be justified prior to year 2020. In view of the value of the site with or without reservoir construction as an integral part of Allamuchy State Park and the projects potential for Delaware River flow augmentation, it is recommended that acquisition be completed at an early date to protect the site from further commercial and residential development.

5. South River Tidal Dam, Project #12

The South River Tidal Dam project proposed the construction of an impoundment of some six billion gallons on South River, a tributary of the lower Raritan River in Middlesex County. The purpose of the project was to stabilize salt water intrusion into the Farrington ground water aquifer and increase by recharge the yield of the Old Bridge sands by as much as 25 MGD. Property within the proposed ponding area

was purchased at a cost of some $500,000. More detailed ground water investigations of the areas, however, indicated that the value of the proposed impoundment on stabilizing the salt water front was questionable and that the recharge benefits from the project would be far less than had previously anticipated. Further, it was found that protection of developed property in Old Bridge would require dikes with continuous pumping. An alternate local plan (Project #80) for the construction of additional recharge ponds in the Sayreville and Perth Amboy well fields to augment yield from the ground water aquifers from the South River and its tributaries is considered to be more effective and less costly. The South River Tidal dam project was judged unrealistic and further purchases of property within the proposed ponding site are not recommended.

6. Two Bridges Reservoir Site, Project #27

The Two Bridges Reservoir site, located in the Big Piece Meadows of the Passaic Valley upstream of the confluence of the Pompton and Upper Passaic Rivers, was proposed by the U.S. Corps of Engineers as part of a comprehensive flood control-water supply program for the Passaic Valley. This reservoir, plus the construction of an up-stream reservoir at Myers Road, would develop a safe yield of 100 MGD. Due primarily to major environmental considerations,the Corps' plan for the Passaic Valley is no longer considered viable. Moreover, the Two Bridges-Ramapo project #39 and 40, approved by the State Water Policy and Supply Council, would develop a safe yield of 79 MGD, would be less costly, have fewer environmental problems and its construction would preclude consideration of reservoir construction in the Big Piece Meadow. Initial acquisition of land at the site has been made. While purchase of the proposed reservoir site for future water supply development cannot be justified, consideration should be given for acquisition of the Big Piece Meadows for open space use including flood storage and pollution control.

3D-5.3 Additional Sites

Additional reservoir sites which should be retained in public ownership or acquired to assure that they are available for future development are as follows:

1. Monksville Reservoir, Project #41

Monksville Reservoir site is located on the Wanaque River in Passaic County, upstream of the NJDWSC Wanaque Reservoir. Development of this reservoir would provide an additional seven billion gallons of storage in the Wanaque watershed for increased diversions from the Ramapo River which would increase the safe yield of the NJDWS System by 25 MGD. The site, most of which is currently owned by the NJDWSC, is being acquired with State Green Acres funds for recreation and future water supply development.

2. Longwood Valley Reservoir, Project #44

The Longwood Valley Reservoir site is located on the upper Rockaway River in Morris County. This 5.2 billion gallon impoundment would develop an estimated safe yield of 11 MGD for local water supply for Morris County or to increase the yield of the Jersey City water supply system. In addition to water supply benefits, a pumped storage power development project could be developed by the construction of a second reservoir on Beaver Brook with transmission facilities connected to the Longwood Valley reservoir. Some of the reservoir site is owned by Jersey City but additional lands are required for the proposed development. Due to high costs, land use encroachment and other factors, plans for the pumped storage power project and the water supply development have been held in abeyance. However, public ownership of the site is recommended to preserve its usefulness for future development, should such needs be required in the future.

3. Washington Valley Reservoir, Project #43

The Washington Valley Reservoir site, located on the Whippany River in Morris County, would have a storage capacity of 1.2 billion gallons and develop a safe yield of 7.0 MGD. This site is being acquired by the Morris County MUA as part of its County water supply development program. Use of the facility for transitory storage of diversions from the Delaware River is no longer contemplated; however, the reservoir might be useful for future diversion from the Raritan River Basin.

4. Sussex North Reservoir, Project #74

The Sussex North Reservoir site is for development of a 14.4 billion gallon storage facility on the Wallkill River in Sussex County for local water supply, stream flow augmentation to meet New York State requirements and out-of-basin diversions to the Pequannock River. It is recommended that the 950 acres required for development be acquired at an estimated cost of $5 million to assure its availability for future development. The fully developed yield of this reservoir is reported to be 52 mgd.

APPENDIX 3D-I

NEW JERSEY STATEWIDE WATER SUPPLY MASTER PLAN
APPENDIX 3D-I: LIST OF ALTERNATIVE PROJECTS

Project Number	Project Name	Primary River Basin	Sub-Basin or Tributary	Other Basins Involved In Project
1	Raritan-Passaic Pipeline (North Route, Main Stem Development)	Raritan	-	Passaic
2	Raritan-Passaic Pipeline (South Route, Main Stem Development)	Raritan	-	Passaic
3	Confluence Reservoir, Pump Station and Force Main	Raritan	(Confluence)	-
4	Delaware River Diversion to Raritan River	Raritan	-	Delaware
5	Delaware River Flood Skimming to Raritan River	Raritan	-	Delaware
6	Delaware River Flood Skimming to Raritan (Round Valley Expansion)	Raritan	-	Delaware
7	Delaware and Raritan Canal Improvements	Raritan	(D&R Canal)	Delaware
8	Six Mile Run Reservoir	Raritan	(D&R Canal)	Delaware
10	Delaware-Raritan Canal Optimization	Raritan	(D&R Canal)	Delaware
13	Upper Raritan Pipeline	Raritan	Lamington	-
14	Round Valley Reservoir Expansion	Raritan	Rockaway	-
16	Hackelbarney Reservoir	Raritan	Lamington	-
17	Ravine Lake Reservoir	Raritan	(North Br)	-
25	Bartley Reservoir	Raritan	(South Br)	-
27	Two Bridges Reservoir (W/Myers Road; Passaic River FC Plan III)	Passaic	Pompton, Ramapo	-
28	Delaware River Diversion, Frenchtown - Two Bridges	Passaic	-	Raritan, Delaware
29	Delaware River Diversion to Canoe Brook - Great Notch	Passaic	Dead River	Raritan, Delaware
30	Delaware River Diversion, Port Jervis - Pequannock	Passaic	Pequannock	Wallkill, Delaware
31	Delaware River Diversion, Tocks Island - Wanaque	Passaic	Wanaque	Delaware
32	Hudson River - Ramapo River Diversion (N.Y. Storage)	Passaic	Ramapo	Hudson
33	Hudson River - Ramapo River Diversion (Ramapo Storage)	Passaic	Ramapo	Hudson
34	Hudson River - Little Falls Continuous Diversion	Passaic	-	Hudson
35	Hudson River - Little Falls Diversion (N.Y. Storage)	Passaic	-	Hudson
36	Hudson River - Great Notch (N.J. Storage)	Passaic	-	Hudson
37	Delaware River Control - Transfer from Kensico	Passaic	-	Hudson, Delaware
39	Wanaque - Oradell Pipeline	Passaic	Wanaque	Hackensack
40	Two Bridges - Ramapo Diversion Project	Passaic	Pompton, Ramapo	-
41	Monksville Reservoir with Ramapo Pump Station	Passaic	Wanaque, Ramapo	-
42	Great Notch Interconnection	Passaic	(Great Notch)	-
43	Washington Valley Reservoir	Passaic	Whippany	
44	Longwood Valley Reservoir	Passaic	Rockaway	
46	Dunkers Pond Reservoir with Wallkill River Diversion	Passaic	Pequannock	Wallkill
48	Hardscrabble Reservoir	Passaic	-	Raritan, Delaware
54	Greenwood Lake	Passaic	Wanaque	-
55	Tocks Island Lake Project	Delaware	-	-
56	Hackettstown Reservoir	Delaware	Musconetcong	-
57	Flat Brook Reservoir	Delaware	Flat Brook	-
58	Flat Brook - Raritan Continuous Diversion	Delaware	Flat Brook	Raritan
60	Ross Corner Reservoir	Delaware	Paulins Kill	-
65	Shades of Death Reservoir	Delaware	Pequest	-
66	Petersburg Reservoir	Delaware	Pequest	-
67	Honey Run Reservoir	Delaware	Pequest	-
72	Franklin Reservoir	Wallkill	-	-

APPENDIX 3D-I: LIST OF ALTERNATIVE PROJECTS (Cont'd)

Project Number		Primary River Basin	Sub-Basin or Tributary	Other Basins Involved In Project
73	Beaver Run Reservoir	Wallkill	-	-
74	Sussex North Reservoir	Wallkill	-	-
75	(See Project 46)	Wallkill	Pequannock	Passaic
76	Upper and Lower Manasquan Reservoirs	Manasquan	-	-
77	Hackensack River Optimization	Hackensack	-	-
78	New York City Diversion from Manhattan	(Emergency)	-	-
79	New York City Diversion from Staten Island	(Emergency)	-	-
80	South River (Middlesex County) Ground Water Pumped Storage Diversion	Raritan	South River	-
81	Weldon Brook Reservoir	Delaware	Musconetcong	-
86	Toms River Reservoir	Toms River	Ridgeway	-
103	South River (Atlantic County) Reservoir Project	Great Egg Harbor	South River	-
113	Raritan- Passaic Pipeline	Raritan	-	Passaic, Delaware
116	Frenchtown Pumped Storage Reservoir	Delaware	-	-
131	Well Field in Wharton Tract (Southwest NJ Supply)	Mullica	Batsto	-
132	Well Field in Wharton Tract (Southeast NJ Supply)	Mullica	Wading	-
135	Burlington County East Zone Well Fields	Mullica	Batsto, Wading	-
136	Alamatong Well Field and Recharge Basin (Under Construction)	Raritan	Lamington	-
137	Delaware River Diversion to Dunker Pond Reservoir	Delaware	-	Passaic
138	Source-Source Interconnection Delaware and Raritan Canal	Raritan	-	-
139	Interstate Transfer - PA to Camden	Delaware	-	-
140	Delaware River Intake at Camden	Delaware	-	-
Projects Added After Subtask 3D Interim Output of November, 1979:				
2A	Raritan- Northeast Pipeline (Reinforcing Purveyor Systems)	Raritan	-	Passaic
113A	Raritan- Passaic Transfer (Tunnel to Dead River)	Raritan	-	Passaic
113B	Raritan- Passaic Transfer (Force Main to Dead River)	Raritan	-	Passaic
141	Raritan- North Branch Pipeline	Raritan	Lamington	Passaic

Abbreviations

The various data sheets in Appendix 3D-II and Appendix 3D-III contain abbreviations which are defined below for the reader's convenience.

DEP - Department of Environmental Protection (NJ)

DRBC - Delaware River Basin Commission

WP&SC - Water Policy and Supply Council (NJ)

COE - U.S. Army Corps of Engineers

Project No. - Project number as assigned in Subtask 3C

Library No. - Reference number of information source as assigned in Subtask 3C bibliography

Project Identification No. (LORDS No.) - location of project, based on Land Orientation and Reference System, as described in Subtask 3C.

GENERAL ENVIRONMENTAL CONSIDERATIONS

(Apply to all projects.)

There are a number of significant impacts that could occur as a result of the proposed projects which cannot be assessed without first conducting detailed studies. These potential impacts, which are briefly discussed below, should be considered in any further environmental studies conducted. They relate to the construction and/or operational phases of a project.

Construction

In some locations it may be desirable to not only clear a reservoir site of vegetation but also to strip away the uppermost layer of soil. This is not a standard operation but may be advisable when the soil is so high

in organic matter (e.g. crop land or boggy wash) so as to pose a serious problem in eutrophication (i.e. nutrient enrichment resulting in algal growth) control. This operation is expensive, and could increase the magnitude of site clearance construction impacts, especially in terms of erosion and sedimentation.

Operation

Reservoirs or Stream Diversions as they Affect the Suitability of a Downstream Aquatic Habitat. A direct relationship exists between the number and composition of fish in a stream and the quantity of stream flow. However, little information on the relationship has been developed. What is known is that fish require particular water velocities and depth to thrive. These conditions in turn affect temperature and water quality. (Water quality can be particularly affected by low flows in streams that are receiving-waters for wastewater effluent).

Water management alternatives such as the creation of resevoirs or the diversion of water from a stream or river can change the species composition by changing the competitive advantage of one species relative to another. This has been found to be particularly true for high productivity streams.

Water management alternatives can also change the total biomass (productivity) of fish in a stream and lead to a change in the fisheries management options. The level of productivity selected by a fisheries agency for a steam dicates that stream's flow requirements. In other words, there really is no minimum flow objective but rather a required flow regime for a specific productivity level and a particular mix of species.

It is especially difficult for aquatic species to adapt to constantly changing contitions e.g. intermittent low flows resulting from pumped storage diversions followed by high flows upon release of the stored water.

Problems Resulting When a Reservoir is Subject to Significant and Periodic Drawdowns. Problems can result when multiple-use of a reservoir for water supply and recreation is planned, especially if the impoundment is expected to experience periodic drawdowns. When the waterline recedes, unsightly mud flats may be exposed; shorelines may become slick and visually unattractive due to algae accumulation. These problems and the eventual eutrophication of the reservoir affect swimmers by changing the quality of the recreational experience.

Also, fish spawning areas could be impacted if lowered water levels expose egg nests. This could weaken or kill the eggs.

The above discussion provides a general description of the types of changes that could occur in connection with various water supply projects. A determination of the effects of a particular water supply alternative on the hydrology and ecology of a river or stream can only be made after detailed studies are completed. (It should be noted, however, that none of the 24 alternatives discussed in this report appear to affect surface waters with a FW-1 (fresh water) classification. These are the most environmentally sensitive surface waters.) The above information, therefore gives a general description of the types of changes that could occur.

APPENDIX 3D-II

NO. 1 RARITAN-PASSAIC PIPELINE (NORTH ROUTE)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 1 Name Raritan-Passaic Pipeline (North Route) Identification No. 25 & 26

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Somerset, Union, Essex, Hunterdon

Author NJDWSC Title NEWS Report 1971 Library No. 202
Gilbert Assoc. 1968 1207.03
Hazen and Sawyer 1206.01

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc. of raw water treatment and potable water transmission facilities to Newark area.	$ 93,200,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc. [2]	10,100,000
Cost per million gallons based on 80 mgd usage	346

Yield - represents purchasable allocation based on drought of 1960's from Round Valley/Spruce Run 80 mgd

Remarks - Treated water delivered to Newark Area

[1] Costs updated from NEWS report adjusted by factors appearing in App. H thereof to reflect instream transport of raw water to Bound Brook and other adjustments. Power estimated at 4¢/KwHr

[2] Fees for use of R.V./S.R. additional to this sum

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 1 Name Raritan-Passaic Pipeline (North Route) L.O.R.D.S. No. _____

Atlas Sheet 25

Region (s) 1 Basin (s) Raritan, Passaic County (ies) Somerset, Union, Essex, Hunterdon

IMPACT ANALYSIS

Construction - Temporary effects of construction could include: erosion and sediment runoff in immediate area - requiring an erosion and sediment control plan to design the facilities properly; required disposal of some spoil; air borne dust, smoke plume and exhaust emission from construction equipment; vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Localized alteration of size, diversity and distribution of species will occur in 28 mile ROW strip and at reservoir site. The disruption of natural habitats, migration routes, and spawning areas may result in a decline of biotic productivity. Shoreline vegetation removal for construction of facilities will be necessary.

Water Quantity & Quality - Temporary impacts could include: reduced water quality due to in-stream transmission lines, increased water turbidity during construction activity. Prevention of stream encroachment along the pipeline route is necessary. Temporary contamination of runoff by toxic or hazardous materials may occur. Accumulation of sediment downstream from construction site must be controlled.

Land Use - Acquisition of land for pumping stations, treatment plant, and 28-mile transmission line, including ROW. ROW in vicinity of pumping station and treatment plant should be kept free of development. Flood plain management will also be necessary over a large area.

Displacement - Unknown.

Economic Development - Facilities are projected to supply demand of 70 mgd for 1980 and 90 mgd for 1988.

Uses/Purposes - Water supply.

Transportation - Transportation routes will be affected during construction periods.

Visual Quality - Pumping station should be of a design in conformance with local architecture to blend into site environment.

NO. 2 RARITAN-PASSAIC PIPELINE (SOUTH ROUTE)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 2 Name Raritan-Passaic Pipeline (South Route) Identification No. 25 & 26

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Somerset, Union, Essex, Hunterdon

Author EWC Title NEWS Report 1971 Library No. 202
Killam Report 1970 1201.01
Hazen and Sawyer 1974 1206.01

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc. of raw water treatment and potable water transmission facilities. Water delivered to Newark area.	$ 92,800,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.[2]	9,970,000
Cost per million gallons based on 80 mgd usage	341

Yield - Represents purchasable allocation based on drought of 1960's from Round Valley/Spruce Run 80 mgd

Remarks - Treated water delivered to Newark Area

(1) Costs updated from NEWS Report, adjusted by factors appearing in App. H thereof to reflect instream transport of raw water to Bound Brook and other adjustments. Power estimated at 4¢/KwHr

(2) Fees for use of R.V./S.R. in addition to this sum

ENVIRONMENTAL EVALUATION

No. 2 Name Raritan-Passaic Pipeline L.O.R.D.S. No. _____

(South Route) Atlas Sheet 25

Region (s) 1 Basin (s) Raritan, Passaic County(ies) Hunterdon,

Somerset, Union, Hudson

IMPACT ANALYSIS

Construction - It is roughly estimated to take several years to complete the transmission pipeline, and over two years to expand the treatment plant. (Pipeline diameter estimated at 6' - 7'.) Temporary impacts of construction activities potentially affecting workers on site and residents in adjacent areas include: 1) air borne dust 2) exhaust and smoke emissions from equipment 3) vehicular and equipment noise. Land uses in the vicinity of the Bound Brook treatment are industrial and commercial. The pipeline route is assumed to follow the Reading Railroad and the Pennsylvania Railroad (at Menlo Park) to minimize disruption to existing uses. Moving east from Bound Brook the route passes through increasingly dense development and the full range of land uses, although the predominant use along the route is mixed industrial/commericial. Construction impacts will only be experienced along one discreet section of the route at a time, and standard practices are available to minimize the air and noise pollution. Further controls related to construction scheduling may be necessary to reduce noise where the pipeline crosses through a residential area.

Land Use - It is roughly estimated that the existing 150 mgd treatment plant might require five additional acres through expansion. (Acreage needed for the pipeline ROW not calculated).

Water Quantity & Quality - At present, Round Valley is supplied by South Branch pumping and direct precipitation, and is used mainly for storage, not for water supply. This project would use the stored water in both the Spruce Run and Round Valley Reservoirs through transmission to Bound Brook during periods of deficient natural flow.

Terrestrial & Aquatic Habitats - No terrestrial habitat is expected to be impacted. The pipeline will cross and potentially affect the follow surface waters and wetlands: Ambrose Brook, Dismal Swamp, South Branch Rahway River, Rahway River, Orchard Brook, Elizabeth River, Passaic River, Hackensack River and the tidal marshes (Hackensack Meadowlands) in Kearny, Hudson County. The wetlands would be expected to recover within relatively short period of time. State stream encroachment permits would be required for each stream or river crossing and U.S. Army Corps of Engineers permits would be required for lines crossing navigable waters. Periodic reduced flows in streams fed by the two reservoirs (see above) may impact temperature-sensitive fish species.

Displacement - Expansion of the Bound Brook treatment plant will probably not require displacement. If the pipeline route follows the railroad right-of-ways (ROWs) no displacement should be necessary.

Uses/Purposes - The net yield of the project is estimated to be 160 mgd. The Elizabethtown Water Company has rights to 79 mgd safe yield out of this total. Newark or Jersey City may be the ultimate users.

Transportation - The pipeline would probably cross several local roads and at least two state highways. Temporary impacts on traffic may result where it is not feasible to use jacking to install the pipe so as not to tear up the roadway.

Visual Quality - The expanded treatment plant will probably not be visible from a nearby residential area; the pipeline will be buried along its length and will have no visual impact except temporarily during construction; the existing intake at Bound Brook, it is estimated, would be expanded to a box-like structure about 10'x10' in diameter and have minimal visual impact.

NO. 2A RARITAN-NORTHEAST PIPELINE
(Reinforcing Purveyor Systems)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 2A Name Raritan-Northeast Pipeline (Purveyor System Reinforcement) Identification No. 25

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Somerset, Middlesex, Morris, Union, Essex, ~~Hudson~~

Author Developed by SWSMP Consultants Title Task 3E Output Library No.

Updated Costs to 1980 (ENR 3100)(1)

Capital For construction, design, land acquisition, etc. treatment facilities, reinforcment of existing purveyors system from Bound Brook to Morris, Essex, Hudson & Middlesex Counties.	$73,800,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	$8,731,000(2)
Cost per million gallons based on 80 mgd usage	$299(3)

(1) Costs updated from NEWS Report Appendix H

(2) Fees for RV/SR in addition to this sum

(3) Electric Power costs set at 4¢ KwHr

This project is designed to utilize existing purveyors delivery systems to the greatest extent practical. Reinforcements, parallel construction, booster stations and storage facilities can accomplish the same result as the one major pipeline described in Project 2.

Unlike Project 2, this one is quite flexible and the various components may be constructed over a period of time. The water treatment facilities may also be expanded incrementally. Units of ten mgd would allow the 80 mgd available in the Raritan River to be recovered in step with increased demands.

Of the 1990 demands, those of northern Middlesex, Union, Essex, Hudson, Morris and Somerset all to the north and east of Bound Brook may be served within a twenty-five mile radius of that point. Additional demands in Bergen County amount to 26 mgd. Substitution of existing sources could allow some of that demand to be satisfied from this source.

The exact routes and construction required to accomplish this is subject to further study and internal review by the purveyors. It was assumed that three parallel lines of total capacity required to the west, center and east of the assumed service area along with sufficient treatment and a booster station on each line would approximate the investment required. This investment would be for new facilities or compensation for existing purveyor capacity dedicated to this use.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 2

PROJECT STATUS:

X	Concept	____	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required

_____ Sought From

_____ Obtained

DRBC _____

ACOE or other states _____

WP&SC X

N.J. Legislature _____

Pinelands Commission _____

D&R Canal Commission _____

Sponsor or Lead Agency Identified Not available although EWCo. would have to be involved

Identified Support or Opposition None as of now.

FINANCIAL:

STATUS OF FUNDS:

_____ $ Already Committed

_____ Financing Anticipated

X Financing Uncertain

_____ Not Significant

For

Site Acquisition _____

Prel. Planning _____

Design _____

Construction _____

Sources of Funds Not available

Pay Back Arrangement: _____ Outright Grant X Not Known

_____ Bond Debt Service _____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Moves water to water short areas of northeast; makes maximum use of existing facilities.

SHOULD NOT: Project 1 or 29 may be more beneficial after a more complete analysis.

NO. 3 CONFLUENCE RESERVOIR, PUMP STATION & FORCE MAIN

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 3 Name Confluence Reservoir, Pump Station & Force Main Identification No. 24, 25

Region(s) 1 Basin(s) Raritan County(ies) Somerset, Hunterdon

Author NJ COE Title NEWS Report Nov. 1971 Library No. 202

Rpt. on Alt. Wtr. Sup. Proj. 1206.01

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc. of impoundment, raw water pumping and transmission to Round Valley	$83,000,000
Operation and Maintenance and Annual Costs[2] Amortization, personnel, power, etc.	8,300,000
Cost per million gallons[2] based on 50 mgd yield	455

Yield - Based on drought of 1960's 50 mgd

Remarks - Raw water in Raritan River below confluence

(1) Costs updated from NEWS Report adjusted by factors appearing in Appendix H thereof to reflect deletion of both water treatment and finished water transmission, except power adjusted to 4¢/Kwhr.

(2) Fees for use of R.V./S.R. in addition to this sum

ENVIRONMENTAL EVALUATION

No. 3 Name Confluence Reservoir L.O.R.D.S. No. _____

Pump Station & Force Main Atlas Sheets 24, 25

Region (s) 1 Basin (s) Raritan County (ies) Somerset,

Morris and Union

IMPACT ANALYSIS

Construction - Approximately 400 acres of cropland or pasture will have to be cleared for the reservoir. (Although unlikely, if the topsoil is deemed sufficiently high in nutrients or economically valuable it may be necessary to remove it. This could cause erosion in areas of steep slopes.) A 60' high earthen dam would be constructed at the confluence of the North Branch and the South Branch of the Raritan. The force main is estimated to be about 6' in diameter and 10.4 miles long -- assumed to follow main roads then switch to the Central Rail Road of New Jersey ROW as it travels southeast. The pipeline route would cross forested land, run along the periphery of residential areas in Raritan and Somerville, and cross industrial/commericial land. Construction of the reservoir may affect residents in eastern Branchburg Township in the vicinity of U.S. Route 202. Temporary impacts of construction activities potentially affecting workers on site and residents in adjacent areas include: 1) air borne dust 2) exhaust and smoke emissions from equipment 3) vehicular and equipment noise. Standard practices are available to minimize these impacts.

Land Use - As of 12/76, 522 acres of land had been purchased under the Green Acres program, and 87 acres remained to be acquired (probably does not include the pipeline ROW). This land is predominantly cropland or pasture.

The Somerset County Master Plan assumes the construction of the Confluence Reservoir and calls for low density rural development from Raritan Township to Hillsborough and Branchburg Townships in part to protect the reservoir from non-point sources.

Water Quantity & Quality - Construction of the reservoir may temporarily increase turbidity in the main stem of the Raritan in the vicinity of the dam. Streams crossed by the pipeline include minor tributaries of Rockaway Creek and Chambers Brook, and possibly Holland Brook. State stream encroachment permits would be required. Construction of these crossings would cause temporary, localized turbidity increases.

Terrestrial & Aquatic Habitats - Although the exact site of the reservoir is not determined as yet, it appears that it could inundate primarily crop and pasture land and parts of two stands of deciduous forest. The ecology of the inundated parts of the North Branch and the South Branch of the Raritan would be altered by the instream reservoir.

Displacement - Displacement resulting from the acquisition of the remaining 87 acres is not expected to be significant.

Uses/Purposes - The reservoir water would be available to the Elizabethtown Water Company, and others.

Transportation - A short stretch of U.S. Route 202 could be inundated.

Visual Quality - No significant negative impact is expected.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 3

PROJECT STATUS:

____ Concept ____ Preliminary Planning __X__ Design ____ Construction ____ Site Acquired

INSTITUTIONAL:

APPROVALS: __X__ Required _____ Sought _____ Obtained

From: DRBC _____; ACOE or other states _____; WP&SC _____; N.J. Legislature 1,2; Pinelands Commission _____; D&R Canal Commission _____

Sponsor or Lead Agency Identified State DEP

Identified Support or Opposition Legislature, voters and Somerset

County have supported reservoir, pump station and force main portions of this project.

FINANCIAL:

STATUS OF FUNDS: (1) X $ Already Committed; _____ Financing Anticipated; (2) X Financing Uncertain; _____ Not Significant

For: Site Acquisition 1; Prel. Planning 1; Design 1; Construction 2

Sources of Funds Most likely a State Bond Issue

Pay Back Arrangement: _____ Outright Grant __X__ Not Known; _____ Bond Debt Service _____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Contributes to the completion of the Raritan Basin Development; significant investment and project development.

SHOULD NOT: Unforeseen detailed issue not presently uncovered; inability to finance construction.

NO. 4 DELAWARE RIVER DIVERSION TO RARITAN RIVER

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 4 Name Delaware River Diversion to Raritan River Identification No. 24, 25

Region(s) 1, 6 Basin(s) Delaware, Raritan County(ies) Hunterdon, Somerset

Author COE, Newark Title NEWS Study Nov. 1971; Alt. W.S. for Newark HS/CB 1974 Library No. 202; 1206.01

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc. as detailed in project description	$461,000,000
Operation and Maintenance and Annual Costs[2] Amortization, personnel, power, etc.	57,700,000
Cost per million gallons[2] based on 300 mgd yield	527
Yield - Based on drought of 1960's[3]	300 mgd

Remarks - Treated water at Bound Brook.

(1) Costs updated by ENR Construction Cost Index - from NEWS Study except power adjusted to 4¢/Kwhr. Does not include costs of Tocks Island, source of raw water.

(2) Fees for use of Round Valley extra

(3) Depends on Tocks Island or other Delaware River Basin storage.

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 4 Name Delaware River Diversion to Raritan River L.O.R.D.S. No. _____ Atlas Sheets 24, 25

Region (s) 1,6 Basin (s) Raritan County (ies) Hunterdon, Somerset

IMPACT ANALYSIS

Construction - Temporary construction effects for the diversion tunnel, intake and pumping systems, and the transmission lines are minimal. Temporary effects to construction workers and residents within the site area include: airborne dust; smoke plume and exhaust emissions from construction activity; and vehicular and equipment noise.

Terrestrial & Aquatic Life - Minor effects may include: distruption of natural habitats, migration routes, and spawning areas; possible impingement and entrainment of aquatic species in both the Delaware River and the North and South Branches of the Raritan River; and temporary removal of vegetation.

Water Quantity & Quality - The impact of using the Raritan River to transmit Delaware River Diversions may include a short term increase in turbidity from disturbance of the stream channel soils. The channel boundary includes the bed and banks of the channel. Intermittent releases of flow into stream may cause temporary turbidity due to initial flushing or erosion. If a constant release is sustained, turbidity may dissipate after the initial erosion and deposition process which is further dependent on channel geometry and hydraulic parameters. The long term effect, however, may be the stabilization of the channel.

Land Use - Several acres needed for intake, treatment plant and pump station facilities.

Displacement - Unknown.

Economic Development - This project alternative is contingent on the Tocks Island Reservoir project. There may be a future need for a pump station and force main when in-stream transmission is available to Bound Brook.

Uses/Purposes - Water supply, storage and distribution

Transportation - Temporary traffic disruptions may occur during the construction periods.

Visual Quality - Special attention should be given to the design and landscaping of the treatment plant facility.

NO. 5 DELAWARE RIVER FLOOD SKIMMING TO RARITAN

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 5 Name Delaware River Flood Skimming to Raritan Identification No. 24, 25

Region(s) 1, 6 Basin(s) Delaware, Raritan County(ies) Hunterdon, Somerset

Author COE Title NEWS Report Nov. 1971; Rept. on Alt. Wtr. Sup. Proj. City of Newark, 1974 Library No. 202; 1206.1

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc. as detailed in project description.	$250,000,000
Operation and Maintenance and Annual Costs[2] Amortization, personnel, power, etc.	29,400,000
Cost per million gallons[2] based on 100 mgd yield	804

Yield - Based on drought of 1960's 100 mgd

Remarks - Treated water at Bound Brook, NJ.

(1) Costs updated by ENR index except power adjusted to 4¢/Kwhr

(2) Fees for Round Valley extra

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 5 Name Delaware River Flood L.O.R.D.S. No. _____

Skimming to Raritan Atlas Sheets 24, 25

Region (s) 1,6 Basin (s) Delaware/Raritan County (ies) Hunterdon

Somerset

IMPACT ANALYSIS

Construction - Temporary major effects may include: erosion and sediment runoff and alteration of ground surfaces; spoil disposal. An erosion and sediment control plan may be necessary. Temporary impacts include: airborne dust; smoke plume and exhaust emission from construction activity; and vehicular and equipment noise.

Terrestrial & Aquatic Life - Environmental impacts may include: permanent removal of vegetation in areas of treatment plant and pipeline construction; disruption of natural habitats, migration routes and spawning areas; and possible impingement and entrainment of aquatic species.

Water Quantity & Quality - Surface water turbidity is likely to occur throughout the entire system. Possible water quality impacts from in-stream transmission i.e., stream encroachment. Erosion and sediment accumulation is possible in downstream flow areas.

Land Use - Several acres are needed for intake treatment plant and pumping station facilities.

Displacement - Unknown.

Economic Development - This project alternative relies on the ability of Round Valley Reservoir to increase storage for several water supply systems.

Uses/Purposes - Water supply and storage.

Transportation - Temporary traffic disruption may occur as a result of construction activity.

Visual Quality - Special attention should be given to designing all treatment plants so they may blend in with the landscape of the area.

NO. 6 DELAWARE RIVER FLOOD SKIMMING TO RARITAN, ROUND VALLEY EXPANSION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 6 Name Delaware River Flood Skimming to Raritan, Round Valley Expansion Identification No. 24

Region(s) 1, 6 Basin(s) Delaware, Raritan County(ies) Hunterdon, Somerset

Author COE Title NEWS Report Nov. 1971 Library No. 202

Updated Costs to 1980 (ENR 3100)[1]

Capital[2] For construction, design, land acquisition, etc. as detailed in project description	$284,000,000
Operation and Maintenance and Annual Costs[3] Amortization, personnel, power, etc.	36,300,000
Cost per million gallons[3] based on 150 mgd yield	662

Yield - Based on drought of 1960's 150 mgd

Remarks - Costs based on summation of Project 5 plus Project 14 and other adjustments.

(1) Costs updated by ENR index except power adjusted to 4¢/Kwhr

(2) Cost for Round Valley outlet, North Dam included

(3) Fees for use of R.V./S.R. additional

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 6 Name Delaware River Flood Skimming to Raritan, Round Valley Expansion L.O.R.D.S. No. _____ Atlas Sheets 24,25

Region (s) 1,6 Basin (s) Delaware/Raritan County (ies) Hunterdon, Somerset

IMPACT ANALYSIS

Construction - Temporary minor effects may include: erosion and sediment runoff and alteration of ground surfaces; spoil disposal. An erosion and sediment control plan may be necessary. Short term impacts include: air borne dust, smoke plume and exhaust emission from construction activity; and vehicular and equipment noise.

Terrestrial & Aquatic Life - Permanent loss of vegetation may occur as the boundaries of the Round Valley Reservoir are expanded. Temporary disruption of natural habitats, migration routes, and spawning areas may also occur.

Water Quantity & Quality - Temporary impacts may include: surface water turbidity; erosion and sediment runoff; and decreased groundwater levels. Special attention should be given to flood control.

Land Use - Additional land is needed for Reservoir expansion.

Displacement - Unknown.

Economic Development - Expansion of Round Valley Reservoir may provide increased yield of 50 mgd and storage from 55 BG to 75 BG.

Uses/Purposes - Water supply and storage.

Transportation - Temporary traffic disruption may occur as a result of construction activity.

Visual Quality - Special attention should be given to designing all treatment plants so they may blend in with the landscape of the area.

NO. 7 DELAWARE AND RARITAN CANAL IMPROVEMENTS

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 7 Name Delaware and Raritan Canal Improvements Identification No. 25, 27 & 28

Region(s) 1, 6 Basin(s) Delaware, Raritan County(ies) Mercer, Somerset

Author SNJ, COE Title Water Res. Cir. 21; NEWS Report Noc. 1971 Library No. 1006; 202

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$ 3,700,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc. (Incremental, above existing canal costs)	316,000
Cost per million gallons for additional water based on 25 mgd yield [2]	35

Yield - Based on **full utilization** of US Supreme Courts 1954 decision permitting NJ 100 mgd from Delaware

[1] Costs updated by ENR index

[2] Yield of 25 mgd - proj 7.

ENVIRONMENTAL EVALUATION

No. 7 & 10 Name Delaware and Raritan Canal L.O.R.D.S. No. _____

Optimization Atlas Sheets 25, 27, 28

Region (s) 1,6 Basins (s) Raritan, Delaware County (ies) __

Raritan, Delaware Somerset, Mercer, Hunderdon,

IMPACT ANALYSIS

Construction - The specific physical improvements and their locations are currently under study and are not known at this time. Activities could include lining the Canal to reduce seepage losses; dredging to remove accumulated sediment; other improvements to increase hydraulic capacity and reduce flooding such as raising the height of the banks of the Canal where it joins other surface waters; and development of improved maintenance plans.

The Canal crosses the low divide between the Raritan and Delaware Rivers and passes through Middlesex, Somerset, Mercer and Hunterdon Counties. It passes through urbanized areas in New Brunswick and Trenton while along much of its length it crosses forests, farmland and suburban areas.

One specific, preliminary recommendation of the current study involves the removal of sediments accumulated in the Trenton double conduit to restore the hydraulic capacity of the Canal and to protect downstream waters from metals, toxic substances, organics and oil and grease from deposited matter.

The extent of land to be disturbed will depend on the extent of dredging, if any, and the method used. Use of a hydraulic suction dredge or some other piece of equipment that could operate from a barge in the river would eliminate the need to clear a path along the banks of the Canal for a dragline dredge (a tractor-like piece of equipment with a bucket suspended from a cable). However, almost all dredging methods would require the establishment of spoil banks or settling ponds to deposit the removed sediment. Raising bank heights in flood-prone areas would also involve earthmoving. Erosion and sediment control plans for these activities would have to be developed.

Other temporary impacts would include increases in 1) air borne dust 2) exhuast and smoke emissions from equipment 3) vehicular and equipment noise. Standard practices are available to minimize these impacts.

Land Use - The extent of land temporarily affected by construction is unknown at this time.

Water Quantity & Quality - Earlier plans called for improvements to result in a capacity of 120 mgd to yield an average 100 mgd. Current capacity for intake is 90 mgd which is effectively reduced by seepage losses to 75 mgd.

Temporary effects on water quality would be increased turbidity and the possible release of organics or chemical pollutants from the sediments that go into

solution. This can be minimized through the use of proper techniques. Foreign substances would be further removed during the water treatment process. A particular problem could result if significant phenol levels are found. This is because phenols dissolve when chlorinated and can impart an objectionable odor to drinking water. Long term effects that may be expected include improved water quality due to the removal of polluted sediment.

Terrestrial & Aquatic Habitats - Because specific improvements to be undertaken are unknown at this time impacts can only be generally discussed. The dredging operations and alteration in bank profiles could result in temporary loss of shoreline vegetation. The removal of a significant portion of overhanging trees should be avoided to minimize erosion and also prevent changes to the temperature of Canal waters (trees provide shade).

Lining the Canal bottom would substantially alter its ecology by removing the benethic community, a source of food supply for the aquatic species. Periodic maintenance dredging would prevent the eventual re-establishment of the benthos.

Displacement - No displacement is expected.

Uses/Purposes - The prime objective of the project is to increase the water supply yield to several water companies and industries and to reduce flooding. Improvements may also provide new opportunities for recreational, industrial and agricultural use of the Canal along its 60-mile length.

Transportation - No impact is expected.

Visual Quality - Because the Canal is used for recreational purposes visual impacts of construction and possibly of operation are an important issue. The creation of settling basins or spoil ponds could result in temporary visual problems depending on location. If bank heights are raised in some areas, the view from shore and upland areas could be altered.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 7

PROJECT STATUS:

X	Concept	X	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required ____ Sought ____ Obtained

From: DRBC ____; ACOE or other states ____; WP&SC X; N.J. Legislature ____; Pinelands Commission ____; D&R Canal Commission X

Sponsor or Lead Agency Identified State DEP

Identified Support or Opposition ____

FINANCIAL:

STATUS OF FUNDS: X $ Already Committed; ____ Financing Anticipated; ____ Financing Uncertain; ____ Not Significant

For: Site Acquisition ____; Prel. Planning X; Design ____; Construction ____

Sources of Funds State Bond Issue

Pay Back Arrangement: ____ Outright Grant; ____ Not Known; ____ Bond Debt Service; X User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Project is an improvement to an existing facility which would permit full use of NJ's 100 MGD allocation to Delaware River.

SHOULD NOT: More economical projects to provide an equivalent yield; problems in ga ning D&R Canal Commission approval if significant alterations are required.

NO. 8 SIX MILE RUN RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 8 Name Six Mile Run Reservoir Identification No. 25-43-400

Region(s) 1 Basin(s) Raritan, Delaware County(ies) Somerset

Author SNJ Title Reference - NEWS Rept. Nov 71 Library No. 202

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$27,500,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	2,555,000
Cost per million gallons based on 38 mgd yield (2)	184

Yield - Based on full utilization of US Supreme Courts 1954 decision permitting NJ 100 mgd from Delaware

(1) Costs updated by ENR index

(2) Yield includes 28 mgd from Six Mile Run pumped storage and 10 mgd from impounding Six Mile Run. Other costs from SNJ applied to Delaware and Raritan Canal not included.

ENVIRONMENTAL EVALUATION

No. 8 Name Six Mile Run Reservoir L.O.R.D.S. No. 25-43-400

Region (s) 1 Basin (s) Raritan/Delaware County (ies) Middlesex

IMPACT ANALYSIS

Construction - Creation of the reservoir will involve clear-cutting the site and the construction of a dam about 45' high. The reservoir will inundate approximately 650 acres of crop, pasture and forested land. A pump station (approximately 20'x30') and a pipeline to withdraw at rates up to 50 mgd from the Delaware and Raritan Canal would also be constructed (specific location undetermined).

Temporary impacts will include increases in 1) air borne dust 2) exhaust and smoke emissions from equipment 3) vehicular and equipment noise. Standard practices are available to minimize these impacts.

Land Use - As noted above, about 650 acres of predominantly cropland, pasture and some forest would be lost due to inundation. A total of 2869 acres will be acquired (2553 already purchased). This larger parcel is predominantly cropland also.

Water Quantity & Quality - Six Mile Run Reservoir would serve as a storage facility for the new capacity created in the Delaware and Raritan (D&R) Canal by Projects No. 7 and No. 10. As such, it could affect the flow characteristics of the D&R Canal. The hydrology of Six Mile Run would be completely altered along a significant portion of its length.

Construction activities could result in temporarily increased turbidity downstream of the reservoir in Six Mile Run and the D&R Canal.

The Middlesex County Areawide Water Quality Management Plan (1977) notes that the Lower Millstone Basin (which includes Six Mile Run) is a developing area with eutrophic impoundments. It recommends alternative types of land use controls to prevent this problem from affecting future impoundments.

Terrestrial & Aquatic Habitats - 650 acres of crop and pasture land and some deciduous forest would be lost. Some small wetland areas may also be inundated.

The ecology of the inundated parts of Six Mile Run will be significantly altered by the creation of the instream reservoir. The impact on fish, however, may be minimized by the fact that it is the downsteam end of Six Mile Run that would be affected.

Displacement - Unknown.

Uses/Purposes - Storage reservoir to regulate an improved D&R Canal. It will enable water to be sold on an average annual day rather than peak day basis.

Transportation - A number of local roads would be inundated in part.

Visual Quality - Impacts during construction probably will not be significant because of the distance from residential areas.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 8

PROJECT STATUS:

X	Concept	X	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: (2)X Required ____ Sought (1)X Obtained

From: DRBC ____; ACOE or other states ____; WP&SC 2; N.J. Legislature 1,2; Pinelands Commission ____; D&R Canal Commission X

Sponsor or Lead Agency Identified State DEP

Identified Support or Opposition None Known

FINANCIAL:

STATUS OF FUNDS: 1 $ Already Committed; ____ Financing Anticipated; 2 Financing Uncertain; ____ Not Significant

For: Site Acquisition 1; Prel. Planning 1; Design 2; Construction 2

Sources of Funds Uncertain

Pay Back Arrangement: ____ Outright Grant X Not Known; ____ Bond Debt Service ____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Would increase effecitve yield of the Canal; State has ownership.

SHOULD NOT: Project 7 or 10 might be more economical.

NO. 10 DELAWARE AND RARITAN CANAL OPTIMIZATION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 10 Name Delaware and Raritan Canal Optimization Identification No. 27, 28 & 25

Region(s) 1, 6 Basin(s) Delaware, Raritan County(ies) Mercer, Somerset, Middlesex

Author SNJ Title NJDEP Rutgers Univ. Study Library No. 1015

Updated Costs to 1980 (ENR 3100)

Capital For construction, design, land acquisition, etc.	Unavailable
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	Unavailable
Cost per million gallons	Unavailable

Yield - Based on utilization of up to 100 mgd allowed NJ by 1954 US Supreme Court decree

Remarks - Costs to be developed by University study

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 10 Name Delaware-Raritan Canal Optimization L.O.R.D.S. No. Atlas Sheets 25,27,28

Region (s) 1,6 Basin (s) Raritan Delaware County (ies) Somerset, Hunterdon, Mercer

IMPACT ANALYSIS

Construction - The canal's ecosystem may be impacted as a result of construction/ rehabilitation activity.

Terrestrial & Aquatic Life - Increased usage may increase velocity into the canal resulting in minor entrainment of aquatic species.

Water Quantity & Quality - No significant impact.

Land Use - Existing agricultural land may be maintained as a result of improved irrigation.

Displacement - No displacement will occur.

Economic Development - May encourage some development as a result of additional supplies for industry and agriculture.

Uses/Purposes - Water supply, flood control, and a potential for water storage.

Transportation - No significant impact.

Visual Quality - No significant change.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 10

PROJECT STATUS:

X	Concept		Preliminary Planning		Design		Construction		Site Acquired

INSTITUTIONAL:

APPROVALS: X Required

_____ Sought

_____ Obtained

From

DRBC _____

ACOE or other states _____

WP&SC X

N.J. Legislature X(Perhaps)

Pinelands Commission _____

D&R Canal Commission _____

Sponsor or Lead Agency Identified Probably State DEP

Identified Support or Opposition _____

FINANCIAL:

STATUS OF FUNDS:

_____ $ Already Committed

_____ Financing Anticipated

X Financing Uncertain

_____ Not Significant

For

Site Acquisition _____

Prel. Planning X

Design X

Construction X

Sources of Funds Uncertain

Pay Back Arrangement:

_____ Outright Grant

_____ Bond Debt Service

_____ Not Known

X Uncertain

_____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Does not require expenditure of capital to increase effective yield.

SHOULD NOT: Duplicates to a degree 7,8; also must be considered in a cost effectiveness analysis.

NO. 13 UPPER RARITAN PIPELINES

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 13 Name Upper Raritan Pipeline Identification No. 24 & 25

Region(s) 1 Basin(s) Raritan County(ies) Hunterdon, Morris, Somerset

Author SNJ Title Raritan R.B. Nat. Flow-Res. Supply Sys. Library No. 1008.1

Updated Costs to 1980 (ENR 3100)

Capital For construction, design, land acquisition, etc.	Unavailable
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	Unavailable
Cost per million gallons	Unavailable

Yield - not determined

Remarks - Yields and pipe carrying capacity and discharge rates to streams have not been determined and therefore costs not developed

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 13 Name Upper Raritan Pipeline L.O.R.D.S. No. _____

Atlas Sheets 24, 25

Region (s) 1 Basin (s) Raritan County (ies) Hunterdon, Morris, Somerset

IMPACT ANALYSIS

Construction - Short term effects of construction could include: erosion and sediment runoff along pipelines -- this may require an erosion and sediment control plan; air borne dust; smoke plume and exhaust emission from construction equipment; and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Localized alteration of size, density, and distribution of species may occur along the ROW. The disruption may temporarily alter the natural habitats and migration routes of some terrestrial and aquatic species.

Water Quantity & Quality - Temporary impacts could include: reduced water quality due to in-stream transmission; increased surface water turbidity during construction. Prevention of stream encroachment along the pipeline route is necessary. Temporary contamination of toxic or hazardous runoff may occur. Accumulation of sediment downstream from the construction site should be avoided.

Land Use - Several acres must be acquired for pipeline and adjacent ROW.

Displacement - Unknown.

Economic Development - Increases net year storage capacity of project #28 system (Delaware Diversion to Two Bridges). Yields and pipe carrying capacity and discharge rates to streams have not been determined. Costs not developed.

Uses/Purposes - Water supply and storage.

Transportation - Short term traffic disruptions may result from construction activity.

Visual Quality - No significant impacts.

NO. 14 ROUND VALLEY RESERVOIR EXPANSION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 14 Name Round Valley Reservoir Expansion Identification No. 24-34-300

Region(s) 1 Basin(s) Raritan County(ies) Hunterdon

Author SNJ Title NEWS Report Library No. 202

Water Resources Circ. 21 1006

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$23,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc. due to expansion.	1,620,000
Cost per million gallons[2] based on 27 mgd yield	164
Yield - Based on drought of 1960's	27 mgd

(1) Costs updated by ENR index deducting from escalation those costs associated with North Dam outlet works

(2) Incremental cost only; total R.V./S.R. costs would reflect combining present costs for existing impoundment to these.
Power costs for project pumping estimated at 4¢/Kwhr

ENVIRONMENTAL EVALUATION

No. 14 Name Round Valley Reservoir Expansion L.O.R.D.S. No. 24-34-300

Regions (s) 1 Basin (s) Raritan County (ies) Hunterdon

IMPACT ANALYSIS

Construction - Expansion of the 2340 acre reservoir will inundate an additional 230 acres. Construction activity will include increasing the height of the two dams by 25' and raising the height of a dike. (The North Dam outlet is completed). The new reservoir area will have to be cleared of vegetation.

Temporary impacts could include increases in 1) air borne dust 2) exhuast and smoke emissions from equipment 3) vehicular and equipment noise. Standard practices are available to minimize these impacts.

Land Use - Round Valley is surrounded by a 400 acre recreational area that probably will in some way be impacted by the expansion. At the southwestern portion of the reservoir is a "day use" area with facilities for swimming and picnicking and a Fish and Game Department boat launch; on the eastern side is a wilderness camp site in a wooded area. Planning for recently constructed and future facilities has taken the reservoir expansion into consideration. However, a parking lot and a few campsites in the wilderness area would have to be moved as would the boat launch. These changes are not considered a major impact by design engineers in the state parks agency as long as the inundated area does not rise above 420 msl. Exceeding this elevation would have an adverse impact on many of the park's recreational facilities.

Water Quantity & Quality - The reservoir is designed to release up to 400 mgd (minimum storage) at the North Dam to the South Branch of Rockaway Creek. This water is not now being used. Alterations to the dams and dikes may result in temporary turbidity increases in the reservoir, Prescott Brook and the South Branch of Rockaway Creek.

The water for the expansion could be diverted from the Confluence Reservoir or Hamden Pump Station. The originally proposed source was to be high-flow skimming from the Delaware River at Frenchtown which is no longer being considered actively.

Terrestrial & Aquatic Habitats - Some shoreline vegetation including deciduous forest would probably be clear cut. Inundation of fish spawning areas along the shore of the reservoir, if they exist, could reduce the fish population in the short-term.

Displacement - (See Land Use Section above).

Uses/Purposes - If Project 3 is also constructed a total of an additional 77 mgd would be available for sale while maintaining a 90 mgd passing flow at Bound Brook.

Transportation - A park access road in the wilderness area may have to be partially relocated.

Visual Quality - Temporary negative impacts during land clearance and dam modifications may affect recreational users of the reservoir. No permanent impacts are expected.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 14

PROJECT STATUS:

X	Concept	____	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required

____ Sought

____ Obtained

From

DRBC ____

ACOE or other states ____

WP&SC X

N.J. Legislature X (Probably)

Pinelands Commission ____

D&R Canal Commission ____

Sponsor or Lead Agency Identified State DEP

Identified Support or Opposition Uncertain

FINANCIAL:

STATUS OF FUNDS:

____ $ Already Committed

____ Financing Anticipated

X Financing Uncertain

____ Not Significant

For

Site Acquisition ____

Prel. Planning X

Design X

Construction X

Sources of Funds Uncertain

Pay Back Arrangement: ____ Outright Grant ____ Not Known X Uncertain

____ Bond Debt Service ____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Utilizes an existing site; fits with several development options for overall Raritan development.

SHOULD NOT: Requires additional water from confluence project (3) or similar equivalent.

NO. 16 HACKLEBARNEY RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 16 Name Hacklebarney Reservoir Identification No. 25-21-200

Region(s) 1 Basin(s) Raritan County(ies) Morris

Author	Title	Library No.
SNJ	TAMS Report 1955	757
	Reserv. Sites NJ 1966	810
	NEWS Study Nov. 1971	202

Updated Costs to 1980 (ENR 3100) (1)

Capital
For construction, design, land acquisition, etc. $19,500,000

Operation and Maintenance and Annual Costs
Amortization, personnel, power, etc. $1,710,000

Cost per million gallons (2)
based on 16.5 mgd yield 283

Yield - Based on assumed net yield of 1/2 mgd per square mile with adequate storage

(1) Costs developed based on parallel impoundments using ENR indexed cost update of parameters contained in App. H NEWS Study, Nov. 1971

(2) Raw water in impoundment

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 16 Name Hacklebarney Reservoir L.O.R.D.S. No. 25-21-200

Region (s) 1 Basin (s) Raritan, Lamington County (ies) Morris

IMPACT ANALYSIS

Construction - Special attention should be given to large amounts of spoil disposal. Temporary impacts include: erosion and sediment runoff and alteration of ground surfaces. A long-term erosion and sediment control plan may be necessary. Short-term minor impacts which will affect construction workers and residents within the site area include: airborne dust; smoke plume and exhaust emission from construction activity; and vehicular and equipment noise.

Terrestrial & Aquatic Life - Temporary effects may include disruption of natural habitats, migration routes, and spawning areas. Long-term minor effects include a permanent loss of vegetation and possibly an alteration in size, diversity and distribution of terrestrial and aquatic species.

Water Quantity & Quality - Short-term effects may include: erosion and sediment runoff; surface water turbidity; and a possible decrease in groundwater levels. Long-term effects include major drainage realignment of 35 sq. miles which must be designed with flood plain considerations.

Land Use - State Park inundated.

Displacement - Unknown.

Economic Development - Limitation on yield due to possible conflict with Confluence Pump Station. Additional supply of 11.0 BG from Hacklebarney Reservoir.

Uses/Purposes - Water supply and storage.

Transportation - Short-term traffic disruptions may occur a a result of construction activity.

Visual Quality - Unknown.

NO. 17 RAVINE LAKE RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 17 Name Ravine Lake Reservoir Identification No. 25-22-100

Region(s) 1 Basin(s) Raritan, North Branch County(ies) Somerset, Morris

Author SNJ Title Site Aquis. Rpt. 1966; Reservoir Sites NJ 1966; NEWS Report Nov. 1971 Library No. 1017; 810; 202

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$19,500,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	1,690,000
Cost per million gallons[2] based on 13.5 mgd yield	343

Yield - Based on assumed net yield of 1/2 mgd per square mile of watershed with adequate (8 B.G.) storage

(1) Capital costs updated by ENR index, O&M costs developed

(2) Raw water impounded in reservoir

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 17 Name Ravine Lake Reservoir L.O.R.D.S. No. 25-22-100

Region (s) 1 Basin (s) Raritan, North Branch County (ies) Somerset, Morris

IMPACT ANALYSIS

Construction - Minor construction impacts may include: erosion and sediment runoff altering ground surfaces. Temporary impacts that will affect construction workers and residents within the site include: airborne dust; smoke plume and exhaust emissions from construction activity; and vehicular and equipment noise.

Terrestrial & Aquatic Life - Temporary effects may include disruption of natural habitats, migration routes and spawning areas. Long term effects include a permanent loss of vegetation and possibly an alteration in size, diversity and distribution of terrestrial and aquatic species.

Water Quantity & Quality - Short term effects may include: erosion and sediment runoff; surface water turbidity; a possible decrease in groundwater levels; minor drainage realignment of 27 squre miles which may need to be designed with flood plain considerations.

Land Use - Inundates existing Ravine Lake.

Displacement - of families, businesses and facilities. Extent of displacement is unknown.

Economic Development - Limitation on yield due to possible conflict with Confluence Pump Station. Additional supply of 8.0 BG provided by spillway crest at 318.5 feet MSL at Ravine Lake Reservoir. While considered small for a regional project, it might be operated as a terminal storage reservoir for a Delaware River diversion.

Uses/Purposes - Water supply and water storage.

Transportation - Temporary traffic disruptions may occur as a result of construction activity.

Visual Quality - Unknown.

NO. 25 BARTLEY RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 25 Name Bartley Reservoir Identification No. 25-11-200

Region(s) 1 Basin(s) Raritan, South Branch County(ies) Morris

Author SNJ Title Raritan R.B. Nat. Flow 1974; NEWS Report Nov. 1971 Library No. 1008.01; 202

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$53,600,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc. Power costs for pumped storage charged under projects 13 or 27, not included here.	4,300,000
Cost per million gallons[2] based on 10 mgd yield	1,180
Yield - Based on drought of 1960's	10 mgd

(1) Costs **estimated** by use of unit cost factors appearing in App. "H", NEWS Report, 1971 as adjusted by ENR Index.

(2) Local drainage area (13 sq. mi.) storage, and raw water terminal reservoir such as for Delaware River diversions.

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALATERNATIVES ANALYSIS

No. 25 Name Bartley Reservoir L.O.R.D.S. No. 25-11-200

Region (s) 1 Basin (s) Raritan South Branch County (ies) Morris

IMPACT ANALYSIS

Construction - Temporary effects will occur as a result of reservoir construction. Erosion and sediment runoff could alter the ground surface and increase turbidity. Spoil disposal must also be taken into consideration because of the large volumes involved. An erosion and sediment control plan should be prepared to insure continued and proper maintenance of this facility. Temporary impacts which will affect construction workers and residents within the surrounding area include: 1) air borne dust 2) smoke plume from construction activity 3) exhaust emissions from construction equipment 4) vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Temporary effects could result in reduction of several terrestrial and aquatic species in and around the inundated areas. The moderate loss of vegetation at the river banks and during new construction will only be a short term effect. The proper disposal of large amounts of vegetation and biota must be considered. The ecosystem within the site area will stabilize after the short term effects of alteration in size, diversity and distribution of the species has ended.

Water Quantity & Quality - Drainage realignment will affect 13 sq. mi. along the South Branch of the Raritan River. Drainage realignment must be designed with flood plain considerations. During construction an increase of surface water turbidity and temperature is expected. Minor and temporary impacts include low flows and increased flow velocity.

Land Use - 490 acres of land must be acquired for this project alternative.

Displacement - Unknown.

Economic Development - Because of the remote location of the facility, there will be a high pumping expense.

Uses/Purposes - Water supply and water storage.

Transportation - Short term traffic tie ups may occur as a result of construction activity.

Visual Quality - Unknown.

NO. 27 TWO BRIDGES RESERVOIR (W/MYERS ROAD)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 27 Name Two Bridges Reservoir (w/Myers Road) Identification No. 26-01-400

Region(s) 1 Basin(s) Passaic, Pompton County(ies) Morris, Essex, Passaic

Author	Title	Library No.
COE	Passaic Flood Plan 1968	231
	NEWS Report 1971	202
	NEWS Report 1977	229.07

Updated Costs to 1980 (ENR 3100)(1)

Capital For construction, design, land acquisition, etc. Flood control, water supply, flow augmentation and recreation	$182,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	27,000,000
Cost per million gallons based on 100 mgd yield	748

Yield - Based on drought of 1960's 100 mgd
including groundwater development from conjunctive use

(1) Costs updated by ENR index from 1975

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 27 Name Two Bridges Reservoir L.O.R.D.S. No. 26-01-400

(w/Myers Road) (Passaic River Flood Control Plan III)

Region (s) 1 Basin (s) Passaic, County (ies) Essex,

Pompton Morris

IMPACT ANALYSIS

Construction - Temporary major construction impacts include large amounts of spoil disposal, erosion and sediment runoff and altering of ground surfaces. An erosion and sediment control plan should be included for the proper design and continued maintenance of the facility. Temporary impacts affecting construction workers and residents within the site area include: air borne dust, smoke plume and exhaust emission from construction equipment, and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Temporary effects may result in the minimal reduction of several terrestrial and aquatic species. The loss in vegetation surrounding the site area is a temporary minor impact. Disposal of vegetation and biota must be considered. The ecosystem within the site area will stabilize after the short term minor effects of construction, which alter the size, diversity, and distribution of the species, have ended.

Water Quantity & Quality - Existing water quality in the area is poor. There may be a moderate eutrophication problem related to long periods of shallow water in the Passaic River. This impact can be major. Substantial development in the area provides point and non-point source runoff, lowers the groundwater and surface water quality considerably. This major impact, combined with the fact that the reservoir displaces major flood plain area and would require extensive dike system and coordinated operation of reservoir with pumping station, must be evaluated for this project alternative. There may be an increased yield in groundwater.

Land Use - Several acres of land must be acquired. Any inundated land may become park land during the dry seasons. Land use controls must be initiated.

Displacement - of families, businesses and other facilities. Extent of displacement is unknown.

Economic Development - Increased water supply serving a large area.

Uses/Purposes - Water supply of 90 mgd surface water and 8 mgd groundwater at Two Bridges. Flow augmentation of 38 mgd to Upper Passaic from Myers Road. Recreation benefits for 7.8 million people annually. Flood control using dry detention at Two Bridges, Whippany, and Myers Road sites along with levees and channel improvements on the Upper Passaic, Whippany, Ramapo, Pompton and Passaic Rivers.

Transportation - Short term traffic tie-ups may occur as a result of construction activity. Several roads, both primary and secondary, may need re-routing and raising . This can be a major impact.

Visual Quality - Unknown.

NO. 28 DELAWARE RIVER DIVERSION: FRENCHTOWN - TWO BRIDGES

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 28 Name Delaware River Diversion: Frenchtown - Two Bridges Identification No. 24, 25, 26

Region(s) 1, 6 Basin(s) Delaware, Raritan, Passaic County(ies) Warren, Hunterdon, Morris, Somerset

Author COE Title NEWS Report Nov. 1971 Library No. 202

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$970,000,000
Operation and Maintenance and Annual Costs[2] Amortization, personnel, power,	116,000,000
Cost per million gallons[3] based on 400 mgd yield	795

Yield - Based on drought of 1960's 300 mgd from Tocks Island Lake on Delaware and 100 mgd from Two Bridges project

(1) Costs updated by ENR Index from NEWS Report except power adjusted to 4¢/Kwhr

(2) Fees for use of Round Valley/Spruce Run additional to this sum

(3) Treated water available at Two Bridges, NJ

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 28 Name Delaware River Diversion L.O.R.D.S. No. _____

Frenchtown-Two Bridges Atlas Sheets 24,25,26

Region (s) 1,6 Basin (s) Delaware County (ies) Warren, Morris,

Raritan, Passaic Passaic

IMPACT ANALYSIS

Construction - Temporary major construction impacts include spoil disposal, erosion and sediment runoff, and altering of ground surfaces. An erosion and sediment control plan should be included for the continued maintenance of the facility. Temporary impacts affecting construction workers and residents within the site area include air borne dust; smoke plume, and exhaust emission from construction equipment; and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Temporary effects will result in the reduction of several terrestrial and aquatic species. The loss in vegetation surrounding the site area and along the pipeline will be a temporary impact. Disposal of biota must be considered. The ecosystem within the site area should stabilize after the short term effects of construction which alter the size, diversity, and distribution of the species have ended.

Water Quantity & Quality - Water quality in the area of the proposed Delaware River pumping station is poor. Entrainment and impingement of aquatic species may become a major impact. The construction of 70 miles of pipeline may temporarily degrade surface water turbidity in nearby streams. The construction of the 5 large pumping stations will have a short term impact on water quality. Special attention should be given to water quality impacts from stream encroachment by the pipeline.

Land Use - Large amounts of spoil may be used for landfill cover or grading around the reservoir sites.

Displacement - of families, businesses and facilities. Extent of displacement is unknown.

Economic Development - This project alternative may only be considered realistic if the Tocks Island Dam is built. There is a high capital expense for the long delivery lines.

Uses/Purposes - Water supply and storage.

Transportation - Extensive traffic diversions may occur as a result of 70 miles of pipeline construction even with small sections being placed in highway ROWs.

Visual Quality - For the pumping stations architectural design must conform with the surrounding area.

NO. 29 DELAWARE RIVER DIVERSION TO CANOE BROOK

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 29 Name Delaware River Diversion to Canoe Brook Identification No. 24 & 25

Region(s) 1, 6 Basin(s) Delaware, Raritan, Passaic County(ies) Warren, Hunterdon, Somerset, Morris, Union, Essex

Author COE Title NEWS Report Nov. 1971; Newark alt. W.S. Projects Library No. 202; 1206.01

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$615,000,000
Operation and Maintenance and Annual Costs[2] Amortization, personnel, power, etc.	65,700,000
Cost per million gallons[3] based on 300 mgd yield	600
Yield - Based on drought of 1960's	300 mgd based on Tocks Island Lake Project

(1) Costs updated by ENR Index from NEWS Report except power adjusted to 4¢/Kwhr

(2) Fees for use of Round Valley/Spruce Run additional to this sum

(3) Treated water available at Great Notch, NJ

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 29 Name Delaware River Diversion L.O.R.D.S. No. _____

To Canoe Brook - Great Notch Atlas Sheets 24,25,26

Region (s) 1,6 Basin (s) Delaware, County (ies) Hunterdon,

Raritan, Passaic Somerset, Morris, Union,

Essex

IMPACT ANALYSIS

Construction - Temporary minor construction activity includes spoil disposal and erosion and sediment runoff. Short term impacts affecting construction workers and residents within the site area include: air borne dust; smoke plume and exhaust emissions from construction equipment, and vehicular and equipment noise. Plans for control of these impacts should be considered.

Terrestrial & Aquatic Life - Temporary effects may result in the minimal reduction of several terrestrial and aquatic species. The loss in vegetation surrounding the site area is a temporary minor impact. Disposal of small amounts of biota must be considered.

Water Quantity & Quality - Short term effects from construction activity include: surface water turbidity in nearby streams and rivers; possible decrease in groundwater levels during tunnel construction. Drainage realignment must be designed with flood plain considerations. Pumping stations should be designed so as not to impinge aquatic species.

Land Use - Several acres of land must be acquired for the pipeline route, treatment plant and pumping station.

Displacement - Unknown.

Economic Development - This project provides flexibility for delivering water to southern Morris Co. and Essex Co. west of the Watchung mountains.

Uses/Purposes - Water supply.

Transportation - Short term traffic diversions may occur.

Visual Quality - Treatment plant and pumping stations should conform to architectural character of the surrounding area.

NO. 30 DELAWARE RIVER DIVERSION - PORT JERVIS TO PEQUANNOCK

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 30 Name Delaware River Diversion - Port Jervis to Pequannock Identification No. 21, 22

Region(s) 1, 6 Basin(s) Delaware, Pequannock County(ies) Sussex, Morris, Passaic

Author City Of Newark Title NEWS Report Nov. 1971 Library No. 202

Updated Costs to 1980 (ENR 3100)(1)

Capital (2) For construction, design, land acquisition, etc.	$440,000,000
Operation and Maintenance and Annual Costs (3) Amortization, personnel, power, etc.	50,100,000
Cost per million gallons based on 150 mgd yield	916
Yield - Based on drought of 1960's	150 mgd

(1) Costs updated by ENR Index from NEWS Report except power adjusted to 4¢/Kwhr

(2) Depends on TILP for compensating releases, but these costs not included

(3) One half water treated at Charlottesburg, balance treated at other Passaic River Basin plants including Jersey City system.

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 30 Name Delaware River Diversion - Port Jervis to Pequannock L.O.R.D.S. No. _____ Atlas Sheets 21 & 22

Region (s) 1 Basin (s) Delaware River, Pequannock River County (ies) Sussex, Morris, Passaic

IMPACT ANALYSIS

Construction - Tunnel construction may result in disposal problems of hard rock. Short term construction impacts include erosion and sediment runoff and alternation of ground surfaces. Temporary impacts affecting construction workers and residents within the site area include: air borne dust; smoke plume and exhaust emission from construction activity; and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Temporary effects may result in some reduction of several terrestrial and aquatic species. There may be a loss in vegetation surrounding the intake and pumping station and the pipeline areas. This is a temporary minor impact.

Water Quantity & Quality - Special attention must be given to the possible impingement and entrainment of species in the Delaware and Rockaway Rivers. Temporary impacts from pipeline construction may result in surface water turbidity in nearby streams.

Land Use - Several acres must be acquired for pipeline route construction.

Displacement - Unknown.

Economic Development - This project alternative incorporates existing systems yet additional large piping is necessary at a relatively high cost.

Uses/Purposes - Water supply and pumped storage.

Transportation - Short term traffic disruption may occur as a result of construction activity.

Visual Quality - No significant impact on visual quality.

NO. 31 DELAWARE RIVER DIVERSION, TOCKS ISLAND TO WANAQUE

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 31 Name Delaware River Diversion, Tocks Island to Wanaque Identification No. 21, 22, 23

Region(s) 1, 6 Basin(s) Delaware, Passaic County(ies) Warren, Sussex, Passaic

Author COE Title NEWS Report Nov. 1971 Library No. 202

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$760,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc. Treatment	68,800,000
Cost per million gallons[2] based on 300 mgd yield	628

Yield - Based on drought of 1960's 300 mgd from Tocks Island Lake Project

(1) Costs updated by ENR index except power adjusted to 4¢/Kwhr

(2) Treated water available at Great Notch, NJ

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 31 Name Delaware River Diversion L.O.R.D.S. No. _____

Tocks Island to Wanaque Atlas Sheets 21,22,23,36

Region (s) 1,6 Basin (s) Delaware, Passaic, Wanaque County (ies) Sussex, Passaic

IMPACT ANALYSIS

Construction - Temporary major construction impacts may include hard rock and spoil disposal; erosion and sediment runoff. Short term impacts affecting construction workers and residents within the site area include: airborne dust; smoke plume and exhaust emissions from construction activity; and vehicular and equipment noise.

Terrestrial & Aquatic Life - Temporary removal of vegetation at construction sites. Alteration of natural habitats and migration routes may occur.

Water Quantity & Quality - Short term impacts may include: surface water turbidity in nearby streams; minor alteration in groundwater levels; minor decrease in groundwater quality; and stream encroachment.

Land Use - Several acres are required for tunnel construction and ventilation shafts.

Displacement - Unknown.

Economic Development - This project alternative is contingent on the construction of the Tocks Island Dam. Cost of conversion to a pumped transmission system is high.

Uses/Purposes - Water supply and distribution. System capacity of 360 mgd between Tocks Island and Wanaque for maximum monthly demands and 450 mgd from Wanaque to Great Notch (for peak day demands). Capacity of 300 mgd in converted transmission system is questionable.

Transportation - Short term traffic disruption may occur.

Visual Quality - No significant impact.

NO. 32 HUDSON RIVER, RAMAPO DIVERSION
STAGE I

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 32 Name Hudson River, Ramapo Diversion Identification No. 23

Stage I

Region(s) 1 Basin(s) Hudson, Ramapo County(ies) Passaic

Author COE Title NEWS Report 1971; NEWS Report 1973 Library No. 202; 205.03

Updated Costs to 1980 (ENR 3100)[1]

Capital[2] For construction, design, land acquisition, etc.	$650,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	70,200,000
Cost per million gallons[3] based on 250 mgd yield	769
Yield - Based on drought of 1960's	250 mgd

(1) Costs updated by ENR Index from 1400 except power adjusted to 4¢/Kwhr

(2) Two stage project. First stage limited by compensating yields from upstate NY reservoirs

(3) Water treated, transported to Great Notch, NJ

NO. 32 HUDSON RIVER, RAMAPO DIVERSION
STAGE II

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 32 Name Hudson River, Ramapo Diversion Identification No. 23
Stage II

Region(s) 1 Basin(s) Hudson County(ies) Passaic
Ramapo

Author COE Title NEWS Report 1971 Library No. 202
NEWS Report 1973 205.03

Updated Costs to 1980 (ENR 3100)[1]

Capital[2]
For construction, design, land acquisition, etc. $1,050,000,000

Operation and Maintenance and Annual Costs
Amortization, personnel, power, etc. 122,200,000

Cost per million gallons[3]
based on 500 mgd yield 670

Yield - Based on drought of 1960's 500 mgd[4]

(1) Costs updated by ENR Index from 1400 except power adjusted to 4¢/Kwhr

(2) Total project cost

(3) Water treated, transported to Great Notch, NJ

(4) Based on 34 BG upper Hudson River storage

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 32 Name Hudson River-Ramapo L.O.R.D.S. No. _____

Diversion-Storage in New York Atlas Sheet 23

Region (s) 1 Basin (s) Hudson, Ramapo County (ies) Passaic

IMPACT ANALYSIS

Construction - Major temporary construction impacts include hard rock and spoil disposal and erosion and sediment runoff. Short term impacts affecting construction workers and residents within the site area include: air borne dust; smoke plume and exhaust emissions from construction activity; and vehicular and equipment noise. Plans for control of these short term impacts should be considered.

Terrestrial & Aquatic Life - Intake and pumping station (in New York) may have a minor impact on the density of aquatic life. Special attention should be given to the design of the intake system to reduce impingement. There will be minor loss of vegetation within the area surrounding the various facilities in both States and along the aqueduct.

Water Quantity & Quality - Flow skimming along Hudson (in New York) may result in alteration of groundwater quality. Construction activity may increase surface water turbidity and groundwater quality. Long term impacts include drainage realignment and stream encroachment.

Land Use - Several acres must be acquired for pipeline construction and ventilation shafts (1 acre/shaft) (in New York). This area must remain cleared, although not completely. This is a short term impact.

Displacement - Unknown.

Economic Development - The feasibility of this project alternative is contingent on the implementation of NEWS Project HU-1, Hyde Park diversion to Kensico Reservoir (N.Y. Project).

Uses/Purposes - Water supply.

Transportation - Short term traffic disruption may occur as a result of pipeline and tunnel construction (in New York).

Visual Quality - All facilities should be in conformance with local architectural character.

NO. 33 HUDSON - RAMAPO DIVERSION, STORAGE RAMAPO

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 33 Name Hudson - Ramapo Diversion, Storage Identification No. 23

Ramapo

Region(s) 1 Basin(s) Hudson County(ies) Passaic

Ramapo

Wanaque

Author COE Title NEWS Report Nov. 1971 Library No. 202

NEWS Summary 1977 229.07

Rpt. Alt. WSP, Hazen & Sawyer 1974 1206.01

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$630,000,000
Operation and Maintenance and Annual Costs (2) Amortization, personnel, power, etc.	85,900,000
Cost per million gallons (3) based on 250 mgd yield	941

Yield - Based on drought of 1960's 250 mgd

(1) Cost update by ENR Index from 1974 (2020) except power adjusted to 4¢/Kwhr

(2) Costs for treatment at Wanaque included

(3) Treated water at Great Notch, NJ

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 33 Name Hudson-Ramapo Diversion, Storage Ramapo L.O.R.D.S. No. _____ Atlas Sheets 22,24,26

Region (s) 1 Basin (s) Hudson, Ramapo, Wanaque County (ies) Passaic

IMPACT ANALYSIS

Construction - Temporary construction impacts include large amounts of hard rock and spoil disposal and erosion and sediment runoff. Short term major impacts affecting construction workers and residents within the site area include: air borne dust; smoke plume and exhaust emissions from construction activity, and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - The construction of the pumping stations, a treatment plant, and force main, a 31-mile aqueduct and a tunnel could have major long term and short term impacts on the terrestrial and aquatic life within the entire site area in both New York and New Jersey. There may be short term impacts affecting the size, diversity and distribution of some species. Disposal of large amounts of biota must be considered. A permanent ROW must be maintained along the proposed routes. Entrainment and impingement of aquatic species may become a major impact.

Water Quantity & Quality - Construction activity can increase surface water turbidity in nearby streams and rivers. Long term minor impacts include drainage realignment and possible stream encroachment and possible adverse environmental impacts of off-stream reservoirs.

Land Use - Several acres must be acquired for the treatment plant (in New Jersey) and pumping stations (at West Park, New York and Pompton Lakes, New Jersey). Easements are also necessary for tunnel lines that divert from street or rail ROWs.

Displacement - Unknown.

Economic Development - Project alternative is expensive. This project provides storage and supply from 3 reservoirs.

Uses/Purposes - Water supply and storage.

Transportation - Short term traffic diversions may occur as a result of construction activity.

Visual Quality - May be hindered slightly by the treatment plant near the Wanaque Reservoir.

NO. 34 HUDSON RIVER - LITTLE FALLS - CONTINUOUS SKIMMING

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 34 Name Hudson River - Little Falls - Continuous Skimming Identification No. 23

Region(s) 1 Basin(s) Hudson, Passaic County(ies) Passaic

Author COE Title NEWS Report Library No. 202

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	Unavailable
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	Unavailable
Cost per million gallons based on mgd yield	Unavailable

Yield - Based on drought of 1960's

[1] Costs not available, job directly related to No. 35

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 34 Name Hudson River - Little Falls L.O.R.D.S. No. _____

Continuous Skimming Atlas Sheet 23

Region (s) 1 Basin (s) Hudson County (ies) Passaic

Passaic

IMPACT ANALYSIS

Construction - Temporary major construction activity includes spoil disposal, erosion and sediment runoff, and altering of ground surfaces. An erosion and sediment control plan should be included for the continued maintenance of the facility. Temporary impacts affecting construction workers and residents within the site area include: air borne dust; smoke plume and exhaust emission from construction activity; and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Temporary effects may result in the reduction of several terrestrial and aquatic species. The loss in vegetation surrounding the site areas is a permanent and major impact. Disposal of biota must be considered. The ecosystem within the area should stabilize after the short term effects of construction have declined.

Water Quantity & Quality - Short term minor construction impacts may result in surface water turbidity in nearby streams within the site areas. Drainage realignment requires a flood control plan. Possible environmental impact on N.Y. Storage Reservoirs. Continuous skimming (of Hudson River) may result in a decrease in water quality at low-flow.

Land Use - Several acres are needed for the 800 mgd filtration plant (in New York), a pipeline extension and construction of a complete aqueduct system (into New Jersey).

Displacement - Unknown

Economic Development - NJ share of 1300 mgd project.

Uses/Purposes - Water supply and storage.

Transportation - Extensive but temporary traffic diversions may occur as a result of the large scale construction activity.

Visual Quality - All facilities should be designed in conformance with local architectural character.

NO. 35 HUDSON RIVER TO LITTLE FALLS, STORAGE IN NY STAGE I

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 35 Name Hudson River to Little Falls, Storage in NY Identification No. 23 Stage I

Region(s) 1 Basin(s) Hudson, Passaic County(ies) Passaic

Author COE Title NEWS Report Nov. 1971 Library No. 202

Newark Alt. W.S. Plans 74 1206.01

NJ NYC CN Alt. W.S. Plans 1008.04

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$642,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	90,100,000
Cost per million gallons[2, 3] based on 175 billion gallon annual yield over seven months	514

Yield - Based on drought of 1960's 800 mgd[2]

(1) Cost update by ENR Index from NEWS Report except power adjusted to 4¢/Kwhr

(2) NJ share of 800 mgd project is 150 mgd

(3) Treated water at Little Falls (Great Notch)

NO. 35 HUDSON RIVER TO LITTLE FALLS, STORAGE IN NY STAGE II

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 35 Name Hudson River to Little Falls, Stage II Storage in NY Identification No. 23

Region(s) 1 Basin(s) Hudson, Passaic County(ies) Passaic

Author COE Title NEWS Report Nov. 1971 Library No. 202

Newark Alt. W.S. Plans 1974 1206.01

NJ-NYC-CN Alt. W.S. Plans 1008.04

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$2,800,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	338,600,000
Cost per million gallons[2,3] based on 350 mgd yield	714
Yield - Based on drought of 1960's	1300 mgd[2]

(1) Cost update by ENR Index from NEWS Report except power adjusted to 4¢/Kwhr

(2) NJ share of 1300 mgd project is 350 mgd

(3) Treated water at Little Falls (Great Notch)

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 35 Name Hudson River to Little Falls L.O.R.D.S. No. _____

Storage in New York Atlas Sheet 23

Region (s) 1 Basin (s) Hudson County (ies) Passaic

Passaic _____

IMPACT ANALYSIS

Construction - Temporary major construction activity is expected to include spoil disposal, erosion and sediment runoff, and altering of ground surfaces. An erosion and sediment control plan should be included for the continued maintenance of the facility. Temporary impacts affecting construction workers and residents within the site area include: air borne dust; smoke plume, and exhaust emission from construction activity; and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Temporary effects may result in the reduction of several terrestrial and aquatic species. The loss in vegetation surrounding the site areas is a permanent and major impact. Disposal of biota must be considered. The ecosystem within the area should stabilize after the short term effects of construction have declined.

Water Quantity & Quality - Short term minor construction impacts may result in surface water turbidity in nearby streams within the site areas. Drainage realignment requires a flood control plan. Flow skimming (intermittent of Hudson River) may have a major impact on groundwater quality. Possible environmental impact on N.Y. Storage Reservoirs.

Land Use - Several acres are needed for the 800 mgd filtration plant (in New York), a pipeline extension and construction of a complete aqueduct system (into New Jersey).

Displacement - Unknown.

Economic Development - Expansion of treatment plant to 1300 mgd (in New Jersey).

Uses/Purposes - Water supply and storage.

Transportation - Extensive but temporary traffic diversions may occur as a result of the large scale construction activity.

Visual Quality - All facilities should be designed in conformance with local architectural character.

NO. 36 HUDSON RIVER-GREAT NOTCH DIVERSION STORAGE IN NJ

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 36 Name Hudson River-Great Notch Diversion Storage in NJ Identification No. 23

Region(s) 1 Basin(s) Hudson, Passaic County(ies) Passaic

Author COE Title NEWS Report 1971 Library No. 202

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	See #35
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	See #35
Cost per million gallons	See #35

Yield - Based on drought of 1960's - 150 and 350 mgd

(1) No direct costs available, similar to project 35, both stages

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 36 Name Hudson River-Great Notch Diversion-Storage in N. J. L.O.R.D.S. No. _____ Atlas Sheet 23

Region (s) 1 Basin (s) Hudson Passaic County (ies) Passaic

IMPACT ANALYSIS

Construction - Temporary major construction activity includes spoil disposal, erosion and sediment runoff, and altering of ground surfaces. An erosion and sediment control plan should be included for the continued maintenance of the facility. Temporary impacts affecting construction workers and residents within the site area include: air borne dust; smoke plume, and exhaust emission from construction activity; and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Temporary effects may result in the reduction of several terrestrial and aquatic species. The loss in vegetation surrounding the site area is a permanent and major impact. Disposal of biota must be considered. The ecosystem within the area should stabilize after the short term effects of construction have declined.

Water Quantity & Quality - Short term minor construction impacts may result in surface water turbidity in nearby streams within the site area. Drainage realignment requires a Flood Control Plan. Flow skimming (intermittent) may have a major impact on groundwater quality. Possible environmental impact on N.Y. Storage Reservoirs.

Land Use - Several acres are needed for the filtration plant, and pipeline extension.

Displacement - Unknown.

Economic Development - Expansion of treatment plant to 1300 mgd.

Uses/Purposes - Water supply and storage.

Transportation - Extensive but temporary traffic diversions may occur as a result of the large scale construction.

Visual Quality - All facilities should be designed in conformance with local architectural character.

NO. 37 DELAWARE RIVER CONTROL - TRANSFER FROM KENSICO

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 37 Name Delaware River Control - Transfer from Kensico Identification No. 23 & 26

Region(s) _____ Basin(s) Delaware, Passaic, Hudson County(ies) Bergen, Passaic

Author COE Title NEWS Report Nov. 1971 Library No. 202

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$530,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	54,700,000
Cost per million gallons (2) based on 300 mgd yield	500
Yield - Based on drought of 1960's	300 mgd (3)

(1) Costs updated by ENR Index from NEWS Report except power adjusted to 4¢/Kwhr

(2) Treated water delivered to Great Notch

(3) Depends upon Tocks Island Lake Project for compensating releases

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 37	Name Delaware River Control	L.O.R.D.S. No.	
	Transfer from Kensico	Atlas Sheets 22,23,26	
Region (s) 1	Basin (s) Delaware,	County ies) Bergen	
	Passaic, Hudson	Passaic	

IMPACT ANALYSIS

Construction - Temporary effects from construction of pumping station and pressure tunnel include: spoil disposal; erosion and sediment runoff; and alteration of ground surfaces. Short term effects to construction workers and residents within the site area include: air borne dust, smoke plume and exhaust emissions from construction activity; and vehicular and equiment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Minor effects may include: disruption of natural habitats and migration routes and temporary alteration of several terrestrial species.

Water Quantity & Quality - Possible water quality problems as a result of in-stream transmission. Temporary surface water turbidity and sediment accumulation as a result of construction activity.

Land Use - Several acres must be acquired for tunnel and ventilation shaft and pumping station.

Displacement - Unknown.

Economic Development - This project alternative is entirely contingent on Tocks Island Reservoir (Alternative 55).

Uses/Purposes - Water supply and flow augmentation.

Transportation - Short term traffic disruptions may occur as a result of tunnel and access shaft construction.

Visual Quality - No significant impacts.

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 37 Name Delaware River Control L.O.R.D.S. No. _____

Transfer from Kensico Atlas Sheets 22,23,26

Region (s) 1 Basin (s) Delaware, County ies) Bergen

Passaic, Hudson Passaic

IMPACT ANALYSIS

Construction - Temporary effects from construction of pumping station and pressure tunnel include: spoil disposal; erosion and sediment runoff; and alteration of ground surfaces. Short term effects to construction workers and residents within the site area include: air borne dust, smoke plume and exhaust emissions from construction activity; and vehicular and equiment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Minor effects may include: disruption of natural habitats and migration routes and temporary alteration of several terrestrial species.

Water Quantity & Quality - Possible water quality problems as a result of in-stream transmission. Temporary surface water turbidity and sediment accumulation as a result of construction activity.

Land Use - Several acres must be acquired for tunnel and ventilation shaft and pumping station.

Displacement - Unknown.

Economic Development - This project alternative is entirely contingent on Tocks Island Reservoir (Alternative 55).

Uses/Purposes - Water supply and flow augmentation.

Transportation - Short term traffic disruptions may occur as a result of tunnel and access shaft construction.

Visual Quality - No significant impacts.

NO. 39 WANAQUE-ORADELL PIPELINE

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 39 Name Wanaque-Oradell Pipeline Identification No. 23-40-000

Region(s) 1 Basin(s) Passaic, Wanaque, Hackensack County(ies) Passaic, Bergen

Author Hack. WC NJDWSC Title Two Bridges -Ramapo Diversion Env. Eval. 1977 TB-Ramapo 1975 Library No. 1011 1202.03

Updated Costs to 1980 (ENR 3100)[1] [2]

Capital For construction, design, land acquisition, etc.	$66,100,000
Operation and Maintenance and Annual Costs[3] Amortization, personnel, power, etc.	8,450,000
Cost per million gallons[4] based on 79 mgd yield	293

Yield - Based on drought of 1960's 79 mgd

(1) Costs updated by ENR index

(2) Costs are for projects 39 and 40 combined

(3) Costs adjusted to reflect pumping allowed in WS Councils approval

(4) 39 mgd to NJDWSC for water delivered into Wanaque Reservoir and 40 mgd to Hackensack Water Co., via Wanaque - Oradell Pipeline.

ENVIRONMENTAL EVALUATION

No. 39 Name Wanaque-Oradell Pipeline L.O.R.D.S. No. 23-40-000 Atlas Sheet 23

Region (s) 1 Basin (s) Passaic, Wanaque, Hackensack County (ies) Passaic, Bergen

IMPACT ANALYSIS

Construction - Temporary effects could occur as a result of pipeline construction. Erosion and sediment runoff could alter ground surfaces. Construction will require some spoil disposal. An erosion and sediment control plan may be necessary. Temporary impacts which can affect construction workers and residents within the site area include: 1) air borne dust 2) exhaust and smoke emissions from construction equipment 3) vehicular and equipment noise. Standard measures are available to minimize these impacts.

Land Use - While the route of the Wanaque-Oradell force main, a 17 mile length of pipeline, is not yet determined, alternatives have been studied (Two Bridges-Ramapo Project Engineering Report, New Jersey District Water Supply Commission and Hackensack Water Company, 1975). One suggestion connects the pipeline to the Hackensack transmission line at Pompton Junction in the vicinity of the intersection of the existing Ramapo River diversion pipeline and Susquehanna Railroad, then follows the railroad ROW through Franklin Lakes to Wyckoff and continues on a north or south route to Oradell Reservoir. Land use between Wanaque and Oradell Reservoirs is predominantly residential with some commercial and other urban uses, and some stands of forest. Were the pipeline to follow existing rights-of-way, as suggested, disturbance of existing land uses should be minimal.

Water Quantity & Quality - Water within the Wanaque and Oradell Reservoir is relatively pollution free, of better quality than either the Pompton or Passaic Rivers. The Two Bridges-Ramapo Water Diversion Project (Alternative 40) is a prerequisite to the Wanaque-Oradell Pipeline project as the diversion will provide the 40 mgd to be transported between Wanaque and Oradell Reservoirs. The quality of this water supply is thus contingent on the mix of Pompton and Passaic River water transported.

Terrestrial & Aquatic Life - Impacts on terrestrial life are expected to be negligible as the predominant land use in the area through which the pipeline route would likely pass is residential or other urban uses. Some forest land exists east of the Wanaque Reservoir but will not necessarily be traversed. If any streams are crossed by the pipeline, precautions should be taken to minimize construction-related or long term impacts on aquatic life. (Stream encroachment permits will be required for all crossings).

Displacement - If the pipeline follows existing ROWs, displacement should not occur. It is unknown whether the pump station will displace any existing structures.

Uses/Purposes - Water supply; the interconnection project will result in more efficient distribution of water supply to meet projected needs.

Transportation - Minor temporary disruption of traffic may occur during the construction period of the pump station and the laying of the pipeline. Such impacts may be minimized by following existing ROWs.

Visual Impacts - The 40 mgd Hackensack Water Company Pump Station is proposed to be located near the existing Pompton River pump station. It will be small in size and will probably have minimal negative impact.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 39,40

PROJECT STATUS:

____ Concept X Preliminary Planning ____ Design ____ Construction ____ Site Acquired

INSTITUTIONAL:

APPROVALS: ____ Required ____ Sought X Obtained From

DRBC ____ N.J. Legislature ____

ACOE or other states ____ Pinelands Commission ____

WP&SC X* D&R Canal Commission ____

*Subject to court affirmation

Sponsor or Lead Agency Identified NJDWSC/HWCo.

Identified Support or Opposition City of Paterson has bitterly opposed the project; DEP has approved it.

FINANCIAL:

STATUS OF FUNDS: ____ $ Already Committed
X Financing Anticipated
____ Financing Uncertain
____ Not Significant

For: Site Acquisition ____ Prel. Planning ____ Design X Construction X

Sources of Funds Local capital

Pay Back Arrangement: ____ Outright Grant ____ Not Known ____ Bond Debt Service X User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: It addresses critical shortages in Bergen County.

SHOULD NOT: Places increased demands on already burdened Passaic.

NO. 40 TWO BRIDGES - RAMAPO WATER DIVERSION PROJECT

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 40 Name Two Bridges - Ramapo Water Diversion Project Identification No. 23 & 26

Region(s) 1 Basin(s) Pompton, Passaic, Ramapo County(ies) Passaic, Essex

Author NJDWSC, HWC, SNJ Title TB - Ramapo W.D. Proj; Envir. Eval. April 1977; NEWS Report Library No. 1011; --; 202

Updated Costs to 1980 (ENR 3100) (1) (2)

Capital For construction, design, land acquisition, etc.	$66,100,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	8,450,000
Cost per million gallons (4) based on 79 mgd yield	293

Yield - Based on drought of 1960's 79 mgd

(1) Costs updated by ENR Index

(2) Costs for projects 39 and 40 combined

(3) Costs adjusted to reflect pumping allowed in WS Council approval

(4) 39 mgd to NJDWSC for water delivered into Wanaque Reservoir and 40 mgd to Hackensack Water Co., via Wanaque - Oradell Pipeline.

ENVIRONMENTAL EVALUATION

No. 40 Name Two Bridges-Ramapo Water Diversion Project L.O.R.D.S. No. _____ Atlas Sheets 23, 26

Region (s) 1 Basin (s) Pompton Ramapo, Passaic County (ies) Passaic, Essex

IMPACT ANALYSIS

Construction - Expansion of the existing Ramapo River pump station (from 100 to 150 mgd) will likely involve placement of new, and larger, pumps but will not necessarily involve the taking of additional acreage at the site. Temporary construction impacts of this expansion, of the new intake and pump station at Two Bridges, and of 11 miles of 6' to 8' diameter transmission pipeline will include 1) airborne dust, 2) exhaust and smoke emissions from construction equipment, and 3) vehicular and equipment noise. Standard practices are available to minimize these impacts.

The new intake and pump station, proposed to be built on the east bank of the Pompton River about 800' upstream from the confluence, will lie within the existing floodplain. Filling should be done only to the extent necessary to protect the pump station and access road from flooding.

Erosion may temporarily affect surface water turbidity and downstream sediment accumulation in the Pompton River. An erosion and sediment control plan should be developed.

Land Use - The intake and pump station at Two bridges--involving trash rack, stilling basin, travelling screens, suction well and a one-story pump station structure--will be constructed on open land currently zoned for industrial use and lying within a floodplain.

Land use in the area through which the 11 mile pipeline would pass is predominantly residential with some wooded areas. The route has not yet been determined but consideration should be given to following existing Conrail ROW (formerly the Greenwood Lake Division of Erie Railroad) or the ROW of the North Jersey District Water Supply Commission.

Water Quantity & Quality - A passing flow of 92.6 mgd is required below Two Bridges. Thus, the diversion from the confluence will consist of skimming of excess flows. Total capacity of the Two Bridges pump station will be 325 mgd, 250 mgd of which will be delivered to the Wanaque Reservoir.

While the diversion is proposed to come from both the Pompton and Passaic Rivers, a comparison of water quality between the two rivers indicates that Pompton water quality is better for all parameters compared, except phenols. The Water Policy and Supply Council requires that diversions may not occur which would result in certain reductions of DO levels or increases in temperature in the Passaic River. State abatement and waste management programs should

result in steady improvement of Passaic water quality but future land development may increase the pollution load. The diversion could be accomplished with a split intake.

Concerns that reduction in Passaic River flows would have adverse impacts have centered on two issues: degradation of aesthetics of the Great Falls of the Passaic River, and lowering of water quality to the Little Falls intake. The Water Policy and Supply Council, however, will prohibit diversions in July and August, the period most likely to experience low flows. Previous studies emphasized that the Great Falls historically had periods of low flow and that the diversion would not create conditions unusual to the site.

Lowering of water quality at Little Falls might be minimized with implementation of a split intake. However, diversion of Pompton River flows, with high DO content, must not occur to such an extent that Passaic River DO levels are lowered to a level contravening state standards.

Passing flow in the Ramapo River is to be maintained at 40 mgd, with diverted water to be transmitted to the Wanaque Reservoir.

Terrestrial & Aquatic Habitats - Impacts of the diversion will be minor, reguiring some vegetation removal for laying of the pipeline between the Pompton/Passaic confluence and Wanague Reservoir. This may be minimized if the route follows an existing railroad ROW.

A potential threat to aquatic biota in the Passaic River would result if DO levels in the river water were depressed to less than 2 mg/liter. The size of the Pompton River diversion should therefore, be regulated to prevent such a reduction in DO levels.

Displacement - While the extent of displacement is yet unknown, it is not anticipated to be a problem. The Two Bridges pump station is proposed for currently open land and the pipeline route should follow existing railroad ROW or street systems whenever feasible.

Uses/Purposes - Water supply. Total population to be served by the project is estimated at 1,400,000 persons. The Passaic Valley Water Commission has expressed concern over possible reduction of Passaic River flow, resultant lowering of water quality at the Little Falls intake and increasing costs of water treatment.

The City of Paterson has expressed concern over the loss of hydroelectric generating capacity if flow at Great Falls is reduced. The Society for Useful Manufacturers Historic District at Great Falls has been considered as a focal point for an urban renewal program by the City of Paterson. Requirements for both water supply and economic development will have to be considered.

Transportation - Some temporary, minor disruption of traffic will occur during construction activities. In the vicinity of the proposed Two Bridges pump station, traffic on Fairfield Avenue may be inconvenienced. Wherever possible, existing rights-of-way should be followed by the pipeline route.

Visual Quality - As the Two Bridges pump station is proposed for land zoned for industrial use visual quality is not likely to be a significant concern.

The aesthetics of the Great Falls and the Historic District of the Passaic River depend on having sufficient stream flow. As the District is a National Historic Landmark, consideration should be given to the visual quality of the Falls.

NO. 41 MONKSVILLE RESERVOIR WITH RAMAPO PUMP STATION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 41 Name Monksville Reservoir with Ramapo Pump Station Identification No. 23-21-700

Region(s) 1 Basin(s) Wanaque, Ramapo County(ies) Passaic

Author NJDWSC Title Pre. Eng. Rpt. Monksville Project NJDWSC Nov. 1972 Library No. 1207.02

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$37,000,000
Operation and Maintenance and Annual Costs[2] Amortization, personnel, power, etc.	3,900,000
Cost per million gallons[3] based on 25 mgd yield	427
Yield - Based on drought of 1960's	25 mgd

(1) Costs updated by ENR Index

(2) Includes costs for use of Wanaque Reservoir

(3) Raw water impounded in reservoir

ENVIRONMENTAL EVALUATION

No. 41 Name Monksville Reservoir with Ramapo Pump Station L.O.R.D.S No. 23-21-700

Region (s) 1 Basin (s) Wanaque, Ramapo County (ies) Passaic

IMPACT ANALYSIS

Construction - About 500 acres of land, almost all of it state-owned, would have to be cleared and a 2000' long, 115' high dam would be constructed at the Village of Monks. The existing Ramapo Pump Station at Pompton Lakes would also be expanded. Temporary impacts could include increases in 1) air borne dust 2) exhaust and smoke emissions from equipment 3) vehicular and equipment noise. Standard practices are available to minimize these impacts. This is a rural area but residential clusters to the north and south of the reservoir site could be affected.

Land Use - The reservoir will inundate 500 acres of forested and residential land. About 480 acres of this total has already been aquired by the State under the Green Acres program. Land requirements, if any, connected with the proposed capacity increase at the Ramapo Pumping Station are unknown.

Water Quantity & Quality - This project would allow an additional 25 mgd to be diverted from the Ramapo River at Pompton Lakes. Detailed hydrologic studies would have to be completed to determine the effects of the diversion on downstream users. Of particular concern is the impact on the Passaic Valley Water Commission (PVWC). However, the proposed diversion would come from flows at Pompton Lakes that exceed 140 mgd. At such high flow periods increased amounts of water would also be available to the PVWC.

Construction of the dam and site clearing may result in temporary increases in turbidity in the Wanaque Reservoir.

Terrestrial & Aquatic Habitat - A large area of deciduous forest will have to be cleared. About three miles of the remaining free-flowing portion of the Wanaque River will be improved.

Displacement - Final engineering plans for the reservoir have not been prepared. Based on available information, which is subject to change, roughly 80 acres of privately held land would have to be acquired. About 20 homes, three commercial buildings and a camping resort would have to be removed. Contemplated changes in design could serve to preclude the need to displace three small factories - only one may eventually be affected. A private cemetary dating back to the early 1800's would probably also have to be relocated.

Uses/Purposes - This project will provide additional supply for existing customers; joint recreational use is planned. The project could also serve for flood control, although this is not now considered in the design.

Transportation - Relocation of a 1.3 mile portion of Greenwood Lake Turnpike would probably have to be relocated. A half-mile portion of Stonetown Road would also have to be relocated downstream of the new dam and a bridge crossing the Wanaque River would be required.

Visual Quality - Nearby residential uses may be impacted during construction. Access to the area downstream from the proposed 115' dam is restricted to protect the Wanaque Reservoir. Therefore, the dam's visual impact is expected to be minimal.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 41

PROJECT STATUS:

____ Concept ____ Preliminary Planning __X__ Design ____ Construction ____ Site Acquired

INSTITUTIONAL:

APPROVALS: _____Required
__X__Sought From
_____Obtained

DRBC _____
ACOE or other states _____
WP&SC X*

N.J. Legislature _____
Pinelands Commission _____
D&R Canal Commission _____

*Application later withdrawn and replaced by Project 39,40.

Sponsor or Lead Agency Identified NJDWSC

Identified Support or Opposition Passaic River diverters

FINANCIAL:

STATUS OF FUNDS:
_____ $ Already Committed
_____ Financing Anticipated
__X__ Financing Uncertain
_____ Not Significant

For
Site Acquisition _____
Prel. Planning _____
Design _____
Construction X

Sources of Funds NJDWSC partners for this project.

Pay Back Arrangement:
_____ Outright Grant _____ Not Known
__X__ Bond Debt Service _____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Within area where reservoirs are accepted locationally; land publicly held.

SHOULD NOT: High cost for yield; Project 39,40 more effective; heavily contested approval process.

NO. 42 GREAT NOTCH INTERCONNECTION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 42 Name Great Notch Interconnection Identification No. 26-02-500

Region(s) 1 Basin(s) Passaic County(ies) Essex

Author COE Title Engr. Feas. Rpt. 1971 Library No. 202
Nat'l Board of Fire Underwriters WSW of No. NJ 1952 1338

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	NA
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	NA
Cost per million gallons (2)	NA

(1) Costs unavailable, project scope subject to wide fluctuation depending on other projects

(2) No yield, transfers existing water among purveyors or used as transfer point for new supplies as Proj. 37, 36, 35, 34, 33, 32, 31, etc.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 42

PROJECT STATUS:

X	Concept		Preliminary Planning		Design		Construction		Site Acquired

INSTITUTIONAL:

APPROVALS: X Required

____ Sought

____ Obtained

From

DRBC ____

ACOE or other states ____

WP&SC X

N.J. Legislature ____

Pinelands Commission ____

D&R Canal Commission ____

Sponsor or Lead Agency Identified Uncertain

Identified Support or Opposition A great idea, but who will fund it?

FINANCIAL:

STATUS OF FUNDS:

____ $ Already Committed

____ Financing Anticipated

X Financing Uncertain

____ Not Significant

For

Site Acquisition ____

Prel. Planning X

Design X

Construction X

Sources of Funds Uncertain

Pay Back Arrangement:

____ Outright Grant X Not Known

____ Bond Debt Service ____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Added flexibility in stressed situations.

SHOULD NOT: Difficulties in indicating a lead agency; gaining cooperation among the participants.

ENVIRONMENTAL EVALUATION

No. 42 Name Great Notch interconnection L.O.R.D.S. No. 26- 02- 500

Region (s) 1 Basin (s) Hudson, Wallkill County (ies) Sussex

IMPACT ANALYSIS

Construction - Temporary effects on surrounding surburban residential uses may occur as a result of interconnection construction. Excavation of 16' pipes could result in erosion problems. Protection of nearby reservoirs should be considered. Temporary impacts which can affect construction workers and residents within the site area include: 1) air borne dust 2) exhaust and smoke emission from construction equipment 3) vehicular and equipment noise. Standard practices are available to minimize these impacts.

Land Use - No land acquisition is needed.

Water Quantit & Quality - Turbidity may be temporarily increased in local tributary streams.

Terrestrial & Aquatic Habitats - No impact.

Displacement - No displacement will occur.

Uses/Purposes - The project should alleviate localized shortages due to increased flexibility.

Transportation - Short term traffic tie-ups may occur as a result of construction activity.

Visual Quality - Will not be altered.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 44

PROJECT STATUS:

____ Concept ____ Preliminary Planning __X__ Design (Completed) ____ Construction ____ Site Acquired

INSTITUTIONAL:

APPROVALS: ____ Required ____ Sought ____ From __X__ Obtained

DRBC ____
ACOE or other states ____
WP&SC __X*__
*although now expired

N.J. Legislature ____
Pinelands Commission ____
D&R Canal Commission ____

Sponsor or Lead Agency Identified J.C. Water Dept.

Identified Support or Opposition Uncertain today; initial approval obtained in late 1960's.

FINANCIAL:

STATUS OF FUNDS: ____ $ Already Committed
____ Financing Anticipated
____ Financing Uncertain
____ Not Significant
__X__ No funds available

For: Site Acquisition ____; Prel. Planning ____; Design ____; Construction __X__

Sources of Funds Local municipal funds

Pay Back Arrangement: ____ Outright Grant __X__ Not Known
____ Bond Debt Service ____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Ready to go status; storage capacity; pump-storage feature.

SHOULD NOT: High unit cost of water.

ENVIRONMENTAL EVALUATION

No. 44 Name Longwood Valley Reservoir L.O.R.D.S. No. 22-43-100

Regions (s) 1 Basin (s) Rockaway River County (ies) Morris

IMPACT ANALYSIS

Construction - As now planned, construction would involve a single dam and reservoir. The site is a narrow valley with steep sides and erosion and sedimentation may be a particular problem. Temporary impacts would include increases in 1) air borne dust 2) exhaust and smoke emissions from equipment 3) vehicular and equipment noise. Standard practices are available to minimize these impacts.

Land Use - A total of 670 acres of residential and forested land will have to be acquired. Part of a U.S. Government Reservation may also be affected. Quarries in the area may be inundated.

Water Quantity & Quality - The reservoir would store 5.2 billion gallons. Temporary increases in turbidity in Rockaway River south of the dam site could occur during construction.

Terrestrial & Aquatic Habitats - A significant amount of deciduous forest may have to be cleared. A free-flowing stretch of the Rockaway River, and Upper Longwood Lake would be inundated.

Displacement - Some residential displacement may be required. Parts of Woodstock and Upper Longwood could be affected.

Uses/Purposes - Jersey City would use the water to supplement the public supply. A proposal for joint use as a power project appears to have been dropped by Jersey Central Power and Light Company. The reservoir could also serve to reduce flooding in the Rockaway watershed.

Transportation - A secondary road would probably be partially inundated.

Visual Quality - Temporary impacts during construction may affect nearby residential areas. The downstream side of the dam may be visible from the Berkshire Valley Wildlife Management Area.

NO. 44 LONGWOOD VALLEY RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 44 Name Longwood Valley Reservoir Identification No. 22-43-100

Region(s) 1 Basin(s) Rockaway County(ies) Morris

Author Jersey City Title J.C.W.S. Needs 1970 Library No. 1203.02

NEWS Report Nov. 1971 202

Rpt. on Longwood Valley Res. 1956 1203.04

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$76,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	7,140,000
Cost per million gallons (2) based on 11 mgd yield	1,780

Yield - Based on drought of 1960's 11 mgd

(1) Costs updated by ENR Index from 1970 figures

(2) Raw water impounded in reservoir

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 43

PROJECT STATUS:

____ Concept __X__ Preliminary Planning ____ Design ____ Construction ____ Site Acquired

INSTITUTIONAL:

APPROVALS: __X__ Required
_____ Sought From
_____ Obtained

DRBC _____
ACOE or other states _____
WP&SC __X__

N.J. Legislature _____
Pinelands Commission _____
D&R Canal Commission _____

Sponsor or Lead Agency Identified Morris County MUA

Identified Support or Opposition Endorsed by State.

FINANCIAL:

STATUS OF FUNDS:
__X__ $ Already Committed
_____ Financing Anticipated
_____ Financing Uncertain
_____ Not Significant

For
Site Acquisition __X__
Prel. Planning _____
Design _____
Construction _____

Sources of Funds Local

Pay Back Arrangement:
_____ Outright Grant __X__ Not Known
_____ Bond Debt Service _____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Possible storage area for Delaware River water in the future.

SHOULD NOT: Project to be implemented by MCMUA.

ENVIRONMENTAL EVALUATION

No. 43 Name Washington Valley Reservoir L.O.R.D.S. No. 25-13-200

Regions (s) 1 Basin (s) Whippany County (ies) Morris

Passaic

IMPACT ANALYSIS

Construction - The project will necessitate the clearance of 370 acres of forestland and, possibly, residential land for the reservoir itself. (Specific location unknown). A new treatment plant (location also unknown) would also have to be constructed. Temporary impacts would include increases in 1) air borne dust 2) exhaust and smoke emissions 3) vehicular and equipment noise. Standard practices are available to minimize these impacts.

Land Use - As noted, forested and residential land totaling 450 acres will have to be acquired.

Water Quantity & Quality - Construction of the dam and land clearing could increase turbidity in the Whippany River downstream of the site.

Terrestrial & Aquatic Habitats - It appears that a significant amount of deciduous forest would have to be cleared; some wetland acreage may be inundated. Because the reservoir will be in-stream, a free-flowing stretch of the Whippany River will be impounded.

Displacement - Extent unknown; some residential relocation likely.

Uses/Purposes - The reservoir would provide a new source of supply for local needs, which are now served by groundwater sources.

Transportation - Because the specific project location is not final, the full extent of inundation of roads cannot be determined.

Visual Quality - Nearby residential uses may be negatively impacted during construction. If the proposed treatment plant is planned for a site nearby a residential area, the structure(s) should be designed so as to be compatible with, and blend into, the surrounding landscape if possible.

NO. 43 WASHINGTON VALLEY RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 43 Name Washington Valley Reservoir Identification No. 25-13-200

Region(s) 1 Basin(s) Whippany, Passaic County(ies) Morris

Author MCMUA Title MC Water Sup. Plan 1970; NEWS Report Library No. 1205.03; 202

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$18,600,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	1,600,000
Cost per million gallons[2] based on 7 mgd yield	626

Yield - Based on drought of 1960's 7 mgd

(1) Costs estimated by use of unit cost factors appearing in App. H of NEWS Report 1971, as adjusted by ENR index.

(2) Raw water in reservoir

NO. 46 DUNKERS POND RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 46 Name Dunkers Pond Reservoir Identification No. 22-23-300 22-23-800

Region(s) 1 Basin(s) Hudson - Wallkill County(ies) Passaic, Sussex, Essex
Passaic
Pequannock

Author Newark Title Rpt. on Alt. W.S.P. 1974 Library No. 1206.01
H&S & C. Bogert Assoc.

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$48,400,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	4,300,000
Cost per million gallons[2] based on 20 mgd yield	590

Yield - Based on drought of 1960's 20 mgd

[1] Costs updated by ENR Index

[2] For treated water at Macopin in Newark system

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 46 Name Dunkers Pond Reservoir with Wallkill River Diversion L.O.R.D.S. No. 22-33-300 22-23-800

Region (s) 1 Basin (s) Hudson-Wallkill, Passaic-Pequannock County (ies) Sussex, Passaic Essex

IMPACT ANALYSIS

Construction - Temporary construction effects of the diversion, pumping station and reservoir are minimal. Temporary effects to construction workers and residents within the site area include: air borne dust; smoke plume and exhaust emissions from construction activity; and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Minor effects may include: disruption of natural habitats, migration routes, and spawning areas; possible impingement and entrainment of aquatic species; and removal of vegetation; in some areas permanent clearance must be maintained.

Water Quantity & Quality - Major long term adverse environmental effects may include: water quality impacts of in-stream transmission; increased surface water turbidity throughout entire system; and erosion and sediment accumulation due to construction activity. Limitation on yield is Wallkill minimum stream flow.

Land Use - Several acres of land must be acquired for the proposed facilities.

Displacement - Unknown.

Economic Development - Pumping is required 1-2 years of every 10.

Uses/Purposes - Water supply and pumped storage.

Transportation - Short term traffic diversions may occur during the construction period.

Visual Quality - Unknown.

NO. 48 HARDSCRABBLE RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 48 Name Hardscrabble Reservoir Identification No. 25-13-700

Region(s) 1 Basin(s) Passaic County(ies) Morris, Somerset

Author	Title	Library No.
SNJ	Res. Site Capacity 1966	810
	TAMS 1955	757
	NEWS Report 1971	202

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$7,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	657,000
Cost per million gallons[2] based on 5 mgd yield	360
Yield - Based on drought of 1960's	5 mgd

(1) Costs estimated by use of unit cost factors appearing in App. H of NEWS Report, 1971 as adjusted by ENR Index and by direct application of ENR Index to published costs.

(2) Raw water impounded in reservoir

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 48 Name Hardscrabble Reservoir L.O.R.D.S. No. 25-13-700

Region (s) 1 Basin (s) Passaic, Upper Passaic County (ies) Morris, Somerset

IMPACT ANALYSIS

Construction - Temporary minor construction impacts may include: alteration of ground surfaces; erosion and sediment runoff. Temporary impacts that will effect construction workers and residents within the site include: air borne dust; smoke plume and exhaust emission from construction activity; vehicular and equipment noise.

Terrestrial & Aquatic Life - Temporary effects may include disruption of natural habitats, migration routes, and spawning areas. Long term effects include a permanent loss of vegetation and possibly an alteration in size, diversity and distribution of terrestrial and aquatic species.

Water Quantity & Quality - Short term effects may include: erosion and sediment runoff; surface water turbidity; a possible decrease in groundwater levels; drainage realignment of 27 square miles which may need to be designed with flood plain considerations.

Land Use - Limitation of size due to National Park at Jockey Hollow.

Displacement - Unknown.

Economic Development - Not a viable project independently. The site is to supply the Passaic Basin. Storage could be 20 BG, however only 6 BG may be needed to develop 8 mgd from the 9 square mile drainage area. Additional storage might be used for pumped storage in a Delaware or Raritan regional plan. Reduction in size from 20 BG is essential to reduce adverse effects. Project now is for 2 BG storage to develop 5 mgd.

Uses/Purposes - Water supply and pumped storage.

Transportation - Minor traffic disruption may occur as a result of reservoir construction.

Visual Quality - Unknown.

NO. 54 GREENWOOD LAKE

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 54 Name Greenwood Lake Identification No. 22-25-400

Region(s) 1 Basin(s) Passaic, Wanaque County(ies) Passaic

Author SNJ COE Title Res. Site Capacity 1966; NEWS Report Nov. 1971 Library No. 810; 202

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	NA
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	NA
Cost per million gallons	No yield established

(1) No costs available, for emergency use only

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 54 Name Greenwood Lake L.O.R.D.S. No. 22-25-400

Region (s) 1 Basin (s) Passaic, Wanaque County (ies) Passaic

IMPACT ANALYSIS

Construction - No significant impact.

Terrestrial & Aquatic Life - Temporary and minor disturbance of natural habitats, migration routes, and spawning areas during emergency storage periods may occur.

Water Quantity & Quality - Temporary and minor loss of vegetation during emergency storage periods may occur.

Land Use - No significant impact.

Displacement - No significant impact.

Economic Development - Possible emergency storage at Greenwood Lake (6.9 BG) would increase Wanaque sub-basin development from 88% (79 mgd) to 97%.

Uses/Purposes - Emergency water storage - limited function.

Transportation - No significant impact.

Visual Quality - No significant impact.

NO. 55 TOCKS ISLAND LAKE PROJECT

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 55 Name Tocks Island Lake Project Identification No. 21-32-800

Region(s) 1, 6 Basin(s) Delaware County(ies) Sussex

Author COE / DRBC Title TILP & Alternatives 1975 Library No. 230

NEWS Report 1971 202

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc., of water supply only.	$735,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc., of water supply only	33,000,000
Cost per million gallons (2) based on 300 mgd yield	300

Yield - Based on drought of 1960's 300 mgd

(1) Costs updated by use of ENR Index from source #230 adjusted for water supply aspects of project only.

(2) Assumes annual cost of project for water supply diversion of 300 mgd to NJ. Value to other Delaware River Basin States not included for recreation, flood control, saline front control, water supply, etc.

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 55 Name Tocks Island Lake Project L.O.R.D.S. No. _____

Atlas Sheet 21

Region (s) 6 Basin (s) Delaware County (ies) Sussex

IMPACT ANALYSIS

Construction - Temporary major impacts may include: large amounts of spoil disposal; erosion and sediment runoff; substantial alteration of ground surfaces. A long term erosion and sediment control plan may be necessary. Short term impacts on construction workers and residents within the site area include: air borne dust; smoke plume and exhaust emission from construction activity; and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Major impacts may include: permanent loss of large amounts of vegetation; permanent major alteration of migration routes, species types and fish spawning patterns; and disposal of large amounts of biota.

Water Quantity & Quality - Major permanent impacts may include: permanent increase in surface water turbidity; major drainage realignment which will require a flood control plan; loss of water (stream) recreation sports; increased stream encroachment in areas when transmission lines crossing the lake are necessary.

Land Use - This major impoundment has a 160 ft. high earthfill dam; extends 37 miles in length up the Delaware to Port Jervis, N.Y. and 9 miles up Flat Brook. Total land required is 63,000 acres. For flood control use storage capacity is 105 BG. Water supply, storage, hydroelectric power and recreation require a 12,425 acre surface area and a 139 BG storage capacity. There remains 31 BG storage listed as inactive.

Displacement - of many families, businesses and facilities. Extent of displacement is unknown.

Economic Development - Unknown.

Uses/Purposes - Water supply and storage, hydroelectric power, flood control and recreation.

Transportation - Major temporary traffic disruptions will occur as a result of construction activity.

Visual Quality - Unknown.

NO. 56 HACKETTSTOWN RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 56 Name Hackettstown Reservoir Identification No. 24-04-600

Region(s) 6 Basin(s) Delaware, Musconetcong County(ies) Warren, Sussex, Morris

Author SNJ / COE Title Sussex-Warren Plan 1974 Library No. 1209.01
Allamuchy Park Plan 1968 1013
DRBC Plan 1972 502.03

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc. of project including recreational facilities. Water supply portion estimated at 40% of project cost.	$47,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc. for water supply facilities only.	2,630,000
Cost per million gallons (2) based on 40 mgd yield	180

Yield - Based on drought of 1960's 40 mgd

(1) Costs updated by ENR Index

(2) Raw water supply at reservoir

ENVIRONMENTAL EVALUATION

No. 56 Name Hackettstown Reservoir L.O.R.D.S. No. 24-04-600

Region (s) 6 Basin (s) Delaware, Musconetcong County (ies) Warren, Sussex, Morris

IMPACT ANALYSIS

Construction - The project would involve the construction of a 1600-acre reservoir and a 1,050' long dam that would rise 85' above the stream channel. Construction is estimated to take about ten years to complete.

The reservoir is one element in a comprehensive plan to create Allamuchy Mountain State Park on 15,000 acres in Morris, Sussex and Warren Counties. Reservoir construction is designated as "Stage III" of the project.

Land Use - The land to be inundated is generally covered by forest, but some residential areas would also be affected.

Water Quantity & Quality - The reservoir storage capacity would be 9.9 billion gallons. Construction could result in temporary increases in turbidity in the Musconetcong River downstream of the site. Non-point pollution from runoff from U.S. Route 80, which crosses the site on an elevated structure, should be prevented.

Terrestrial & Aquatic Habitats - Site clearance will probably involve the removal of some deciduous forest. Marshes in the general area are the habitats for muskrat, ducks and geese. Inundation of these areas should be prevented. Creation of the reservoir will inundate a six-mile portion of the now free-flowing Musconetcong River.

Displacement - The reservoir would inundate several structures, and require the relocation of a number of local roads, power lines and six miles of Delaware-Lackawanna and Western Railroad. Of particular concern is Waterloo Village, a National Historic Landmark area consisting of 26 structures (including some private homes), which faces complete inundation. The State Dept. of Conservation, Division of Parks has proposed moving or reconstructing the entire village on a nearby location. The estimated cost for this operation was $2 million in 1968.

Uses/Purposes - The project is foremost a recreational development and secondarily a water supply project. (The local area is adequately served by groundwater resources.) Much of the 20-mile shoreline could support recreational uses. The Hackettstown Municipal Utilities Authority would distribute the water.

Transportation -Interstate Route 80 crosses the reservoir site. A portion of it was constructed at elev. 700' and it rises 60-70' above the Musconetcong River. Depending on final design of the reservoir, it may be possible to prevent inundation of the road. Other local roads may be affected.

Visual Quality - The reservoir is expected to be a scenic attraction because of its location within steep, forested and rocky mountain walls.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 56

PROJECT STATUS:

____ Concept __X__ Preliminary Planning ____ Design ____ Construction ____ Site Acquired

INSTITUTIONAL:

APPROVALS: 2 Required

_____ Sought

1 Obtained

From

DRBC _____

ACOE or other states _____

WP&SC 2

N.J. Legislature 1,2

Pinelands Commission _____

D&R Canal Commission _____

Sponsor or Lead Agency Identified State DEP

Identified Support or Opposition Local base of opposition to reservoirs of any kind in northwest New Jersey.

FINANCIAL:

STATUS OF FUNDS:

1 $ Already Committed

_____ Financing Anticipated

2 Financing Uncertain

_____ Not Significant

For

Site Acquisition 1

Prel. Planning 1

Design 2

Construction 2

Sources of Funds Bond Issue for site acquisition; design/construction uncertain.

Pay Back Arrangement: _____ Outright Grant X Not Known

_____ Bond Debt Service _____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Most immediate prospect for implementation of all northwest Jersey reservoir projects; site being acquired; may be needed for compensating releases in Delaware mainstem.

SHOULD NOT: Without downstream compensating release requirement, Hackettstown is only beneficiary; considerable relocation required.

NO. 57 FLAT BROOK RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 57 Name Flat Brook Reservoir Identification No. 21-23-800

Region(s) 6 Basin(s) Delaware River County(ies) Sussex

Flatbrook

Author SNJ Title Comp. Study TILP 1975 Library No. 230.04

Tech Memo 9/29/72 1008.11

757

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$134,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	13,300,000
Cost per million gallons (2) based on 236 mgd yield	155

Yield - Based on drought of 1960's 236 mgd

(1) Costs updated by ENR Index from source 230.04 except power adjusted to 4¢/Kwhr

(2) Costs for raw water in reservoir

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 57 Name Flat Brook Reservoir L.O.R.D.S. No. 21-23-800

(Dam Site)

Region (s) 6 Basin (s) Delaware River, Flat Brook County (ies) Sussex

IMPACT ANALYSIS

Construction - Short term minor impacts include: some erosion and sediment runoff, which should be controlled; disposal of spoil and vegetation; air borne dust; noise, exhaust emissions, and smoke plumes from construction vehicles and equipment.

Terrestrial & Aquatic Life - Trout stream preservation must be considered. Permanent loss of vegetation will occur within the reservoir area. Minor alterations of size, density, and distribution of terrestrial and aquatic species, and temporary disruption of natural habitats, spawning areas, and migration routes may occur. The ecosystem is expected to stabilize after these impacts are felt.

Water Quantity & Quality - Short term impacts include: erosion and sediment runoff; increased surface water turbidity; and minor accumulation of sediment downstream of the site. Permanent effects include drainage realignment.

Land Use - Inundation of large area to create impoundment.

Displacement - Unknown.

Economic Development - The proposed Flat Brook Reservoir may supplement natural tributary flows (drainage area of 65 SM).

Uses/Purposes - Water supply and storage, flow augmentation, and flood control.

Transportation - Temporary traffic disruptions may occur as a result of construction activity.

Visual Quality - Unknown.

NO. 58 FLATBROOK - RARITAN CONTINUOUS DIVERSION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 58 Name FlatBrook - Raritan Continuous Diversion Identification No. 21 & 24

Region(s) 1, 6 Basin(s) Delaware; Flatbrook; Raritan County(ies) Sussex

Author	Title	Library No.
Env. Def. Fund	Alt. to Tocks Island Res.	511
	M. Disko Assoc. 10/73	-
	TAMS Report 1955	757

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$1,030,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	54,400,000
Cost per million gallons[2] [3] based on 300 mgd yield	497

Yield - Based on drought of 1960's 300 mgd

(1) Costs developed based on related projects, 14, 28 and 57

(2) Costs of treated water, delivered at Two Bridges

(3) Costs for use of Round Valley/Spruce Run additional

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 58 Name Flat Brook-Raritan Continuous Diversion L.O.R.D.S. No. _____ Atlas Sheets 21, 24

Region (s) 1,6 Basin (s) Delaware, Flat Brook, Raritan County (ies) Sussex

IMPACT ANALYSIS

Construction - Temporary construction impacts include disposal of spoil and vegetation from 400 mgd pumping station site and along the route of the proposed (108 inch) pipeline to Round Valley Reservoir; erosion and sediment runoff, requiring control plan for proper design and maintenance of facilities; noise, airborne dust, exhaust emissions, smoke plumes from construction vehicles and equipment. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Permanent removal of vegetation at facilities' sites; pipeline ROW must be maintained. Alteration in size, diversity, distribution of terrestrial species and disruption of natural habitat, migration routes, and spawning areas of terrestrial fauna, and aquatic fauna in streams crossed by the pipeline, may occur. Aquatic species in interconnected reservoirs may also be affected. The ecosystem is expected to stabilize after these effects are felt. Special consideration should be given to the Flat Brook watershed when it is inundated.

Water Quantity & Quality - Short term impacts may include increased surface water turbidity in area's streams and water bodies; some sediment accumulation in streams in the vicinity of pipeline construction; erosion and sediment runoff. Stream encroachment by the pipeline should be prevented. Water pumped from the Delaware River is of poor quality. During periods of low Delaware River flow, water will be released from Flat Brook Reservoir if appropriate conditions exist at Trenton and Frenchtown, N.J., and Montague, N.J. For project to be feasible, ability must exist to obtain 300 mgd yield and maintain 3000 cfs at Trenton.

Land Use - Acquisition of land for 400 mgd pumping station, pipeline route and ROW will be required.

Displacement - Unknown.

Economic Development - A limitation on yield is the capacity and outlet of Round Valley.

Uses/Purposes - Water supply, pumped storage, flow augmentation.

Transportation - Temporary diversion of traffic during construction will occur.

Visual Quality - Unknown.

NO. 60 ROSS CORNER RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 60 Name Ross Corner Reservoir Identification No. 22-21-800

Region(s) 6 Basin(s) Delaware, Paulins Kill County(ies) Sussex

Author SNJ Title Paulins Kill Hydrology & Reservoirs 1974 Library No. 1008.10

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$19,600,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	1,980,000
Cost per million gallons[2] based on 20 mgd yield	271

Yield - Based on drought of 1960's 20 mgd

(1) Costs estimated by use of unit cost factors appearing in App. H of NEWS Report, 1971, as adjusted by ENR Index except power adjusted to 4¢/Kwhr.

(2) Raw water impounded at reservoir

ENVIRONMENTAL EVALUATION

No. 60 Name Ross Corner Reservoir L.O.R.D.S. No. 22-21-800

Region (s) 6 Basin (s) Delaware, Paulins Kill County (ies) Sussex

IMPACT ANALYSIS

Construction - Creation of the reservoir will involve clearing a 650-acre site and construction of a dam (size not specified). Construction of a small treatment plant as well as a pump station (part of the pumped storage operation) would be required. (The size and location of these facilities have not been specified). Temporary air and noise impacts resulting from earthmoving operations and vehicular emissions can be minimized by standard practices. The area is rural, with no residential clusters in close proximity to the site.

Land Use - Total required land acquisition would be 1,400 acres. The project would affect forested, crop and pasture land.

Water Quantity & Quality - The reservoir would have a capacity of ten billion gallons. The reservoir would be located on a minor tributary of Paulins Kill and construction may result in temporary turbidity increases in the tributary and the main stem. The project is proposed for water supply/pumped storage use and hydrologic studies would be required to determine the impact of the intermittent withdrawal and release of stored water into the river.

Terrestrial & Aquatic Habitats - Some small areas of deciduous forest may have to be cleared. A small area of freshwater marsh may be inundated. The ecology of both the impounded reach of the Paulins Kill tributary and the area below the dam could change as a result of the pumped storage aspect of the project.

Displacement - Unknown.

Uses/Purposes - Water suply, possibly for Town of Newton; pumped storage.

Transportation - Unknown

Visual Quality - Construction impacts expected to be minimal due to absence of nearby developed areas. The impact of the pump station and related power generation facilities are unknown due to lack of detailed information.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 60

PROJECT STATUS:

X	Concept	____	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required

_____ Sought

_____ Obtained

From

DRBC _____

ACOE or other states _____

WP&SC X

N.J. Legislature X

Pinelands Commission _____

D&R Canal Commission _____

Sponsor or Lead Agency Identified State DEP

Identified Support or Opposition Northwest New Jersey resistance to reservoirs.

FINANCIAL:

STATUS OF FUNDS:

_____ $ Already Committed

_____ Financing Anticipated

X Financing Uncertain

_____ Not Significant

For

Site Acquisition _____

Prel. Planning _____

Design _____

Construction _____

Sources of Funds Uncertain

Pay Back Arrangement: _____ Outright Grant X Not Known

_____ Bond Debt Service _____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Compensating release contribution; substitute for Tocks Project.

SHOULD NOT: Purpose not well defined; early stage in development; likely prospect of local opposition.

NO. 65 SHADES OF DEATH RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 65 Name Shades of Death Reservoir Identification No. 24-04-100

Region(s) 6 Basin(s) Delaware, Pequest County(ies) Warren

Author SNJ Title Hud.-Del. Bas. - Res. Site Data, S-W Res. Con. & Dev. Proj. 74 Library No. 1008.9 (a), 1209.01

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$38,800,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	3,560,000
Cost per million gallons[2] based on 27 mgd yield	361

Yield - estimated at 27 mgd operating independently

(1) Costs estimated by use of unit cost factors appearing in App. "H" of NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr.

(2) Raw water at impoundment

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 65 Name Shades of Death Reservoir L.O.R.D.S. No. 24-04-100

Region (s) 6 Basin (s) Delaware, Pequest County (ies) Warren

IMPACT ANALYSIS

Construction - Temporary construction impacts are expected to be minor and will include: some erosion and sediment runoff, which should be controlled; disposal of spoil and vegetation; noise, airborne dust, exhaust emissions, smoke plumes from construction vehicles and equipment. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Permanent loss of vegetation will occur in reservoir area. Minor alterations of size, diversity, and distribution of terrestrial species and temporary disruption of natural habitats, migration routes, and spawning areas may occur. Special attention should be given to aquatic species in Bear Swamp and to terrestrial species within Stokes State Park.

Water Quantity & Quality - Short term impacts may include increased surface water turbidity in nearby streams and water bodies; erosion and sediment runoff; some sediment accumulation downstream from the construction site. Drainage realignment, requiring flood plain management considerations, will occur over an 86 sq. mi. drainage area. Special consideration should be given Bear Swamp, south of the proposed reservoir, as it may be an environmentally sensitive ecosystem. Spill crest must be controlled.

Land Use - Acquisition of 800 acres, 250 of which will be inundated, will be required. Located in Jenny Jump Park.

Displacement - Unknown.

Economic Development

Uses/Purposes - Water supply, pumped storage.

Transportation - Some temporary disruption of traffic may occur during construction.

Visual Quality - Reservoir would enhance area's visual quality and create recreational opportunities.

NO. 66 PETERSBURG RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 66 Name Petersburg Reservoir Identification No. 24-04-400

Region(s) 6 Basin(s) Delaware, Pequest County(ies) Warren

Author SNJ Title Hud.-Del. Bas. Res. Site Data, W-S Plan 1974 Library No. 1008.9 (a), 1209.01

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$31,600,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	3,100,000
Cost per million gallons based on 35 mgd yield	243

Yield - estimated at 35 mgd operating independently

(1) Costs estimated by use of unit cost factors appearing in App. "H" of NEWS Report, 1971, as adjusted by ENR Index except power adjusted to 4¢/Kwhr.

(2) Raw water at impoundment

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 66 Name Petersburg Reservoir L.O.R.D.S. No. 24-04-400

Region (s) 6 Basin (s) Delaware, Pequest County (ies) Warren

IMPACT ANALYSIS

Construction - Temporary construction impacts will be minor and may include: noise, airborne dust, exhaust emissions, smoke plumes from construction vehicles and equipment; some erosion and sediment runoff, which should be controlled; and disposal of spoil and vegetation.

Terrestrial & Aquatic Life - Permanent loss of vegetation will occur in the reservoir area and perhaps at the pumping station sites. Minor alterations of size, diversity, and distribution of terrestrial species and temporary disruption of natural habitats, spawning areas, and migration routes may occur. The ecosystem is expected to stabilize after these impacts are felt.

Water Quantity & Quality - Short term impacts could include erosion and sediment runoff; increased surface water turbidity; and some accumulation of sediment downstream from sites. Permanent effects could include drainage realignment, requiring flood plain management considerations.

Land Use - Acquisition of 500 acres for water and 215 acres for land at the reservoir site will be required.

Displacement - Residential displacement; extent unknown.

Economic Development - Unknown.

Uses/Purposes - Water supply; pumped storage.

Transportation - Temporary traffic disruption may occur during construction.

Visual Quality - Unknown.

NO. 67 HONEY RUN RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 67 Name Honey Run Reservoir Identification No. 24-03-400

Region(s) 6 Basin(s) Delaware, Pequest County(ies) Warren

Author SNJ Title Hud.-Del. Bas. Site Data, S-W Res. Con & Dev. Proj. 1974 Library No. 1008.9 (a), 1209.01

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$72,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	6,820,000
Cost per million gallons based on 32 mgd rate of use	584
Estimated rate of use	32 mgd

(1) Costs estimated by use of unit cost factors appearing in App. "H" NEWS Report, 1971, as adjusted by ENR Index except power adjusted to 4¢/Kwhr

(2) Raw water at impoundment

ENVIRONMENTAL EVALUATION

No. 67 Name Honey Run Reservoir L.O.R.D.S. No. 24-03-400

Region (s) 6 Basin (s) Delaware, Pequest County (ies) Warren

IMPACT ANALYSIS

Construction - A total of about 2,000 acres of cropland and wetlands will have to be cleared for the reservoir itself. A dam and facilities for pumped storage, including a pumping station, will be constructed. Water is to be supplied to the reservoir through a pipeline from the Delaware River. No route has been selected for this line. Temporary air and noise impacts resulting from earthmoving operations and vehicular emissions can be minimized by standard practices. Measures should be taken to prevent the construction activities from impacting visitors to nearby Jenny Jump State Forest.

Land Use - The project has extensive land requirements totaling 4,425 acres. As noted, this consists predominantly of cropland. Sussex and Warren Counties have prepared a Resource Conservation and Development Project Plan (1974) that supports the reservation of several sites, including Honey Run, for water supply development.

Water Quantity & Quality - Honey Run would have a storage capacity of 30.5 billion gallons. Water would be pumped from the Delaware River to the reservoir and stored, to be released back to the Delaware at times when flows are low. Creation of the reservoir would inundate now free-flowing portions of Honey Run and Muddy Brook. Construction may cause temporary turbidity increases in these streams below the site. Hydrologic studies of the impact of the pumped storage operations on the receiving streams may be necessary.

Terrestrial & Aquatic Habitats - 2,000 acres of crop and pasture land will be inundated; portions of Brookaloo swamp could also be inundated. The ecology of Honey Run and Muddy Brook could change as a result of the pumped storage aspect of the project and periodic releases to the Delaware.

Displacement - Unknown.

Uses/Purposes - The primary purpose would be storage to allow for flow augmentation in the Delaware at times of low flows.

Transportation - A few local roads may be inundated in part (specific location of the reservoir unknown).

Visual Quality - Construction impacts for the reservoir itself are expected to be minimal due to absence of nearby developed areas.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 67

PROJECT STATUS:

X	Concept	____	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required

_____ Sought

_____ Obtained

From

DRBC _____

ACOE or other states _____

WP&SC X

N.J. Legislature X

Pinelands Commission _____

D&R Canal Commission _____

Sponsor or Lead Agency Identified State DEP

Identified Support or Opposition Northwest New Jersey resistance to reservoirs.

FINANCIAL:

STATUS OF FUNDS:

_____ $ Already Committed

_____ Financing Anticipated

X Financing Uncertain

_____ Not Significant

For

Site Acquisition _____

Prel. Planning _____

Design _____

Construction _____

Sources of Funds Uncertain

Pay Back Arrangement:

_____ Outright Grant

X Not Known

_____ Bond Debt Service

_____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Large storage capacity; closeness to River.

SHOULD NOT: Early stage of development; most useful for Delaware River pump storage; not welcomed locally.

NO. 72 FRANKLIN RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 72 Name Franklin Reservoir Identification No. 22-22-800

Region(s) 1, 6 Basin(s) Hudson, Wallkill County(ies) Sussex

Author SNJ Title Wallkill Hyd. & Res. 1974; Sussex-Warren Plan 1974 Library No. 1008.9; 1209.01

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$15,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	1,520,000
Cost per million gallons (2) based on 14 mgd yield	297
Yield - Based on drought of 1960's	14 mgd

(1) Costs estimated by use of unit cost factors appearing in App. "H", NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr.

(2) Raw water at impoundment

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 72 Name Franklin Reservoir L.O.R.D.S. NO. 22-22-800

Region (s) 1 Basin (s) Hudson, Wallkill County (ies) Sussex

IMPACT ANALYSIS

Construction - Temporary construction impacts are expected to be minor: noise, airborne dust, exhaust emissions, smoke plumes from construction vehicles and equipment, particularly at site of pumping station construction. Some erosion and sediment runoff may occur. Disposal of some spoil and vegetation may be required.

Terrestrial & Aquatic Life - Permanent loss of vegetation at reservoir and pumping station sites. Minor alterations of size, diversity, and distribution of terrestrial and aquatic species and temporary disruption of natural habitats, spawning areas, and migration routes of terrestrial fauna may occur. The ecosystem is expected to stabilize after these impacts. Some loss of aquatic life may occur at the intake pumping station.

Water Quantity & Quality - Short term effects may include erosion and sediment runoff; increased surface water turbidity; minor accumulation of sediment downstream from construction site. Permanent effects may include drainage realignment over the 32 sq. mi. Wallkill River drainage area, requiring consideration of flood plain management. Crest elevation will be 580 ft. above msl; spill crest will have to be controlled.

Land Use - Acquisition of 700 acres for water and 700 acres for land, additional land for pumping stations. Proposed Sussex County landfill near site -- uses conflict.

Displacement - Unknown.

Economic Development - If Franklin Reservoir is constructed with Sussex North and Beaver Run Reservoirs, the storage capacity will be increased from 7.6 BG for Franklin Reservoir alone to 27.5 BG for all three reservoirs. The combined drainage area would be 213 sq. mi.

Uses/Purposes - Water supply, pumped storage.

Transportation - Traffic may be disrupted during construction activity, including traffic on Rtes. 23 and 94.

Visual Quality - Pumping station should be designed to harmonize with landscape or existing architectural styles in the area.

NOS. 72 & 74 FRANKLIN AND SUSSEX NORTH RESERVOIRS

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 72 & 74 Name Franklin & Sussex North Reservoirs Identification No. 21-12-900
22-22-800

Region(s) 1, 6 Basin(s) Hudson, Wallkill County(ies) Sussex

Author SNJ Title Wallkill Hyd. & Res. 1975; S-W Plan 1974 Library No. 1008.9; 1209.1

Updated Costs to 1980 (ENR 3100) (1) (2)

Capital For construction, design, land acquisition, etc.	$54,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	5,380,000
Cost per million gallons (3) based on 66 mgd yield	223
Yield - Based on drought of 1960's (4)	66 mgd

(1) Costs estimated by use of unit cost factors appearing in Appendix H NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr

(2) Combined costs proj. 72, 74

(3) Raw water impounded at Sussex North Reservoir

(4) Combined yield, two reservoirs working together

NO. 73 BEAVER RUN RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 73 Name Beaver Run Identification No. 22-22-500

Region(s) 6 Basin(s) Wallkill River County(ies) Sussex

Author SNJ Title Wallkill Hyd & Res 1975 Library No. 1008.9

Sus.-War. Plan 1974 1209.01

Updated Costs to 1980 (ENR 3100)[1][2]

Capital For construction, design, land acquisition, etc.	$16,200,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	1,760,000
Cost per million gallons[3] Based on yield of 28 mgd	172

Yield based on drought of 1960's 28 mgd

(1) Costs estimated by use of cast factors appearing in App. "H" NEWS Report, 1971 as adjusted by ENR Index except as noted.

(2) Power costs set at $0.04/Kwhr.

(3) Raw water, in reservoir

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 73 Name Beaver Run Reservoir L.O.R.D.S. No. 22-22-500

Region (s) 1 Basin (s) Hudson, Wallkill County (ies) Sussex

IMPACT ANALYSIS

Construction - Temporary construction impacts should be minor: noise, airborne dust, exhaust emissions, smoke plumes from construction vehicles and equipment. Some erosion and sediment runoff may occur and should be controlled. Disposal of some spoil and vegetation will also be required.

Terrestrial & Aquatic Life - Permanent loss of vegetation is expected in the reservoir area and at the pumping station sites. Minor alterations of size, diversity, and distribution of terrestrial and aquatic species and temporary disruption of natural habitats, spawning areas, and migration routes of terrestrial fauna may occur. The ecosystem is expected to stabilize after these impacts. Some loss of aquatic biota may occur at the intake pumping station.

Water Quantity & Quality - Short term impacts may include erosion and sediment runoff; increased surface water turbidity, particularly in Beaver Run; some accumulation of sediment downstream from construction sites. Permanent effects may include drainage realignment over a 54 sq. mi. drainage area, requiring flood plain management. The water elevation of the reservoir will approximate 580 ft. above msl; the spill crest will have to be controlled.

Land Use - Acquisition of 1,525 acres (750 acres for water, 775 acres for land) will be required for the reservoir site and some land for the pumping station site.

Displacement - Unknown.

Economic Development - Reservoir capacity will be 5.5 BG; if three reservoir system (Beaver Run, Franklin, and Sussex North Reservoirs) is constructed, total storage will be 27.5 BG.

Uses/Purposes - Water supply; pumped storage.

Transportation - Traffic may be disrupted during construction activity.

Visual Quality - Pumping station should be of a design to harmonize with landscape or conform with area's architectural styles.

NO. 74 SUSSEX NORTH RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 74 Name Sussex North Reservoir Identification No. 22-12-900

Region(s) 1 Basin(s) Hudson, Wallkill County(ies) Sussex

Author SNJ Title Wallkill Hyd. & Res. 1975; Sus.-War. Plan 1974 Library No. 1008.9; 1209.1

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$39,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	3,960,000
Cost per million gallons[2] based on 52 mgd yield	209

Yield - Based on drought of 1960's 52 mgd[3]

(1) Costs estimated by use of cost factors appearing in App. H NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr.

(2) Raw water impounded in reservoir

(3) Estimated yield reservoir working alone

ENVIRONMENTAL EVALUATION

No. 74 Name Sussex North Reservoir L.O.R.D.S. No. 22-12-900

Region (s) 1 Basin (s) Hudson, Wallkill County (ies) Sussex

IMPACT ANALYSIS

Construction - Approximately 950 acres of predominatly crop and pasture land would have to be cleared for the reservoir. A 142 mgd pump station and a pipeline from the wallkill River to the site would have to be constructed.

Temporary air and noise impacts should have a minimal impact due to the distance of the site from developed areas.

Land Use - A total of 1,270 acres of mostly crop and pasture land and some forested land would be acquired for the project. Land requirements for the pipeline ROW and the pump station have not been calculated.

Water Quantity & Quality - The reservoir would have a storage capacity of 14.4 billion gallons. The safe yield of Sussex North, if operated in tandem with the proposed Franklin Reservoir has been estimated at 52 mgd. The safe yield, if operated with the proposed Franklin and Beaver Run Reservoirs, has been estimated at 55 mgd.

Because the reservoir is off-stream, construction-related turbidity increases should be minimal.

Hydrologic studies of the Wallkill would be necessary to assess the impact of the pumped storage withdrawal/release on the stream.

Terrestrial & Aquatic Habitats - A relatively small area of deciduous forest might have to be cleared.

Displacement - Unknown, although it is likely none will be required.

Uses/Purposes - Water supply, pumped storage.

Transportation - The project would inundate a section of N.J. Route 284, and potentially, parts of two other local roads.

Visual Quality - Construction impacts will be minimal due to distance from sensitive uses.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 74

PROJECT STATUS:

X	Concept	____	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required / ____ Sought / ____ Obtained From

DRBC ____

ACOE or other states ____

WP&SC X

N.J. Legislature X

Pinelands Commission ____

D&R Canal Commission ____

Sponsor or Lead Agency Identified Uncertain; could be Newark, Sussex County MUA, or State DEP.

Identified Support or Opposition Dependent upon sponsor

FINANCIAL:

STATUS OF FUNDS:

____ $ Already Committed

____ Financing Anticipated

X Financing Uncertain

____ Not Significant

For

Site Acquisition ____

Prel. Planning ____

Design ____

Construction ____

Sources of Funds Uncertain

Pay Back Arrangement: ____ Outright Grant X Not Known

____ Bond Debt Service ____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: One of few available options for this section of Sussex County; could stabilize stream flows and allow compensatory flows in Wallkill River.

SHOULD NOT: Needs sponsor.

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 73 with 72, 74 Name Franklin. Beaver Run and Sussex North Identification No. 22-22-500

Region(s) 1 Basin(s) Wallkill, Hudson County(ies) Sussex

Author SNJ Title Wallkill Hyd. & Res. 1975; Sus.-War. Plan 1974 Library No. 1008.9; 1209.01

Updated Costs to 1980 (ENR 3100)(1) (2)

Capital For construction, design, land acquisition, etc.	$70,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	6,780,000
Cost per million gallons (3) based on 97 mgd yield	192

Yield - Based on drought of 1960's (4)

(1) Costs estimated by use of cost factors appearing in App. "H" NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr

(2) Combined costs of proj. 72, 73 and 74.

(3) Raw water in Reservoirs.

(4) Combined yields, three reservoirs operating together, may be 15% less depending on actual siting of intakes storage areas.

NO. 75 WALLKILL RIVER DIVERSION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 75 Name Wallkill River Diversion Identification No. 22

Region(s) 1 Basin(s) Hudson-Wallkill, Passaic-Pequannock County(ies) Sussex, Passaic, Essex

Author Newark Title Rpt. on Alt. WSP 1974 Library No. 1206.01

Updated Costs to 1980 (ENR 3100) (1)

Capital
For construction, design, land acquisition, etc.

Operation and Maintenance and Annual Costs
Amortization, personnel, power, etc.

Cost per million gallons
based on mgd yield

Yield - Based on drought of 1960's mgd

(1) Project combined with #46 Dunkers Pond for cost and yield information

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 75 Name Wallkill River Diversion L.O.R.D.S. No. _____

Atlas Sheet 22

Region (s) 1 Basin (s) Hudson-Wallkill, Passaic-Pequannock County (ies) Sussex, Passaic, Essex

IMPACT ANALYSIS

Construction - Temporary construction effects for the diversion, pumping station and reservoir are minimal. Temporary effects to construction workers and residents within the site area include: airborne dust; smoke plume and exhaust emissions from construction activity; and vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Minor effects may include: disruption of natural habitats, migration routes, and spawning areas; possible impingement and entrainment of aquatic species; and removal of vegetation. In some areas permanent clearance must be maintained.

Water Quantity & Quality - Major long-term adverse environmental effects may include: water quality impacts of in-stream transmission; increased surface water turbidity throughout entire system; and erosion and sediment accumulation due to construction activity. Water quality of Wallkill River is poor.

Land Use - Several acres of land must be acquired for the proposed facilities.

Displacement - Unknown.

Economic Development - Unknown.

Uses/Purposes - Water supply.

Transportation - Short term traffic diversions may occur during the construction period.

Visual Quality - Unknown.

NO. 76 UPPER AND LOWER MANASQUAN RESERVOIRS

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 76 Name Upper and Lower Manasquan Reservoirs Identification No. 29-33-100
29-22-700

Region(s) 2 Basin(s) Manasquan County(ies) Monmouth
Ocean

Author SNJ Title Manasquan Reservoir Proj. Library No. 229.07
NEWS Summary Report 1977

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$33,600,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	5,600,000
Cost per million gallons[2] based on 35 mgd yield	438

Yield - Based on drought of 1960's 35 mgd[3]

(1) Costs updated by use of ENR Index

(2) Treated water at treatment works near lower reservoir

(3) Assumes yield of 10 mgd lower combined with 25 mgd yield from upper reservoir

ENVIRONMENTAL EVALUATION

No. 76 Name Upper and Lower Manasquan Reservoirs L.O.R.D.S. No. 29-22-700 29-33-100 Atlas Sheet 29

Region (s) 2 Basin (s) Manasquan County (ies) Monmouth, Ocean

IMPACT
ANALYSIS

Construction - Temporary impacts resulting from creation of Allaire and Oak Glen Reservoirs and the connecting force main could include: disposal of spoil and vegetation from the reservoir sites and from the force main construction corridor, expected to be 80 to 100 feet wide; stripping and some removal of top soil could cause increased erosion, sedimentation and an erosion control plan should be developed; increased tubidity in Manasquan River below Hospital Road; raising of water temperatures in the stream; disruption of fishing and canoeing, and golfing at Spring Meadow Golf Course; airborne dust, noise, exhaust emissions from construction vehicles and equipment.

Construction will proceed in two phases: Allaire Reservoir is to be completed 2 to 3 years following final plan approval; Oak Glen Reservoir and the connecting force main to be completed 10 to 15 years after creation of Allaire. Construction impacts, therefore, will be temporary but will occur over an extended period of time. Potential impacts should be minimized through proper scheduling and construction procedures.

Land Use - Land use at the reservoir sites is predominantly forest land, cropland and pasture; 840 acres of public open land will be inundated. The force main route, while still undetermined, could pass through forest land, cropland and pasture, wetlands, or some residential areas. Wherever possible, the route should follow existing railroad ROW or road systems.

Acquisition of land for the reservoirs is nearly complete. As of 12/76, 1,211 acres of a total of 1,220 acres have been purchased. Allaire Reservoir will have a water surface area of about 70 acres, Oak Glen of 770 acres.

Water Quantity & Quality - The proposed reservoir system will have a safe yield of 35 mgd; after the first phase, Allaire Reservoir will have a safe yield of 10 mgd directly from Manasquan River streamflow. Allaire and Oak Glen Reservoirs will have storage capacities of 100 million and 5 billion gallons respectively. Oak Glen Reservoir will store peak flows from the Manasquan River and surplus water in periods of low demand. During low flow periods, Oak Glen water may be released for flow augmentation of the Manasquan River. This may serve to control temperatures, dilute natural nutrients and increase dissolved oxygen levels during low flow periods.

Major point sources may contribute to water quality problems. Such sources include the Lone Pine Landfill, Debors Creek and its tributaries with 4 major treated wastewater discharges and five minor discharges. Also, sampling in the Manasquan River has indicated periodic concentrations above recommended

standards for iron, cadmium, chromuim, lead and molybdenum. High loads of phosphorous, ammonia, suspended solids, oxygen demand and organic carbon will enter Allaire Reservoir and may result in eutrophication. Nitrogen and phosphorous control, the proposed raw water treatment plant and regional wastewater planning should take place to maintain good water quality in the reservoir system.

The underlying soils at the reservoir sites are of a sandy nature. Since such a layer would permit leaking, lining of the reservoirs may be necessary.

With creation of the proposed reservoir system, groundwater production will not have to increase beyond current withdrawal rates. Groundwater levels may actually increase as a result of the project during otherwise low periods. It is expected that ground water quality will improve.

The upper Manasquan estuary could pose a problem of salt water intrusion because water would be taken directly from streamflow. Upstream salt wedge movement may be minimized however, by release of stored reservoir water during low flow periods.

Finally, stream encroachment by the force main should be avoided or minimized wherever possible. Procurement of a state stream encroachment permit for each stream crossing would be necessary.

Terrestrial & Aquatic Habitats - During construction, vegetation on lands adjacent to the reservoir sites and along the 80 to 100 ft. wide force main corridor will be disrupted. Large areas of mature forest and various successional forest stages will be eliminated by creating Oak Glen Reservoir.

Again depending on the ultimate force main route, vegetation may be disrupted to a greater or lesser degree. The greatest potential vegetation disruption would occur if the route were to pass through the Manasquan River flood plain forest, including Allaire State Park and the Squankum area. Other routes would result in some disruption of roadside vegetation or young upland forest areas.

Long term impacts on fauna will include: loss of species unable to adapt to aquatic habitats; benefit to shorebirds and migrating waterfowl due to the extensive open water available; exposed mudflats during reservoir drawdowns, encouraging breeding of waterfowl but precluding muskrat or beaver colonization.

Consideration must be given to trout maintenance in the Manasquan River. Creation of Allaire Reservoir will eliminate 2600 feet of the Manasquan for trout angling and will reduce the number of stocked trout. Potential salt water intrusion must be prevented to permit trout maintenance.

The reservoirs may serve as warm water fisheries, provided nutrient levels and potential entrophication are controlled.

Habitats along the force main route are expected to recover and revegetate, subsequent to temporary construction-related losses. Habitats may be disrupted if erosion is severe. Small streams found to support bog turtles should be avoided or disruptions minimized.

Displacement - At the Oak Glen site, relocation of from 2 to 5 households will be required. An additional 31 households may require relocation.

Uses/Purposes - Water supply, pumped storage, recreation. The proposed reservoir system will become part of a major integrated recreational area stretching for 11 miles of the Manasquan Valley from Oak Glen Reservoir to the estuary. The area is to be publicly owned and will provide freshwater swimming, lake and stream fishing, bicycling, and hiking.

Upon completion of Allaire Reservoir, the Manasquan Basin Ocean Shore area and the Bayshore area will be served. With completion of Oak Glen Reservoir, the service area will be expanded to include, but not be limited to, Freehold Borough, Freehold township, Hazlet, Holmdel, Monmouth Consolidated Water Company service area, and Lakewood.

Transportation - During construction, particularly that of the force main, traffic disruptions are likely to occur. Long term impacts will include increased traffic in the area due to the expanded recreational opportunities.

Visual Quality - The treatment plants should be designed for minimal visual disruption. The visual quality of the area may be gradually altered as recreational facilities are developed but it need not be negatively impacted if design controls are imposed.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 76

PROJECT STATUS:

____ Concept _X_ Preliminary Planning ____ Design ____ Construction ____ Site Acquired

INSTITUTIONAL:

APPROVALS: ____ Required ____ Sought ____ Obtained From

DRBC ____ N.J. Legislature ____

ACOE or other states ____ Pinelands Commission ____

WP&SC ____ D&R Canal Commission ____

Sponsor or Lead Agency Identified State DEP for now

Identified Support or Opposition Uncertain

FINANCIAL:

STATUS OF FUNDS: _1_ $ Already Committed; ____ Financing Anticipated; _2_ Financing Uncertain; ____ Not Significant

For: Site Acquisition 1; Prel. Planning 1; Design 2; Construction 2

Sources of Funds State Bond funds for acquisition and design

Pay Back Arrangement: ____ Outright Grant _X_ Not Known ____ Bond Debt Service ____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Only new surface water project in area; well into final environmental analysis; site acquired.

SHOULD NOT: Need for commitments to buy water; environmental problem; decision on project implementation.

NO. 77 HACKENSACK RIVER OPTIMIZATION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 77 Name Hackensack River Optimization Identification No. 23 & 26

Region(s) 1 Basin(s) Hackensack County(ies) Bergen

Author	Title	Library No.
HWC	TAMS Report 1955	757
COE	Site Capacity in NJ 1966	810
	NEWS Report 1969	201

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	NA
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	NA
Cost per million gallons (2) based on 15 mgd yield	NA
Yield - Based on drought of 1960's	15 mgd (3)

(1) No costs available for optimization program

(2) Yield results from optimizing storage capacities and reducing letdowns.

(3) Approximately one-half of yield presently developed.

ENVIRONMENTAL EVALUATION

No. 77 Name Hackensack River Optimization L.O.R.D.S. No. _____

Atlas Sheets 23 and 26

Region (s) 1 Basin (s) Hackensack River County (ies) Bergen

IMPACT ANALYSIS

Construction - Construction of a series of pump stations and transmission pipelines between the DeForest Lake, Lake Tappan, and Oradell Reservoirs will result in temporary impacts including erosion and sediment runoff; air borne dust, exhaust emissions, and noise from construction vehicles and equipment. The extent of these impacts is unknown, however, as the number of pump stations to be constructed is not yet determined.

Land Use - Land use in the Hackensack River basin area is predominantly residential, with some forest areas. Most of Bergen County's 700,000 people live in the Hackensack Basin.

Water Quantity & Quality - The Hackensack Basin reservoir system can be developed beyond existing capacity by expansion of pumping stations and transmission facilities, specifically to divert excess Oradell Reservoir water to Lake Tappan and excess Tappan water to DeForest Lake Reservoir, thus, upper reservoir storage volumes would be increased through greater reliance on Oradell Reservoir for capturing additional water.

Further, the maximum permissible diversion at Saddle River will be increased from 10 to 15 mgd, reducing required releases below the Saddle River pump station.

Terrestrial & Aquatic Life - No significant impacts are anticipated beyond the removal of vegetation at construction sites.

Displacement - It is unknown whether any displacements will be necessary as the number and locations of proposed pump stations is not yet determined.

Uses/Purposes - Water supply. The Hackensack River Basin provides water supply for the Hackensack Water Company in New Jersey and New York.

Transportation - Some temporary disruption of traffic may be experienced during construction of pump stations or laying of pipelines. Whenever possible, pipeline routes should follow existing ROWs.

Visual Quality - As the locations of pump station sites are not yet determined, consideration should be given to placing them where they will be least disruptive to existing visual quality.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 77

PROJECT STATUS:

_X_ Concept ____ Preliminary Planning ____ Design ____ Construction ____ Site Acquired

INSTITUTIONAL:

APPROVALS: _X_ Required ____ Sought ____ Obtained From DRBC ____ ACOE or other states ____ WP&SC _X_ N.J. Legislature ____ Pinelands Commission ____ D&R Canal Commission ____

Sponsor or Lead Agency Identified Hackensack Water Company

Identified Support or Opposition Not available

FINANCIAL:

STATUS OF FUNDS: ____ $ Already Committed ____ Financing Anticipated ____ Financing Uncertain _X_ Not Significant For Site Acquisition ____ Prel. Planning ____ Design ____ Construction ____

Sources of Funds Company funds

Pay Back Arrangement: ____ Outright Grant ____ Not Known ____ Bond Debt Service _X_ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Can be implemented without land disturbances

SHOULD NOT: Not very thoroughly developed; not large enough to meet needs addressed by Project 39,40.

NO. 78 NEW YORK CITY DIVERSION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 78 Name New York City Diversion Identification No. 26-04-900

Region(s) 1 Basin(s) Hudson County(ies) Bergen

Author SNJ Title -- Library No. --

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	NA
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	NA
Cost per million gallons[2]	NA

Yield - undetermined

[1] Costs not available, for emergency use only

[2] No capacity figures suggested

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 78 Name New York City Diversion from Manhattan L.O.R.D.S. No. 26-04-900

Region (s) 1 Basin (s) Hudson River County (ies) _____

IMPACT ANALYSIS

Construction - Temporary construction impacts will include: noise, exhaust, and smoke plumes from construction vehicles and equipment. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - No effects expected.

Water Quantity & Quality - No effects expected.

Land Use - Easements to construct pipeline across George Washington Bridge must be obtained from appropriate authorities.

Displacement - No effects expected.

Economic Development - Unknown.

Uses/Purposes - Emergency water supply.

Transportation - Temporary but major traffic disruption on bridge will occur.

Visual Quality - Impact on visual quality will depend on placement and design of proposed pipeline.

NO. 79 NEW YORK CITY DIVERSION FROM STATEN ISLAND

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 79 Name New York City Diversion from Staten Island Identification No. 26-32-000

Region(s) 1 Basin(s) Hudson R. County(ies) Union, Middlesex

Author SNJ Title -- Library No. --

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	NA
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	NA
Cost per million gallons[2]	NA

Yield - undetermined

[1] Costs not available, for emergency use only

[2] No capacity figures suggested

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 79 Name New York City Diversion from Staten Island L.O.R.D.S. No. 26-32-000

Region (s) 1 Basin (s) Hudson River County (ies) Union, Middlesex

IMPACT ANALYSIS

Construction - Temporary construction impacts affect primarily construction workers and include equipment noise and emissions. Disposal of large amounts of spoil will be necessary if a tunnel is constructed. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Short term and probably minimal adverse impacts on aquatic biota would result, if pipeline constructed. Tunnel would not be expected to affect biota. Alterations in size and diversity of aquatic biota would be slight and the aquatic ecosystem would stabilize after such effects. Since water quality in the Hudson is already poor, aquatic life which might be affected is not extensive.

Water Quantity & Quality - Water quality of the Hudson is not likely to be significantly deteriorated by emplacement of a pipeline/tunnel.

Land Use - An easement must be obtained from the appropriate authorities for construction of a pipeline or tunnel.

Displacement - Unknown.

Economic Development - Unknown.

Uses/Purposes - Emergency water supply.

Transportation - No impact expected.

Visual Quality - No impact expected.

NO. 81 WELDON BROOK RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 81 Name Weldon Brook Reservoir Identification No. 22-42-300

Region(s) 1 Basin(s) Delaware, Musconetcong County(ies) Morris

Author MCMUA Title MC Water Supply Plan 1970 Library No. 1205.03

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$10,100,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	980,000
Cost per million gallons (2) based on 3.5 mgd yield	767
Yield - Based on drought of 1960's	3.5 mgd

(1) Costs estimated by use of cost factors appearing in App. "H", NEWS Report, 1971, as adjusted by ENR Index.

(2) Costs for raw water in reservoir

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 81 Name Weldon Brook Reservoir L.O.R.D.S. No. 22-42-300

Region (s) 1 Basin (s) Delaware, Musconetcong County (ies) Morris

IMPACT ANALYSIS

Construction - Temporary impacts of creation of on-river reservoir include: disposal of some spoil and vegetation; airborne dust, exhaust emissions, smoke plumes, and noise from construction activity; erosion and sediment runoff, requiring a control plan for proper construction and maintenance of facility. Plans for control of all these temporary impacts should be considered.

Terrestrial & Aquatic Life - Slight alterations in size, diversity,and distribution of terrestrial and aquatic biota should be a short term effect, after which the ecosystem is expected to stabilize. Loss of some vegetation within the reservoir area will result from creation of the reservoir.

Water Quantity & Quality - 3 BG storage at a high water elevation of 1060 feet msl as it has a limited watershed of 3.5 square miles. (The safe yield of the reservoir could be greatly increased with pumping of flows from the Musconetcong River.) Water quality in the reservoir is expected to be comparable to that of the Musconetcong River. Minor drainage realignment will occur.

Land Use - Acquisition of land for reservoir. Some land has already been acquired.

Displacement - Unknown.

Economic Development - Unknown.

Uses/Purposes - Water supply.

Transportation - No impact likely.

Visual Quality - Recreational opportunities at Musconetcong River will be enhanced with creation of reservoir.

NO. 86 TOMS RIVER RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 86 Name Toms River Reservoir Identification No. 29-31-800

Region(s) 2 Basin(s) Toms River County(ies) Ocean

Author SNJ Title NJ Res. Site Acq. Rpt. Library No. 1017

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$88,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	10,800,000
Cost per million gallons (2) based on 100 mgd yield	296
Yield - Based on drought of 1960's (3)	100 mgd

(1) Costs estimated by use of cost factors appearing in App. "H" NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr.

(2) Treated water at impoundment

(3) Yield may be excessive

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 86 Name Toms River Reservoir L.O.R.D.S. No. 29-31-800

Region (s) 2 Basin (s) Toms River County (ies) Ocean

IMPACT ANALYSIS

Construction - Temporary construction impacts include: disposal of large amounts of spoil and vegetation from reservoir site; erosion and sediment runoff, requiring a long term control plan for proper design and maintenance of facility; airborne dust, smoke plumes, exhaust emissions, and noise from construction activity. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Permanent removal of vegetation from reservoir site but only temporary clearing of vegetation in area surrounding site. Minimal reduction of several terrestrial and aquatic species may occur but is expected to be a short term effect, after which the ecosystem is expected to stabilize. Vegetation in area along the pumpline to the reservoir may be adversely affected if salt water intrusion occurs.

Water Quantity & Quality - During construction, increased runoff to nearby streams and water bodies may occur and surface water turbidity may be expected to increase. Long term impacts include drainage realignment in the area; potential for eutrophication. A flood plain management plan will be necessary. Quantity of available water with creation of reservoir may be excessive to need.

Land Use - Acquisiton of 840+ acres for reservoir.

Displacement - Unknown.

Economic Development - Opportunities for recreational activities will arise in vicinity of reservoir. Yield is expected to exceed need and may thus provide water supply for potential future development.

Uses/Purposes - Water supply. Toms River Reservoir is a pumped storage facility, supplied from confluence of the Ridgeway Branch and Toms River.

Transportation - Short term disruption of traffic may occur during construction activities.

Visual Quality - Creation of a reservoir is likely to enhance area's visual quality.

NO. 103 SOUTH RIVER RESERVOIR PROJECT

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 103 Name South River Reservoir Project Identification No. 35-15-100

Region(s) 3 Basin(s) Great Egg Harbor River County(ies) Atlantic

Author SNJ Title Feas. Rept. GEHR Basin for South River Proj. 1966 Library No. 1012

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$32,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	3,020,000
Cost per million gallons[2] based on 69 mgd yield	120
Yield - Based on drought of 1960's[3]	69 mgd

(1) Costs estimated by use of cost factors appearing in App. "H" NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr.

(2) Raw water at reservoir

(3) Annual yield of supply. Seasonal yield 92 mgd plus irrigation, another option.

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 103 Name South River Reservoir Project L.O.R.D.S. No. 35-15-100

Region (s) 3 Basin (s) Great Egg Harbor River County (ies) Atlantic

IMPACT ANALYSIS

Construction - Temporary impacts of construction of dam, pump station, and reservoir include: disposal of spoil and vegetation; erosion and sediment runoff, requiring a control plan for proper design and maintenance of facilities; noise, exhaust emissions, smoke plumes, and airborne dust from construction activity. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Removal of vegetation at facilities' location during construction, and permanently in vicinity of pump station. Minimal reduction in several terrestrial and aquatic species and slight alterations in distribution of species. Natural habitats, migration routes and spawning areas may be permanently altered by the dam which will be 5000 ft. long and will rise 50 ft. above the South River stream bed. The ecosystem is expected to stabilize after these impacts.

Water Quantity & Quality - Surface water turbidity in streams and water bodies downstream from construction sites may increase temporarily. Natural stream flow from the South River will provide 2.96 BG to filling of the reservoir. Drainage realignment will require development of a flood control plan; the spillway crest must also be controlled. The project assumes 0.125 mg/sm passing flow which may be too low to fill reservoir.

Land Use - Acquisition of land for reservoirs (water surface area of about 1800 acres; maximum pool elevation of 60 ft. msl), dam (5000 ft. long, rising 50 ft. above stream bed), and pump station will be necessary.

Displacement - Consideration must be given to major potential impact of inundation of 2 miles of medium duty roads, about 20 buildings, and 3 miles of transmission line.

Economic Development - Recreational opportunities will arise with creation of the 1800 acre reservoir. Irrigation of about 25,000 acres during the growing season will be possible. Coastal municipalities will get summer load assistance.

Uses/Purposes - Water supply, pumped storage, recreation, irrigation. For water supply, reservoir can maintain constant storage of aquifers and summer load assistance for coastal municipalities, with guaranteed 92 mgd annually. For irrigation in growing season, and year round for water supply, reservoir can irrigate about 25,000 acres and guarantee a 9-month recharge to aquifers, and constant yearly water supply averaging 69 mgd.

Transportation - Temporary traffic disruption will occur during construction. Inundation of 2 miles of medium duty roads may result, making these roads unusable.

Visual Quality - The reservoir will have positive effects on visual quality of area, creating potential for recreational activity.

NO. 113 RARITAN-PASSAIC PIPELINE

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 113 Name Raritan-Passaic Pipeline Identification No. 24 & 25

Region(s) 6 Basin(s) Delaware, Raritan County(ies) Hunterdon

Author SNJ Title NEWS Study Nov. 1971 Library No. 202

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$280,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	40,500,000
Cost per million gallons (2) (3) (4) based on 300 mgd yield	370
Yield - Based on drought of 1960's	300 mgd

(1) Costs estimated by use of cost factors appearing in App. "H" NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr.

(2) Depends on Tocks Island Project, or other Delaware River Basin storages, for which costs are additional.

(3) Raw water delivered to Passaic River

(4) Fees for Round Valley/Spruce Run in addition

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 113 Name Raritan- Passaic Pipeline L.O.R.D.S. No. _____

Atlas Sheet 24

Region (s) 6 Basin (s) Delaware, Raritan County (ies) Hunterdon

IMPACT ANALYSIS

Construction - Temporary impacts of pipeline construction include: disposal of vegetation and spoil; erosion and sediment runoff in the immediate area, requiring a control plan; airborne dust, exhaust emissions, smoke plumes, and noise from construction activity.

Terrestrial & Aquatic Life - Localized alteration of size, diversity, and distribution of species in pipeline ROW may occur. Minimal disruption of natural habitats, migration routes, and spawning areas is expected. The effected ecosystem is expected to stabilize after these short term impacts. Vegetation will have to be removed from the pipeline ROW, permanently.

Water Quantity & Quality - Prevention of stream encroachment along pipeline route will be necessary. Accumulation of sediment downstream from the construction site should be controlled. Increased surface water turbidity in nearby streams or water bodies may be temporary as a result of construction activity.

Land Use - Acquisition of land for pipeline and necessary ROW will be required. The ROW will need to be maintained.

Displacement - Unknown.

Economic Development - Unknown.

Uses/Purposes - Water supply.

Transportation - Some traffic disruption may occur with construction activity.

Visual Quality - Unknown.

NO. 113A70 RARITAN-PASSAIC TRANSFER
(Via Force Main, Tunnel & Dead River)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 113A Name Raritan-Passaic Transfer Identification No. 25

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Somerset, Morris, Union, ~~Essex, Passaic~~

Author Developed by SNJ-SWSMP Consultants Title Task 3E Output Library No.

Updated Costs to 1980 (ENR 3100)(1)

Capital For construction, design, land acquisition, etc. Raw water intake, pump station on Raritan River near Bound Brook, forcemain and tunnel to Dead River plus withdrawal and treatment of water from Passaic River for 70 mgd	$75,700,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	$ 9,490,000(2)
Cost per million gallons Yield 70 mgd available in Raritan River from SR/RV -'60s drought	$ 371(2) (3)

(1) Costs updated from NEWS Report, factors appearing in App. H

(2) Fees for use of RV/SR in addition to this sum

(3) Electric Power Costs set at 4¢ KwHr

NO. 113A$_{100}$ RARITAN-PASSAIC TRANSFER
(Via Force Main, Tunnel & Dead River)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 113A Name Raritan-Passaic Transfer Identification No. 25

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Somerset, Morris, Union, ~~Essex, Passaic~~

Author Developed by ~~SNJ-SWSMP~~ Consultants Title Task 3E Output Library No.

Updated Costs to 1980 (ENR 3100)(1)

Capital For construction, design, land acquisition, etc. Raw water intake, pump station on Raritan River near Bound Brook, forcemain and tunnel to Dead River plus withdrawal and treatment of water from Passaic River at 100 mgd capacity	$86,300,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	$11,420,000(2)
Cost per million gallons At 100 mgd yield using 80 mgd in available RV-SR water in Raritan plus 20 mgd in new water	$ 404(2) (3)

(1) Costs updated from NEWS Report, factors appearing in App. H

(2) Fees for use of RV/SR in addition to this sum which includes proportionate costs for development of Confluence Supply ($3,320,000 Annually)

(3) Electric Power Costs set at 4¢ KwHr

No. 113B70 RARITAN-PASSAIC TRANSFER
(Via Forcemain & Dead River)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 113B Name Raritan-Passaic Transfer Identification No. 25

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Somerset, Morris, Union, ~~Essex, Passaic~~

Author Developed by SNJ-SWSMP Title Task 3E Output Library No.

Updated Costs to 1980 (ENR 3100)(1)

Capital For construction, design, land acquisition, etc. Raw water intake, pumpstation on Raritan River near Bound Brook, Force Main to Dead River plus withdrawal and treatment of water from Passaic River at 70 mgd capacity	$65,300,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	$ 9,540,000 (2)
Cost per million gallons Yield - 70 mgd available in Raritan River from SR/RV - '60s drought	$ 373 (2) (3)

(1) Costs updated from NEWS Report, adjusted by factors appearing in App. H

(2) Fees for use of RV/SR in addition to this sum

(3) Electric Power Costs set at 4¢ KwHr

NO. 113B100 RARITAN-PASSAIC TRANSFER
(Via Forcemain & Dead River)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 113B Name Raritan-Passaic Transfer Identification No. 25

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Somerset, Morris, Union, Essex, Passaic

Author Developed by SNJ-SWSMP Title Task 3E Output Library No.

Updated Costs to 1980 (ENR 3100)(1)

Capital
For construction, design, land acquisition, etc.
Raw water intake, pumpstation on Raritan River near Bound Brook, Force Main to Dead River plus withdrawal and treatment of water from Passaic River at 100 mgd capacity — $78,000,000

Operation and Maintenance and Annual Costs
Amortization, personnel, power, etc. — $11,937,000(2)

Cost per million gallons
At 100 mgd yield using 80 mgd in available RV/SR water in Raritan plus 20 mgd in new water — $ 418(2) (3)

(1) Costs updated from NEWS Report, adjusted by factors appearing in App. H

(2) Fees for use of RV/SR in addition to this sum which includes costs for development of Confluence Supply ($3,320,000 Annually)

(3) Electric Power Costs set at 4¢ KwHr

113A
113B

RARITAN-PASSAIC TRANSFER
VIA DEAD RIVER

These alternative systems are projected to transfer instream flow from the Raritan River from a point between the Confluence and Bound Brook to the Dead River, a tributary of the Passaic River for further instream transport to treatment facilities at Canoe Brook, Little Falls or other point.

System 113A is part force main and part tunnel to reduce pumping expenses while 113B is entirely a force main over the intervening ridges resulting in lower capital costs but higher pumping costs.

The Raritan River at Bound Brook is normally at elevation 20 msl. The first ridge begins 1 ½ miles to the north but gaps allow a continuous rise to elevation of 310 msl at Martinsville. A three mile tunnel under the second ridge and other high ground would leave less than a mile of pipe to the Dead River at elevation 210 msl. The total system would be 7.5 miles long. The tunnel would be 200 feet below ground at its deepest. In the other system, the tunnel would be eliminated and a longer route over ridge would be substituted. This would reach elevation 470 msl and the total length would be 9.4 miles from Bound Brook to Dead River.

Economic tunnel construction requires a finished bore of at least six feet. If made with 78 inch internal diameter, up to 100 mgd could be transfered by this route. An additional project would be required to generate this volume on a sustained basis, as the Raritan River has an existing Round Valley surplus of 80 mgd. Competing demands for this water in Middlesex County make an additional project necessary if the transfer project is to function near capacity. A diameter of six feet would be adequate to handle available water.

The water would be discharged into the Dead River a shortway above its Passaic River junction. It would flow through a relatively undeveloped stretch of the Passaic River. The river flows sluggishly through the Great Swamp with little natural fall. Existing points of extraction at Canoe Brook in Millburn are maintained by the Commonwealth Water Company and at Totowa (Little Falls) by the Passaic Valley Water Commission. These can be enlarged from current 12 and 75 mgd capacities or another point could be established to withdraw this volume of water being transported.

After treatment this water would be available to customers of the PVWC and by transfer through NJDWSC to Newark. With some transmission improvements Hackensack Water Company and Jersey City could also benefit.

High flows in the Raritan would be skimmed and stored in Round Valley for release to the Raritan when needed. This water could be taken from that river transferred by pumping to the Dead River and Passaic Rivers from which it would be withdrawn, treated and distributed.

With power charges computed at 4¢ Kwhr, both projects have approximately equal unit costs. If energy costs escalate, however, project 113A (tunnel) will cost less than 113B (Entirely force main).

NO. 116 FRENCHTOWN RESERVOIR

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 116 Name Frenchtown Reservoir Identification No. 24-32-500

Region(s) 6 Basin(s) Delaware County(ies) Hunterdon

Author SNJ Title -- Library No. --

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Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$135,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	13,200,000
Cost per million gallons (2) based on 44 mgd rate of use (3)	822

(1) Costs estimated by use of cost factors appearing in App. "H", NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr.

(2) Quantity available estimate based on impoundment size.

(3) Raw water at impoundment

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 116 Name Frenchtown Reservoir L.O.R.D.S. No. 24-32-500

Region (s) 6 Basin (s) Delaware County (ies) Hunterdon

IMPACT ANALYSIS

Construction - Temporary impacts include disposal of large amounts of spoil and vegetation, construction activity noise, exhaust emissions, smoke plumes, air borne dust; increased surface turbidity in Harihokake Creek; erosion and sediment runoff. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Permanent removal of vegetation for creation of reservoir. Alteration of terrestrial and aquatic flora and fauna species' size, diversity, and distribution may result, as may disruption of natural habitats, migration routes, and spawning areas. The ecosystem should stabilize after these short term effects.

Water Quantity & Quality - Increased turbidity in Harihokake Creek during creation of reservoir is likely but will be localized if accumulation of sediment downstream from the site is controlled. Drainage realignment should be considered in conjunction with a flood plain management plan. The spillway crest flow should be controlled. Consideration for town of Mt. Pleasant should include prevention of inundation.

Land Use - Acquisition of 2,200 acres for reservoir.

Displacement - Inundates town of Mt. Pleasant.

Economic Development - Unknown.

Uses/Purposes - Water supply, pumped storage.

Transportation - Temporary traffic disruption may occur due to movements of construction equipment.

Visual Quality - Recreational opportunities will result due to creation of reservoir. Vegetation removal will alter landscape slightly but will not diminish visual quality.

NO. 137 DELAWARE RIVER DIVERSION TO DUNKER POND

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 137 Name Delaware River Diversion to Dunker Pond Identification No. 22-33-300

Region(s) 1, 6 Basin(s) Passaic, Pequannock County(ies) Passaic, Warren, Sussex

Author Newark Title City of Newark, Alt. Water Supply Project Library No. 1206.01

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$65,800,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	7,260,000
Cost per million gallons (2) based on 30 mgd yield	663

Yield - Based on drought of 1960's 25-30 mgd

(1) Costs estimated by use of cost factors appearing in App. "H" NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr.

(2) Raw water impounded in reservoir

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 137 Name Delaware River Diversion to Dunker Pond Reservoir L.O.R.D.S. No. 22-33-300

Region (s) 1,6 Basin (s) Passaic County (ies) Passaic, Sussex, Warren

IMPACT ANALYSIS

Construction - Short term impacts of 26 mi. transmission main, pumped storage (300 ft. head), dam and dike construction are expected to include erosion and sediment runoff altering ground surfaces and increasing turbidity in Yard's Creek, Dunker Pond and Oak Ridge Reservoir; dredge spoil and vegetation disposal; impacts of air borne dust, construction activities' smoke plumes and exhaust emission to construction workers. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Permanent effects include removal of vegetation at sites of pipeline, dam, dike, and reservoir. Short term construction and long term effects may be alteration of size, diversity, and distribution of species. Disruption of natural habitats, migration routes, and spawning areas, decline in biotic productivity may result, especially in the area of the reservoir.

Water Quantity & Quality - Increased surface water turbidity resulting from flow skimming of Delaware River. Drainage realignment may result from creation of the Dunker Pond reservoir. Prevention of stream encroachment along pipeline route necessary, as is control of sediment accumulation downstream from construction. Spillway crest volume should be controlled.

Land Use - Acquisition of land for dam, dike, reservoir required; land should be kept free of vegetation and development. Easement from City of Newark to construct transmission main in railroad ROW. Flood plain management will be necessary for large area around new reservoir.

Displacement - Unknown.

Economic Development - Alternative has potential as regional supply; Dunker Pond Reservoir could facilitate gravity feed to Wanaque system of NJDWSC, Hackensack system, Pequannock system, and/or the Raritan. Hydroelectric power would be generated for peak demands. Creation of reservoir may improve recreational potential.

Uses/Purposes - Water supply - increase capacity of Pequannock Watershed from 14.4 to 25.4 BG. Pumped storage, hydroelectric power generation, recreation.

Transportation - Transmission pipeline will follow railroad ROW with possible disruption of RR movements to be avoided where possible.

Visual Quality - Construction of dams and dike to create Dunker Pond Reservoir will alter visual quality of area immediately and through possible recreational development in future. Transmission pipeline will follow N.Y. Susquehanna and Western RR ROW, requiring vegetation removal but not eroding visual quality.

NO. 138 SOURCE - SOURCE INTERCONNECTION D&R CANAL

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 138 Name Source - Source Interconnection D&R Canal Identification No. 25

Region(s) 1, 6 Basin(s) Delaware, Raritan County(ies) Hunterdon, Somerset, Middlesex

Author Middlesex Water Co. Title Interview Library No. --

Updated Costs to 1980 (ENR 3100)

Capital (1) For construction, design, land acquisition, etc.	$900,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	454,000
Cost per million gallons (2) based on 25 mgd yield	50

Yield - Based on existing unused D&R Canal capacity - 25 mgd

(1) Cost estimates by use of factors appearing in App. "H" NEWS Report, 1971, as adjusted by ENR Index, except power adjusted to 4¢/Kwhr.

(2) Raw water in canal

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

No. 138 Name Source-Source Interconnection L.O.R.D.S. No. 22-33-300

Delaware and Raritan Canal

Region (s) 1,6 Basin (s) Delaware, Raritan County (ies) Hunterdon, Somerset, Middlesex

IMPACT ANALYSIS

Construction - Emplacement of low lift pump may result in minor, temporary impacts of increased turbidity.

Terrestrial & Aquatic Life - Pumping at confluence of Millstone & Raritan River may disrupt natural habitats, migration routes, spawning areas of aquatic species, may result in decline in biotic productivity though impacts likely to be minor. The ecosystem is expected to stabilize after these short term effects.

Water Quantity & Quality - Low lift pumping may increase surface water turbidity though impact will be minor. Water quality of pumped water will be poor. Water quantity will be increased in Canal through pumping and will make up for loss due to leakage.

Land Use - Acquisition of land required for placement of pump facility.

Displacement - None.

Economic Development - Would increase useable water supply from D & R Canal, though ability to meet peak needs will depend on Canal's hydraulic capacity.

Uses/Purposes - Water supply.

Transportation - No effects on transportation are anticipated.

Visual Quality - Minor effect on visual quality at Millstone & Raritan Rivers' confluence due to location of low-lift pump.

NO. 139 INTERSTATE TRANSFER PHILADELPHIA TO CAMDEN

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 139 Name Interstate Transfer Philadelphia to Camden Identification No. 31

Region(s) 5 Basin(s) Delaware County(ies) Camden

Author Camden Water Dept. Title Interview Library No. --

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$6,280,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, purchase of finished water, etc.	3,800,000
Cost per million gallons[2] @25 mgd	416

(1) Sales price of water per purveyor interview. Capital investment costs per Appendix-H NEWS Study as adjusted by ENR Index, except power cost adjusted to 4¢/Kwhr.

(2) Amount of water required assumed at guaranteed 25 mgd; transmission capacity assumed at 35 mgd.

ENVIRONMENTAL EVALUATION

No. 139 Name Interstate Transfer-Pa. to Camden L.O.R.D.S. No. 31

Region (s) 5 Basin (s) Delaware County (ies) Camden

IMPACT ANALYSIS

Construction - Construction of one or possibly two, pipelines, across the Betsy Ross Bridge may result in temporary impacts affecting construction workers and bridge users including exhaust and smoke emissions from construction activities, and increased vehicular and equipment noise. Construction of pipelines from Torresdale, Penn. to the bridge and from the bridge to the point of distribution will be required, entailing similar construction-related impacts.

Land Use - The pipeline routes will pass through urbanized areas and would probably follow the existing street system.

Water Quantity & Quality - Laying of pipelines may result in increased turbidity in the Delaware River. Control measures should be implemented to minimize runoff.

Terrestrial & Aquatic Habitats - Impacts on terrestrial and aquatic habitats are unlikely.

Displacement - No displacement is expected.

Uses/Purposes - Water supply for the City of Camden. Problems of implementing an interstate transfer of the water may arise.

Transportation - Temporary disruption of bridge traffic will occur during construction.

Visual Quality - The pipeline, with a diameter of about 4 feet, will be placed on the underside of the Betsy Ross Bridge. The bridge's design and overall visual effect should be considered in planning this project so as to minimize any negative impact to its visual quality.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 139

PROJECT STATUS:

X	Concept	____	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required

_____ Sought

_____ Obtained

From

DRBC X

ACOE or other states _____

WP&SC X

N.J. Legislature _____

Pinelands Commission _____

D&R Canal Commission _____

Sponsor or Lead Agency Identified Not determined

Identified Support or Opposition _____

FINANCIAL:

STATUS OF FUNDS:

_____ $ Already Committed

_____ Financing Anticipated

X Financing Uncertain

_____ Not Significant

For

Site Acquisition _____

Prel. Planning _____

Design _____

Construction _____

Sources of Funds Uncertain

Pay Back Arrangement: _____ Outright Grant X Not Known

_____ Bond Debt Service _____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Large source of supply for emergency purposes.

SHOULD NOT: Implementation uncertainties; who would finance; how to distribute among separate South Jersey purveyors

NO. 140 DELAWARE RIVER INTAKE , CAMDEN AREA

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 140 Name Delaware River Intake at Delanco, NJ Identification No. 31

Region(s) 5 Basin(s) Delaware County(ies) Camden

Author DRBC Title DBRC Level B Study 1979[1] Library No. --

Updated Costs to 1980 (ENR 3100)[2]

Capital For construction, design, land acquisition, etc.	$23,600,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	2,600,000
Cost per million gallons [3]	472

(1) Project scope reduced from study. Costs are for a 50 mgd installation to provide 26 mgd of potable water and 24 mgd for aquifer recharge for seven months for City of Camden use. Water supplied from present sources for five months (June-October).

(2) Costs estimated by use of unit cost factors appearing in Appendix H NEWS Report 1971 as adjusted by ENR Index except power adjusted to 4¢/Kwhr.

(3) Based on seven months of potable water at 26 mgd (5.512 BG). Another 24 mgd recharged to well field during this period. Costs for operation of well field balance of year additional.

ENVIRONMENTAL EVALUATION

No. 140 Name Delaware River Intake at Camden L.O.R.D.S. No. _____

Region (s) 5 Basin (s) Delaware County (ies) Camden

IMPACT ANALYSIS

Construction - Construction activity will result in temporary impacts including increases in 1) airborne dust, 2) exhaust and smoke emissions from construction equipment, 3) vehicular and equipment noise in the vicinity of the intake and pump station site and along the route of any necessary transmission lines. Standard measures are available to minimize these impacts.

Land Use - An exact location for the facility has not been selected. The area is generally urbanized.

The length of pipeline required will be determined by location of the pump station. In any case, the pipeline route should follow existing street systems or railroad ROWs.

Water Quantity & Quality - Projected water supply need from the proposed project, which would replace the Camden well fields, is an average 35 mgd.

In the vicinity of Camden, the Delaware River's surface water classification is tidal (TW-2); north and south of Camden, classification becomes TW-1; further north in the vicinity of Trenton, fresh water (FW-2).

Two options are under consideration. One would place a river intake in the tidal stretch of the Delaware River at Delanco, about opposite Philadelphia's Torresdale plant. The other would locate the intake above the head of tide at Trenton. Costs for the up river intake project are estimated to be three times greater, but long term advantage in quality might offset this. The potential for salt water intrusion in the lower river and connected aquifers due to excessive withdrawals from the Delaware River at Trenton must be investigated.

Terrestrial & Aquatic Life - No significant impact is anticipated.

Displacement - Unknown.

Uses/Purposes - Water supply. Diversion rights to implement a river intake system will have to be acquired. It is likely that project cost would be very high.

Transportation - Temporary disruption of traffic may be expected during facilities construction.

Visual Quality - The extent of any impact on visual quality will be determined, in part, by the location and size of the facilities. Consideration should be given to minimizing any adverse impacts.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 140

PROJECT STATUS:

X	Concept	____	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required

_____ Sought

_____ Obtained

From

DRBC X

ACOE or other states _____

WP&SC X

N.J. Legislature _____

Pinelands Commission _____

D&R Canal Commission _____

Sponsor or Lead Agency Identified Not established

Identified Support or Opposition _____

FINANCIAL:

STATUS OF FUNDS:

_____ $ Already Committed

_____ Financing Anticipated

X Financing Uncertain

_____ Not Significant

For

Site Acquisition _____

Prel. Planning _____

Design _____

Construction _____

Sources of Funds Uncertain

Pay Back Arrangement: _____ Outright Grant X Not Known

_____ Bond Debt Service _____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Need to have an alternative for stressed Camden system.

SHOULD NOT: Water quality in Delaware at Camden Diversion Point.

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 141 Name Raritan-North Branch Pipeline (A modification of #113, #17 and #2A-part) Identification No. _____

Region(s) 1 Basin(s) Raritan, Passaic County(ies) Somerset, Morris

Author Developed by SNJ-SWSMP Title Task 3E Output Library No. _____

Updated Costs to 1980 (ENR 3100)(1)

Capital For construction, design, land acquisition, etc. Raw water intake & pumping station at confluence Lamington River & North Branch Raritan River with force main to Ravine Lake; then Booster pumping station to terminal storage tanks at ridgeline Raritan-Passaic River Basins near Mendham. (Staged Development)	$18,100,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	$ 5,300,000(2)
Cost per million gallons based on average daily use of 31 mgd	472(2)

Yield - undetermined

(1) Cost estimated by SNJ-SWSMP

(2) Fees for use of Spruce Run/Round Valley not included

(3) Electrical Energy at 4¢/kw-hr

APPENDIX 3D-III

Task 3D. Analysis and Evaluation of Ground-Water Projects

A total of five ground-water projects are included among the 64 projects judged to be favorable for meeting New Jersey's water supply needs. These five projects and their assigned identification numbers are as follows:

a) 80-South River (Middlesex County) Ground-Water Pumped Storage Diversion

b) 131-Well Field in Wharton Tract (Southwest New Jersey Supply)

c) 132-Well Field in Wharton Tract (Southeast New Jersey Supply)

d) 135-Burlington County East Zone Well Fields

e) 136-Alamatong Well Field and Recharge Basin

All the five projects are concerned primarily with developing additional water supplies although the South River project also has salt-water intrusion control as an objective.

The five projects, except for the Alamatong Well Field which is located in the Triassic lowlands, are located in the Coastal Plain physiographic province. Each of the projects relies on inducing surface-water recharge to the ground-water reservoir to develop well supplies.

In order of decreasing potential yield the projects are as follows: Burlington County East Zone Well Fields (113 mgd), Well Field in Wharton Tract (Southwest New Jersey Supply - 100 mgd), South River (Middlesex County) Ground Water Pumped Storage Diversion (30 mgd), Well Field in Wharton Tract (Southeast New Jersey Supply - 22 mgd), and Alamatong Well Field and Recharge Basin.

Project 131 - Well Field in Wharton Tract (Southwest New Jersey Supply)

This project was described in "Survey of New Jersey Water Resources Development" in December 1955 by Tippetts, Abbett, McCarthy, and Stratton. The proposed project consists of installing 120 wells in four stages through the year 2000 along the Mullica and Batsto Rivers. As much as 100 mgd would be developed from the wells with the water supply derived almost entirely from induced river infiltration with only a small amount removed from ground-water storage. The water will be chlorinated and then transmitted to the Camden city area. This water supply development would take place in Regions 3 and 5 in Atlantic and Burlington Counties with the water supplied to Region 5 - Camden County.

The capital costs for this project as estimated in 1955 were 15.6 million dollars which included the wells, pumps, intercepting pipe line (between wells), booster pumping station, and transmission line to the Camden distribution system. The cost for a million gallons of delivered water (estimated in 1955) was $48.00 based on an annual average supply of 80 mgd.

One of the major drawbacks to this project is the potential reduction in streamflow in the Mullica and Batsto Rivers from ground-water pumpage. A joint study by biologists and engineers was undertaken to determine the maximum amount of water that could be withdrawn from the Mullica River basin through the conjunctive use of surface and ground water without causing undue environmental impacts (Granstrom, Nieswand, and Ahmed, 1973, and Durand, Granstrom, and Rudolph, 1974). A minimum streamflow was established that would maintain a certain salinity level that would result in minimal adverse effects on biological communities in the Great Bay estuary into which the

Mullica River flows. A digital model of the basin's aquifer/stream system indicated a maximum withdrawal of 118 mgd of surface and ground water could occur while still maintaining the minimum streamflow.

In the above study, water was removed directly from streams during high flow periods. It would appear feasible that this water could also be removed by wells through induced infiltration as proposed under Project 131, at least during high flow periods. However, in the joint study discussed above, water was pumped from wells at some distance from streams during low surface flow periods (late summer-early fall). This was done to minimize impacts on already low streamflows by obtaining most of the water from groundwater storage and not from induced infiltration.

In order for Project 131 to be successful, additional wells (beyond those originally planned) will have to be installed at a greater distance from the rivers so that ground water in storage can be tapped during low flow periods and thereby minimize impact on already low streamflows.

Another factor effecting the successful implementation of this proposed project is the degree of hydraulic connection between the aquifer and rivers that drain it. Rhodehamel (1973) reports that data collected from a pumping test run adjacent to the Mullica River revealed a poor hydraulic connection between the river and aquifer, which was attributed to a thin, relatively impermeable bog iron deposit in the river bed. In order for the induced infiltration technique to work, there must be a good connection between aquifer and river. To insure a good connection it may be necessary to dredge parts of the Mullica and Batsto channels before pumping begins, and periodically thereafter as routine maintenance. The costs for this work must be added to the cost of the supplied water.

A final point to consider is water quality. The project as proposed only has plans for chlorination of the water. According to Rhodehamel (1970) the ground water of the Pine Barrens region (in which the Mullica and Batsto Rivers are located) has low pH, high dissolved iron, and sometimes undesirable color. Therefore, additional treatment of the ground water will be necessary, and this will further add to the cost of the project.

Project 80 - South River (Middlesex County) Ground Water Pumped Storage Diversion

This project was described in "South River Tidal Dam Project" in 1965 (Special Report 21) by the State of New Jersey Division of Water Policy and Supply. This project involves constructing a tidal dam on the South River in Middlesex County (Region 1) the purpose of which is to prevent salt water intrusion into the Old Bridge Sand and possibly stabilize salt-water intrusion into the Farrington Sand. Recharge to any yield from the Old Bridge Sand would be increased by stripping the bed of the lake formed behind the dam.

The capital cost for this project, based on 1962 prices was $4.7 million. This capital expenditure does not include money for the construction of wells, treatment of water, or construction of delivery mains required to utilize the recharge potential of the project.

Based on similar water-supply developments in Middlesex County, especially at Duhernal Lake, it does appear to be technically feasible to increase the yield of the Old Bridge Sand in the above manner, provided that the bed of the lake is maintained to prevent silting. Silting would reduce

recharge to the Old Bridge Sand. Costs for this maintenance would have to be added to the overall project cost.

Stabilization of salt-water intrusion into the Farrington Sand through the construction of this dam does not appear to be possible. In Special Report 21, it is stated that stabilization of the salt water intrusion is dependent on raising heads in the Farrington Sand and thereby forming a ground-water barrier between the salty and fresh water portions of the aquifer. However, in order for the heads in the Farrington to be significantly effected by the lack created on the Old Bridge Sand there must be a direct hydraulic connection between the two aquifers. To date, this connection, if it exists, has not been proven. Even if this connection does exist, it would probably be impossible to create an effective ground-water divide because of the deep cone of depression in the Farrington Sand in northern Middlesex County downdip of the present salt/fresh water interface.

The dam and lake should effectively protect the Old Bridge Sand from salt water intrusion. However, with the industrialization present in northern Middlesex County, the threat of contamination from man's activities may be much more severe than that from salt-water intrusion.

Project 132 - Well Field in Wharton Tract (Southeast New Jersey Supply)

This project was described in "Survey of New Jersey Water Resources Development" in December 1955 (TAMS Report) by Tippetts, Abbett, McCarthy, and Stratton. The project consists of installing 28 wells in stages through the year 2000 along the lower reaches of the east and west branches of the Wading River. A maximum of 22 mgd (seasonal) would be developed with all the water derived from induced stream infiltration. The water will be

chlorinated and then transmitted to Atlantic City. The water supply development would take place in Region 5 in Burlington County and the water supplied to Region 3 in Atlantic County.

The capital costs for this project as estimated in 1955 were $6.0 million which included the wells, pumps, intercepting pipe line (between wells), booster pumping station, and transmission line to Atlantic City. The cost for 1 million gallons of delivered water (estimated in 1955) was $176 based on an annual average supply of 8 mgd.

As with project 131, one of the major drawbacks to this project is the potential reduction in streamflow in the Wading River. Both projects are located within the Mullica River basin although in separate sub basins. The total maximum yield of the two projects is 122 mgd which exceeds the maximum withdrawal rate for the basin that would not cause undue environmental impacts. Therefore, until further data are available that prove otherwise, one or both of these projects will have to be reduced in magnitude.

Maintaining a good hydraulic connection between aquifer and river is also necessary for the success of this project and will add to the cost figures given above. Additionally, as discussed above for Project 131, water treatment beyond chlorination will likely be needed, which will further increase the project's cost.

Project 136 - Alamatong Well Field and Recharge Basin

This project has already begun and will not be discussed further.

Project 135 - Burlington County East Zone Well Fields

This project was described in "Water Facilities Study-- Burlington County, New Jersey," 1970, by Land Engineering and Surveying Company, Inc. The proposed project consists of constructing two dams and impounding reservoirs on the Batsto and Wading Rivers. A maximum of 58 wells, installed in stages through the year 2000, would be located along the banks of the two rivers. As much as 113 mgd would be developed from the wells with the entire supply derived from induced river infiltration. The water will be transmitted to the coastal areas of Burlington and Atlantic Counties and to central and western Burlington County and the Camden area. This water-supply development would take place in Region 5 in Burlington County with the water supplied to Regions 5 and 3.

Operating and maintenance costs and costs per mgd were not given separately but instead were combined with costs for a separate surface-water project. However, capital expenditures for the ground-water supply only were given at $56.3 million (1970 estimate).

This project has the same potential drawbacks and problems as projects 131 and 132, and if all three projects were to be put into operation, a maximum withdrawal rate of 235 mgd from the Mullica River basin would be reached, which is double the maximum sustained yield of 118 mgd that was determined for the basin. In effect, this project is a duplication of projects 131 and 132 with the only substantial difference being a wider distribution area for the developed water.

Summary

The potential for development of significant ground-water supplies in the Coastal Plain is great, and projects 80, 131, 132, and 135 all appear to be technically capable of developing additional water. Based on needs in the areas to be served, the projects in order of importance would be as follows:

Project 131-Well Field in Wharton Tract (Southwest New Jersey supply)

Project 80-South River (Middlesex County) Ground-Water Pumped Storage Diversion

Project 132-Well Field in Wharton Tract (Southeast New Jersey supply)

Project 135-Burlington County East Zone Well Fields

Data needs include up-to-date cost estimates for all factors involved for each project. In addition, before any of these projects can be undertaken, aquifer characteristics at specific sites (on which to base well yields, well spacing, required number of wells) should be determined in greater detail. The efficiency of surface-water infiltration needs to be better defined, and knowledge of potential long-term environmental effects on stream flows, ground-water levels, vegetative communities, and bay salinities should be expanded.

REFERENCES

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Rhodehamel, E.C., 1973, Geology and Water Resources of the Wharton Tract and the Mullica River Basin in Southern New Jersey. New Jersey Department of Environmental Protection, Division of Water Resources, Special Report 36.

NO. 80 SOUTH RIVER GROUNDWATER PUMPED STORAGE DIVERSION

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 80 Name South River Groundwater Pumped Storage Diversion Identification No. 28-05-400

Region(s) 1 Basin(s) Raritan, South River County(ies) Middlesex

Author SNJ Title Water Resources Circular 20 1969 Library No. 1007

Updated Costs to 1980 (ENR 3100) (1)

Capital For construction, design, land acquisition, etc.	$5,300,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	720,000
Cost per million gallons (2) (3) based on 15 mgd yield	131

Yield - Based on drought of 1960's 15 mgd

(1) Costs updated by use of ENR Index

(2) Yield represents increase available through well supply

(3) Raw water in conjunctive use reservoir

ENVIRONMENTAL EVALUATION

No. 80 Name South River Groundwater Pumped Storage Diversion L.O.R.D.S. No. 28-05-400

Region (s) 1 Basin (s) Raritan South River County (ies) Middlesex

IMPACT ANALYSIS

Construction - Construction of a 60 mgd pumping station and 3.79 miles of 54-inch delivery pipeline will result in temporary impacts, including: removal and disposal of some vegetation and spoil; erosion and sediment runoff, sediment accumulation downstream or in Duhernal Lake; airborne dust, exhaust emissions, noise from construction vehicles and equipment. Standard measures are available to minimize air and noise pollution impacts.

Land Use - Land use in the vicinity of Duhernal Dam and the existing Sayreville wellfields and recharge ponds ranges from residential and industrial to forested lands and forested wetlands. A few mines are located in the vicinity of the well fields. The Amboy Division of the Pennsylvania Railroad passes through the area.

About 1 acre will be required for the pump station.

Water Quantity & Quality - This pumped storage diversion system will provide 15 mgd from South River surface waters. Excess surface waters will be skimmed and transported to ponds established in existing well fields for recharge of the aquifer. As proposed, the project will not protect the Old Bridge Sand from saltwater intrusion. Such protection may, however, be possible through regulatory control of the pumped diversions from Old Bridge Sands.

Groundwater levels in the aquifer should be maintained above mean sea level where adjacent to saline surface water bodies.

Terrestrial & Aquatic Life - No significant impacts are anticipated, as the 3.79 miles of pipeline may follow either existing railroad ROW or existing roads. The pump station site will likely require clearing of vegetation over approximately a one-acre area.

Displacement - No dislocation of utilities or displacement of properties is anticipated.

Uses/Purposes - Water supply,groundwater recharge. The project is proposed to supply local needs in the Sayreville vicinity. It is unclear whether sufficient water will be derived to justify the project's cost.

Transportation - Temporary and minor disruptions of traffic will likely occur during periods of construction.

Visual Quality - The siting and design of the pump station should serve to minimize disruption of existing visual quality.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 80

PROJECT STATUS:

X	Concept	____	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required ____ Sought ____ Obtained

From

DRBC ____
ACOE or other states ____
WP&SC X

N.J. Legislature ____
Pinelands Commission ____
D&R Canal Commission ____

Sponsor or Lead Agency Identified Not established

Identified Support or Opposition Uncertain

FINANCIAL:

STATUS OF FUNDS:

____ $ Already Committed
____ Financing Anticipated
X Financing Uncertain
____ Not Significant

For

Site Acquisition ____
Prel. Planning ____
Design ____
Construction ____

Sources of Funds Uncertain

Pay Back Arrangement: ____ Outright Grant X Not Known

____ Bond Debt Service ____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: May meet localized need; based upon existing practices.

SHOULD NOT: A matter of localized use.

NO. 131 WELLFIELD IN WHARTON TRACT (SOUTHWEST NJ)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 131 Name Wellfield in Wharton Tract (Southwest, NJ) Identification No. 32-32-400

Region(s) 3,4,5 Basin(s) Mullica R, Batsto R County(ies) Atlantic, Burlington

Author SNJ, TAMS Title TAMS Report 1955 Library No. 757

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$73,300,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	8,020,000
Cost per million gallons[2] based on 100 mgd yield	220

Yield - Based on 1955 estimate of 100 mgd

(1) Costs updated by use of ENR Index

(2) Untreated well water at central pumping station wellfield

ENVIRONMENTAL EVALUATION

No. 131 Name Well Field in Wharton Tract L.O.R.D.S. No. 32-32-400

(Southwest N.J.)

Region (s) 3,4,5 Basin (s) Mullica River County (ies) Atlantic

Batsto River Burlington

IMPACT ANALYSIS

Construction - Installation of 120 wells, and construction of an intercepting pipeline between wells, booster pumping station, and transmission lines will involve removal and disposal of vegetation and spoil; some erosion and runoff, sediment accumulation downstream in the Batsto and Mullica Rivers; airborne dust, exhaust emissions and noise from construction vehicles and equipment. Standard practies are available to minimize these impacts. Construction will take place in four stages through the year 2000.

Land Use - The exact well locations are unknown. However, they are likely to affect an undetermined amount of forested wetlands bordering both the Mullica and Batsto Rivers within the State Forest and Water Reserve, Wharton Tract. Beyond the wetlands, evergreen forests predominate.

Water Quantity & Quality - A minimum streamflow in the two rivers is required to maintain a certain salinity level downstream and minimize adverse effects on biological communities in the Great Bay estuary into which the Mullica River flows. The maximum withdrawal possible while still maintaining minimum streamflow and safe groundwater levels is 118 mgd. The potential yield of the 120 well system is 100 mgd. During periods of low flow, withdrawal rates would have to be reduced if impacts on stream flow were to be minimized.

In order to achieve the potential yield and still maintain adequate streamflow, additional wells will need to be installed at a greater distance from the river. During periods of low streamflow (late summer, early autumn) these additional wells could draw upon groundwater reserves and so reduce the induced stream infiltration. While the number of additional wells is not yet specified, it should be noted that disruption of the wetlands, forested areas, and streamflow could be greater if the number of additional wells is substantial.

Before pumping is initiated, dredging of the Mullica and Batsto channels may be required to improve the hydraulic connection between the rivers and the aquifer. Dredging for routine maintenance purposes would result in periodic increases in turbidity. Appropriate dredging methods and equipment would minimize the quantity of suspended sediment.

Groundwater in the Pine Barrens has low pH, high dissolved iron, and occasionally undersirable color. Chorination of the water may, therefore, be inadequate and additional treatment will be necessary.

Terrestrial & Aquatic Habitats - Installation of the facilities will require clearing of trees for each well site, the booster pump stations and along the pipeline routes. This vegetation is predominantly pine oak and cedar forest. As these forest stands are dependent on the groundwater, tapping the aquifer during periods of low streamflow could prove detrimental to the flora. Long term draw-downs may result in changes in the flora as species adaptable to fluctuating or decreased groundwater supplies may become established.

Dredging of the rivers will deepen the channels, slow down streamflow. Dredging would have an adverse impact on benthic communities, especially because it will occur periodically.

Consideration must be given to minimizing adverse impacts on any endangered species, such as the tree frog, in the area.

Displacement - No displacement is anticipated.

Uses/Purposes - Water supply. Potential maximum yield of the 120 well system is 100 mgd. The proposed 28 well system along the Wading River, also located in Wharton Tract, will provide a maximum of 22 mgd. Since the safe maximum withdrawal for the Mullica River basin is 118 mgd, these two projects could not be implemented together without reducing their design capacity.

The recipient of the water will probably be the Camden County urbanized area.

Recreational use of the rivers is in important consideration in this area. Streamflow should be maintained at an adequate level for canoeing if recreational uses are to be continued.

Transportation - No significant impacts are anticipated.

Visual Quality - Each of the 120 well sites will be cleared of trees (pine oak and cedar, predominantly) and fenced in. In order to protect the visual quality of the rivers and the forests when viewed from the rivers, the wells should be installed at least 100 feet from the river banks. Remaining vegetation would screen the well sites from the river at this distance.

Intercepting pipelines and the transmission aqueduct are not likely to adversely affect visual quality. The booster pump station should be located and designed to minimize its visibility to the forest's visitors.

NO. 131A WELLFIELD IN WHARTON TRACT (SOUTHWEST NJ)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 131A Name Wellfield in Wharton Tract (Southwest, NJ) Identification No. 32-32-400

Region(s) 5 Basin(s) Mullica R, Batsto R County(ies) Camden

Author SNJ, TAMS Title TAMS Report 1955 Library No. 757

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$49,700,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	5,040,000
Cost per million gallons[2] based on 25 mgd yield	552

Yield - Based on 1955 estimate of 100 mgd for entire tract.

(1) Costs estimated by use of unit cost factors appearing in Appendices H & I NEWS Report 1971 as adjusted by ENR index except electric energy used at 4¢/KwHr.

(2) Treated well water delivered to Camden.

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 131,132

PROJECT STATUS:

X	Concept	____	Preliminary Planning	____	Design	____	Construction	____	Site Acquired

INSTITUTIONAL:

APPROVALS: X Required

____ Sought

____ Obtained

From

DRBC ____

ACOE or other states ____

WP&SC X

N.J. Legislature X

Pinelands Commission X

D&R Canal Commission ____

Sponsor or Lead Agency Identified Not known - presumably the State

Identified Support or Opposition Very difficult to do anything in the Pine Barrens until regulatory framework is stabilized.

FINANCIAL:

STATUS OF FUNDS:

X $ Already Committed

____ Financing Anticipated

1 Financing Uncertain

____ Not Significant

For

Site Acquisition X

Prel. Planning 1

Design 1

Construction 1

Sources of Funds Uncertain

Pay Back Arrangement: ____ Outright Grant X Not Known

____ Bond Debt Service ____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Significant source of supply to address regional problems.

SHOULD NOT: Pine Barrens uncertainties; requires extensive distribution network because of purveyor Balkanization.

NO. 132 WELLFIELD IN WHARTON TRACT (SOUTHEAST NJ)

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 132 Name Wellfield in Wharton Tract (Southeast, NJ) Identification No. 32-33-500

Region(s) 2,3,5 Basin(s) Wading R County(ies) Burlington

Author SNJ, TAMS Title TAMS Report 1955 Library No. 757

Updated Costs to 1980 (ENR 3100)[1]

Capital For construction, design, land acquisition, etc.	$28,400,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	3,000,000
Cost per million gallons[2] based on 22 mgd yield	374

Yield - Based on 1955 estimate at 22 mgd

(1) Costs updated by use of ENR Index

(2) Untreated well water at central pump station in wellfield

ENVIRONMENTAL EVAULATION

No. 132 Name Well Field in Wharton Tract (Southeast N.J.) L.O.R.D.S. No. 32-33-500

Region (s) 2,3,5 Basin (s) Wading River County (ies) Burlington

IMPACT ANALYSIS

Construction - Installation of 28 wells, an intercepting pipeline, a booster pumping station, and a transmision aqueduct will involve removal and disposal of vegetation and spoil; some erosion and run off, sediment accumulation downstream in the East and West Branches of the Wading River; airborne dust, exhaust emissions, and noise from construction vehicles and equipment. Standard practices are available to minimize these impacts. Construction will take place in several stages through the year 2000.

Land Use - Forested wetlands exist along the lengths of both branches of the Wading River, located within the State Forest and Water Reserve, Wharton Tract. Evergreen forests predominate beyond the wetlands; there are substantial areas of cranberry bogs which will require special consideration in development of this project.

Water Quantity & Quality - A maximum yield of 22 mgd is projected for this well system, and induced stream infiltration will be the source of supply. Reduction in Wading River streamflow is a potential problem, however, and may constrain the amounts actually produced. Both this project and Alternative 131 are located within the Mullica River basin, which has a maximum withdrawal rate of 118 mgd. The projects combined would yield 122 mgd and so one or both would have to be reduced to prevent undue environmental damage.

Dredging of the branches of the Wading River prior to initial pumping will be required to establish a good hydraulic connection between the river and the aquifer. Such dredging will be required periodically as a maintenance measure and will result in periodic and temporary increases in stream turbidity. Appropriate dredging methods and equipment would minimize the quantity of suspended sediment.

As for Project 131, the water derived from this induced river infiltration will probably require treatment beyond chlorination before transmission to the recipients.

Terrestrial & Aquatic Habitats - Installation of the facilities will require clearing of trees for each well site, the booster pump station, and along the pipeline routes. Special attention must be given to existing cranberry bogges as excessive drawdowns could adversely affect this profitable crop. The forested wetlands and evergreen forests are also very dependent on groundwater supplies and long-term drawdowns could result in alteration of resident types of species.

Dredging of the river branches will deepen the channels, reduce streamflow velocity, and result in adverse impacts on benthic communities especially because dredging will be done periodically.

Displacement - No displacement is anticipated.

Uses/Purposes - Water supply, possibly to Camden.

Transportation - No significant impacts are anticipated.

Visual Quality - Each of the 28 well sites will be cleared of trees and fenced in. The sites should be located at least 100 feet from the river banks to minimize their visibility from the river and its recreation users.

Pipelines are not likely to have adverse impacts on the visual quality. The booster pump station should be located and designed to minimize its visibility to the area's recreational visitors.

NO. 135 BURLINGTON COUNTY EAST ZONE WELL FIELDS

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 135 Name Burlington County East Zone Well Fields Identification No. 32-32-900

Region(s) 3,5 Basin(s) Batsto R, Wading R County(ies) Burlington

Author Land Engr & Surveying Co. Title Water Fac. Study, Burl Co. NJ 1970 Library No. 1211.01

Updated Costs to 1980 (ENR 3100)

Capital (1) For construction, design, land acquisition, etc.	$126,000,000
Operation and Maintenance and Annual Costs (2) Amortization, personnel, power, etc.	15,200,000
Cost per million gallons (3) based on 80 mgd yield	519

Yield - Based on drought of 1960's 80 mgd

(1) Costs updated by use of ENR Index

(2) Costs estimated by use of cost factors

(3) Includes transmission to urban areas, disinfection

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS: ALTERNATIVES ANALYSIS

32-32-900
32-43-600

No. 135 Name Burlington County East Zone Well L.O.R.D.S. No. 32-32-400

Fields

Region (s) 3,5 Basin (s) Batsto River County (ies) Burlington

Wading River

IMPACT ANALYSIS

Construction - Short term construction impacts of dams and reservoirs, 58 wells, aqueducts, booster pumping station, and interceptors include: erosion and sediment runoff altering ground surfaces and requiring an erosion and sediment control plan to properly design facilities; required disposal of large amounts of spoil; air borne dust, smoke plumes and exhaust emissions from construction activities; vehicular and equipment noise. Plans for control of these temporary impacts should be considered.

Terrestrial & Aquatic Life - Short term construction and long term land use changes may result in alteration of size, diversity, and distribution of species. Disruption of natural habitats, migration routes, and spawning areas may result in a decline of biotic productivity. Vegetation removal may be necessary over a large area. Special attention should be accorded terrestrial and aquatic flora and fauna in the Pine Barrens.

Water Quantity & Quality - Groundwater levels and water levels in Batsto and Wading Rivers may be lowered. Surface water turbidity may increase during construction; accumulation of sediment downstream from construction must be controlled; temporary contamination of runoff by toxic or hazardous materials may occur. Drainage realignment will occur. Special care should be taken to preserve water quality in the Pine Barrens.

Land Use - Acquisition of land required over large area for construction of dams, reservoirs, wells, aqueducts, pumping station and interceptors. Flood plain management will be necessary. The environmentally sensitive Pine Barrens must be given special attention if development of these facilities is likely to seriously affect the area, which is protected by conservation legislation.

Displacement - Unknown.

Economic Development - Unknown.

Uses/Purposes - Water supply from induced river infiltration, to be transmitted to coastal areas of Burlington and Atlantic Counties and to central and western Burlington County and Camden area.

Transportation - Traffic will be temporarily affected during construction of facilities.

Visual Quality - Creation of reservoirs will present recreational opportunities, improve visual quality of area. Much vegetation removal for facilities is required.

ENVIRONMENTAL EVALUATION

No. 136 Name Alamatong Well Field and Recharge Basin L.O.R.D.S. No. 25-02-700

Region (s) 1 Basin (s) Raritan, Lamington, Black Rivers County (ies) Morris

This project is currently in operation. There are three wells currently in operation in the vicinity of the Black River in Randolf and Roxbury Townships with a capacity of 450 gallons per minute each.

A number of pilot wells will be begun in the near future. A booster pumping station and a three million gallon storage tank supply water to Randolf Township and Mine Hill. The supply comes completely from groundwater sources and there is no surface water storage.

The major environmental issue connected with the project is the effect of goundwater withdrawal on flows in the Black River, especially in light of the planned expansion. There is concern that the waste assimilative capacity of the river will be reduced. The Morris County Muncipal Utilities Authority notes that flows in the Black River are monitored everyday at a U.S.G.S gaging station.

NO. 136 ALMATONG WELL FIELD AND RECHARGE

MONETARY COSTS AND TECHNICAL CONSIDERATIONS

No. 136 Name Almatong Well Field and Recharge Identification No. 25-02-700

Region(s) 1 Basin(s) Raritan, Lamington, Black County(ies) Morris

Author MCMUA Title MC Water Supply Plan 1970 Library No. 1205.03

Updated Costs to 1980 (ENR 3100) (1) (2)

Capital For construction, design, land acquisition, etc.	$9,000,000
Operation and Maintenance and Annual Costs Amortization, personnel, power, etc.	1,000,000
Cost per million gallons (3) based on 5 mgd yield	550

Yield - Based on estimates of 5 to 10 mgd

(1) Costs updated by ENR Index

(2) Construction underway

(3) Estimated yield

TASK 3D: Decision-Making: Institutional and Financial Considerations

Project No. 136

PROJECT STATUS:

____ Concept ____ Preliminary Planning ____ Design __X__ Construction in part __X__ Site Acquired

INSTITUTIONAL:

APPROVALS: _____Required _____Sought _X_Obtained From

DRBC _____
ACOE or other states _____
WP&SC _X_
N.J. Legislature _____
Pinelands Commission _____
D&R Canal Commission _____

Sponsor or Lead Agency Identified Morris County MUA

Identified Support or Opposition Endorsed by State

FINANCIAL:

STATUS OF FUNDS: _X_ $ Already Committed
_____ Financing Anticipated
_____ Financing Uncertain
_____ Not Significant

For
Site Acquisition _____
Prel. Planning _____
Design _X_
Construction _X_

Sources of Funds Local bond and some grants

Pay Back Arrangement: _____ Outright Grant _____ Not Known
_X_ Bond Debt Service _____ User Charges

Summary: What are the most significant reasons why the State should support the project/should not support the project?

SHOULD: Ongoing effort financed by local monies; addresses ever growing need for water in Morris County.

SHOULD NOT:

APPENDIX 3D-IV

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

COLLEGE OF ENGINEERING • BUREAU OF ENGINEERING RESEARCH
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October 1, 1979

DELAWARE AND RARITAN CANAL PROJECT

HYDROLOGY AND HYDRAULICS

EXECUTIVE SUMMARY

The Delaware and Raritan Canal Project conducted by Rutgers University for the Bureau of Water Facility Operations of the New Jersey Department of Environmental Protection consisted of four parts: structural integrity, institutional arrangements, water quality, and hydrology and hydraulics. The latter is the topic of this summary.

The hydrology and hydraulics of the Canal were considered under two conditions:- the first was low or normal flows and the second flood flows.

Low or Normal Flows

It has been a common experience of Canal operation that most times the hydraulic capacity of the Canal was less that the Delaware Basin Compact allocation of 100 mgd; and, in fact, in the summer months when tributary inflow in the downstream reaches decreased water had to be let into the Canal at the Millstone Aqueduct to meet the downstream needs. The study of reasons for the hydraulic limitations was the major effort.

The Canal was not intended to transport water; it was transformed to that purpose by using the barge locks as flow control gates. Restricting flow at any gate would affect the entire downstream reach. The Canal was badly silted in many places and in the summer months rooted vegetation clogged sections of the Canal.

The hydraulic flow characteristics of the Canal channel (at many reaches) and the locks were determined from field data. Those analyses plus the detailed geometric data obtained from several sources permitted estimation of the Canal under a variety of conditions. The variables considered were: size of gate openings, effects of weed cutting, and effect of dredging the Canal to its design profile and estimated cross sections.

It is estimated that several combinations of gate openings, weed cutting and dredging at different reaches (between the locks) will permit the Canal to carry the desired 100 mgd from the Delaware Basin to the Raritan Basin. The capacity could be increased beyond that 100 mgd value in all of the reaches with the raising of some of the Canal overflow spillways.

Flood Flows

The Canal is subject to flooding from the tributaries, the overflow from inadequate culverts under the Canal and from high water levels in the contiguous rivers, i.e. Delaware, Millstone and Raritan.

Flood hydrographs for some 200 tributary inflows, both rural and urban, for each of four different rainfall recurrence intervals (2, 10, 50 and 100 years) were generated. These were added in both time and space to the Canal channel and outflows at the spillways and waste gates were subtracted and location of points of potentially serious problem of overbank spillages have been determined. Suggestions for location of supplemental spillways and waste gates have been made.

A limited water quality assessment was undertaken as one element of the Delaware and Raritan Canal hydraulics and hydrology project, presently nearing completion by Rutgers University. This element was intended to supplement the basic quantity studies of the project. The objective was to identify obvious, existing water quality problems and to evaluate the likelihood of changes in water quality as a consequence of steps taken to increase normal capacity of the Canal and to abate storm runoff effects. Interest in the interaction between quantity and quality suggested the probable importance of suspended solids and sedimentary deposits in the Canal.

In December 1977, a water quantity and quality data base was published. This report summarized data from several sources, including: NJDEP, USGS, STORET, NPDES, five water purveyors and other isolated sources. Water company data is excellent, but is reported at relatively long intervals, i.e., monthly and quarterly. The exception is turbidity data which is reported for two- and four-hour intervals. This data base includes precipitation data from several gages in the general vicinity of the D&R Canal. Since the overall goal of the project was an assessment of the carrying capacity and storm responses of the Canal, precipitation data was fundamental to both the quantity and quality elements of the study.

Also included in that 1977 report was a table listing 22 potential problem areas and types of discharges. The bulk of the tabulation references non-point runoff, storm sewage and a limited number of direct industrial discharges. Chemical and physical quality issues are principally solids and solids related parameters, such as hydrocarbons, heavy metals, nutrients and pesticides.

During the summer of 1978, the D&R Canal showed considerable evidence for active eutrophication. Many reaches displayed algal blooms and extensive growths of rooted aquatic plants. A field smapling program, focussing on phosphorus, was

undertaken. This program lasted for several months and led to the conclusion that the Canal carries an extensive phosphorus burden. An earlier study, published as a thesis, had highlighted the sources of phosphorus in Lake Carnegie and the present eutrophic condition of that water body. Phsophorus data and dissolved oxygen data were reported. The study of 1977 appeared to implicate crossflows between Lake Carnegie and the D&R Canal along the Canal aqueduct adjoining the Lake. Other groundwater and surface water exchanges between the Canal, the Lake, and the Upper Millstone River appear likely. All of these water bodies display high levels of phosphorus.

A second study was undertaken in 1978. Land use, soil types and other factors necessary to use of the Universal Soil Loss Equation were tabulated. The potential for soil erosion and sediment production was calculated for all areas directly and indirectly tributary to the D&R Canal. The Universal Soil Loss Equation was predicated upon an extremely simple physical mechanicm of energy exchange and particle transport. It must be viewed as a predictor of erosion potential, i.e., a means of assessing the upper limit of sediment production for a particular watershed or tibutary basin. All areas tributary to the Canal were ranked, qualitatively, on the basis of potential for soil erosion and sediment delivery to the Canal. The results of these predictions were compared with the locations of existing sediment deposits, based on recent survey data. There is excellent agreement between present locations of sediment deposits and those areas expected to be highly erodible and to have high sediment yields. In short, deposits within the Canal seem to arise from areas immediately tributary to the points of deposition.

A more comprehensive water quality sampling program was carried out during the summer of 1978. This program included more intense evaluation of phosphorus loads. Also, sediment characteristics including particle size distribution,

total carbon, total nitrogen, total phosphorus, chemical oxygen demand and total levels of eight selected heavy metals. Semi-qualitative elemental scans were run on water column samples, also. A summary of Rutgers data, together with data obtained from NJDOT, was published in December 1978. In 1979 a special reconnaissance was undertaken in support of an engineering study of the enclosed portion of the Canal, in Trenton. Two "barrels" or conduits carry the Canal under the central portion or urban area of Trenton. These conduits have been filling with sediment over a period of time and require dredging. During the time the divers were occupied evaluating the extent of deposition, bottom samples were taken. These samples were evaluated for oils and greases, chemical oxygen demand, heavy metals and other chemical characteristics.

The final water quality section of the overall hydraulics and hydrology project report has been completed and draft submission made to the Bureau of Water Facility Operations (NJDEP). This section of the final report summarizes all of the information gathered over a two-year period and makes some specific recommendations and draws several specific conclusions. The key conclusions drawn can be summarized as follows.

Tributary areas have been divided into four qualitative indices of erosion potential. This index of potential erosion provides a reasonable qualitative estimate of sediment deposition in the Canal. Trap efficiency of the Canal appears to be high and sediment is largely retained at or near the point of delivery.

An estimate of annual suspended solids transport was possible at the Kingston gage. Combining volumetric flow data from the gage and turbidity data from the Princeton Water Company, it was possible to make a comparison of sediment transport at this point in the Canal, versus potential contributions upstream of this point. Actual transport of suspended solids in the Canal is a very small fraction of the erosion potential and/or sediment delivery to the Canal.

Several water quality problems were identified. These include dissolved oxygen, heavy metals, phenol, oil and grease, and nutrients. Dissolved oxygen levels go below the desired level of 5.0 mg/l, at locations downstream of the enclosed Trenton conduit system. Disssolved oxygen levels in other parts of the Canal vary diurnally as a consequence of oxygen production by biomass. Qualitative assays for heavy metals suggest that lead and manganese are higher than desirable in the water column at several places in the Canal. Water purveyor data demonstrates that treatment effectively eliminates any excess concentrations of these metals. NJDOT data suggests that phenol and oil and grease may be excessive at times.

Observation and determination of nutrients lead to the positive conclusion that much of the Canal is in a eutrophic state. Adequate nitrogen, phosphorus and inorganic carbon resources are available to nourish extensive algal blooms and significant masses of rooted aquatic plants. Note, that the latter contribute to the reduction of the Canal capacity and present a seasonal nuisance comparable to a number of the sedimentary deposits within the Canal.

Canal sediments are heavily loaded with nitrogen and phosphorus; they display substantial chemical oxygen demand. Sediments from the enclosed conduit system in Trenton are heavily contaminated with oil and grease. These sediments also display relatively high levels of cadmium, lead and zinc. Generally, Canal sediments display moderate to heavy contamination with lead and heavy with zinc. Also, there is some evidence for high levels of copper and iron as well.

In summary, dissolved oxygen, heavy metals and oxygen demand have been identified as water quality problems in the D&R Canal. All are effectively managed by the purveyors, through treatment processes. Water quality deficiencies all appear to be sediment related. Problem species are readily adsorbed on the clay and organic fractions of sedimentary material and are found in much greater concentrations here than in the water column.

The water quality element of the D&R Canal hydraulics and hydrology project did not directly identify any problems associated with exotic or hazardous organic substances. These materials will be considered of primary importance in an ongoing water quality planning and assessment study, initiated in July 1979. In addition, the sediments of the Canal are an established source of concern. Material that must be dredged does contain substantial concentrations of selected heavy metals and significant chemical oxygen demand. The removal of this material, without damage to the water column and safe disposal elsewhere is a matter to be studied under another project to be initiated within the very near future. On the whole, Canal water quality is acceptable, but displays some deficiencies. Problems that have been identified are linked to erosion and transport and deposition of sediment in the Canal. These problems are associated with the oxygen demand of organic matter, nutrients and heavy metals. The latter arise most likely from non-point discharges from urban areas, both overland and through storm sewers. Fortunately, heavy metals and organic matter are readily adsorbed on particulates and settled. Thus, the impact on the water column is relatively modest and is easily managed by the water purveyors utilizing Canal water as a supply.

APPENDIX 3D-V

SUBJECTIVE EVALUATIONS

REALISTIC PROJECTS

Appendix 3D-V shows the results of the subjective evaluation made for each project by the matrix method described in the Subtask 3G output - Recommended Plan Selection Methodology. The total subjective score of each project is the sum of weighted scores of the four evaluation categories shown on the tabulation. These categories are comprised of four to seven evaluation factors as described in the Subtask 3G output. The higher the total score, the better the particular project is considered to meet the preferred criteria of the various evaluation factors in the subjective portion of the plan selection methodology.

APPENDIX 3D-V

SUMMARY OF SUBJECTIVE EVALUATION MATRIX SCORES

REALISTIC WATER SUPPLY ALTERNATIVES (* = Preferred Alternative Project)

Project Number	Project Name	Subjective Evaluation Scores By Category				
		I Technical	II Environmental	III Socio-Economic	IV Implementation	Total
1	Raritan/Passaic/Hackensack Pipeline (North Route, Main Stem Development)	10	18	7	19	54
2*	Raritan/Passaic/Hackensack Pipeline (South Route, Main Stem Development)	10	18	8	24	60
2A*	Raritan/Northeast Pipeline (Reinforcing Purveyor Systems)	12	23	8	21	64
3*	Confluence Reservoir, Pump Station and Force Main	12	21	12	25	70
4	Delaware River Diversion to Raritan River	10	22	9	17	58
5	Delaware River Flood Skimming to Raritan River	8	22	10	13	53
6	Delaware River Flood Skimming to Raritan (Round Valley Expansion)	8	20	10	13	51
7*	Delaware and Raritan Canal Improvements	16	19	13	25	73
8*	Six Mile Run Reservoir	11	18	12	25	66
10	Delaware-Raritan Canal Optimization	16	19	13	25	73
13	Upper Raritan Pipeline	10	22	7	13	52
14*	Round Valley Reservoir Expansion	10	23	16	25	74
16	Hacklebarney Reservoir	14	18	15	13	60
17	Ravine Lake Reservoir	14	18	11	14	57
25	Bartley Reservoir	9	18	13	14	54
27	Two Bridges Reservoir (W/Myers Road; Passaic River to FC Plan III)	14	16	12	17	59
28	Delaware River Diversion, Frenchtown - Two Bridges	8	12	7	16	43
29	Delaware River Diversion to Canoe Brook - Great Notch	8	22	10	17	57
30	Delaware River Diversion, Port Jervis - Pequannock	9	20	7	17	53
31	Delaware River Diversion, Tocks Island - Wanaque	8	18	7	17	50
32	Hudson River - Ramapo River Diversion (N.Y. Storage)	8	20	7	17	52

Appendix 3D-V (Continued)

Project Number	Project Name	Subjective Evaluation Scores By Category I Technical	II Environmental	III Socio-Economic	IV Implementation	Total
33	Hudson River - Ramapo River Diversion (Ramapo Storage)	8	20	7	17	52
34	Hudson River - Little Falls Continuous Diversion	8	16	7	17	48
35	Hudson River - Little Falls Diversion (N.Y. Storage)	8	18	7	17	50
36	Hudson River - Great Notch (N.J. Storage)	8	18	7	17	50
37	Delaware River Control - Transfer from Kensico	10	18	8	17	53
39,40*	Wanaque - Oradell Pipeline and Two Bridges - Ramapo Diversion Project	10	20	8	25	63
41*	Monksville Reservoir with Ramapo Pump Station	10	19	13	25	67
42*	Great Notch Interconnection	14	16	7	24	61
43*	Washington Valley Reservoir	15	18	15	23	71
44*	Longwood Valley Reservoir	15	21	15	14	65
46	Dunkers Pond Reservoir with Wallkill River Diversion	7	14	13	19	53
48	Hardscrabble Reservoir	13	17	11	13	54
54	Greenwood Lake	13	21	9	17	60
55	Tocks Island Lake Project	12	17	15	13	57
56*	Hackettstown Reservoir	14	20	14	25	73
57	Flat Brook Reservoir	8	15	11	13	47
58	Flatbrook - Raritan Continuous Diversion	8	15	11	13	47
60*	Ross Corner Reservoir	12	21	12	23	68
65*	Shades of Death Reservoir	10	21	12	23	66
66*	Petersburg Reservoir	10	21	12	23	66
67	Honey Run Reservoir	10	20	12	19	61
72*	Franklin Reservoir	13	19	12	20	64
73*	Beaver Run Reservoir	13	21	12	20	66

Project Number	Project Name	Subjective Evaluation Scores By Category I Technical	II Environmental	III Socio-Economic	IV Implementation	Total
74*	Sussex North Reservoir	13	21	11	20	65
75	(See Project 46)	10	20	9	19	58
76*	Upper and Lower Manasquan Reservoirs	13	23	15	17	68
77*	Hackensack River Optimization	9	19	8	28	64
78	New York City Diversion from Manhattan	10	23	8	16	57
79	New York City Diversion from Staten Island	10	23	8	16	57
80*	South River Ground Water Pumped Storage Diversion	10	21	8	28	67
81	Weldon Brook Reservoir	12	20	12	13	57
86	Toms River Reservoir	9	21	12	15	57
103	South River Reservoir Project	10	20	8	18	56
113	Raritan-Passaic Pipeline	9	22	7	17	55
113A	Raritan-Passaic Transfer (Tunnel to Dead River)	9	22	11	20	62
113B	Raritan-Passaic Transfer (Force Main to Dead River)	9	23	9	20	61
116	Frenchtown Reservoir	7	16	7	14	44
131*	Well Field in Wharton Tract (Southwest N.J. Supply)	12	14	9	16	51
132	Well Field in Wharton Tract (Southeast N.J. Supply)	12	14	9	16	51
135	Burlington County East Zone Well Fields	12	12	11	16	51
136	Alamatong Well Field and Recharge Basin (under construction)	-	-	-	-	-
137	Delaware River Diversion to Dunker Pond	8	16	10	14	48
138*	Source-Source Interconnection, Delaware and Raritan Canal	15	14	7	20	56
139*	Interstate Transfer - PA to Camden	10	24	8	14	56
140*	Delaware River Intake, Camden	7	16	8	16	47
141*	Raritan-North Branch Pipeline	11	18	7	24	60

Statistical Parameter	Subjective Evaluation Scores By Category				
	I Technical	II Environmental	III Socio-Economic	IV Implementation	Total
Preferred Projects (N = 26)					
$\bar{x}$, mean	11.85	19.58	10.85	22.00	64.30
s, sample variance	2.25	2.61	2.87	3.92	6.47
CV, Coeff. of Variation, %	18.9	13.3	26.5	17.8	10.1
Deferred Projects (N = 40)					
$\bar{x}$, mean	9.85	18.65	9.60	16.20	54.30
s, sample variance	2.23	2.97	2.38	2.59	5.54
CV, Coeff. of Variation, %	22.6	15.9	24.8	16.0	10.2
All Realistic Projects (N = 66)					
$\bar{x}$, mean	10.64	19.03	10.09	18.50	58.26
s, sample variance	2.40	2.85	2.65	4.28	7.67
CV, Coeff. of Variation, %	22.5	15.0	26.3	23.1	13.2

NEW JERSEY
STATEWIDE WATER SUPPLY MASTER PLAN

HAVENS AND EMERSON, INC.
PARSONS, BRINCKERHOFF, QUADE & DOUGLAS, INC.
WESTWATER, GASTON & DUNKA
WATER RESOURCES ENGINEERS, INC.
GERAGHTY & MILLER, INC.
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3-1188-03-1

February 1980

Letter of Transmittal:

This document represents our draft submission of TASK 3E/F - Regional Water Supply Development.

In order to orient the reader to the requirements of the contract, the following is excerpted directly from the Scope of Work: -

TASK 3E

The purpose of this activity is to combine individual projects to form alternative programs which will be sufficiently flexible to provide for the overall State water supply needs for the next 30 to 50 years, recognizing the uncertain nature of the fulfillment of demand projections.

Socioeconomic, engineering and environmental issues are also to be combined in this activity to measure the effectiveness of existing and proposed projects in meeting regional water demands. Possible institutional and legal impacts developed in Tasks 8, 9 and 10 will be incorporated as necessary. Public inputs from Task 11 will be similarly included.

Computer optimization techniques may be used in concert with graphical evaluation techniques and subjective matrix evaluation methods to complete the evaluations.

The analysis suggested must be tailored in order to include a number of region-wide constraints including:

1. Demand resulting from high, medium and low growth,

2. Maintenance of high, low and existing minimum stream flow targets,

3. Consideration of the following subsets of possible source development options:

   a. Delaware River only

   b. Hudson River only

   c. Both of the above

   d. Neither of the above

4. Consideration of interconnections at:

   a. Current level

   b. Greatly expanded level

Variations external to the specific project information may include:

1. Upgrading existing facilities (pump storage and importation),

2. Ground water recharge with treated wastewater,

3. Demand modifications by water grading and selected reuse,

4. Conjunctive use of aquifers and surface waters,

5. Conjunctive use of desalting plants and developed studies.

The number of alternative projects to be considered State-wide may total over 100. The range of programs developed from this number of projects suggests the use of computer screening techniques. Cases will be evaluated for an intensive one-year drought and a multi-year drought.

Comparative costs data for facilities, interconnections, low-grade distribution systems and recharge facilities will be developed to a suitable level to support this screening approach. Such data will be extracted from the studies already conducted by others. Cost data will be adjusted to current dollars so that costs are comparable.

The factors of flexibility, environmental effects and social impact will be assessed externally to the computer screening, perhaps by use of a subjective matrix approach. The screening of regional plans and its results will be reviewed with the Expert Advisory Council.

The reanalysis of past decisions to acquire reservoir sites will be conducted after the regional water plans are developed. Reservoir site acquisition will be reevaluated as will the current State positions on raw water transmission. The effect of demand modification by water reuse will be explored in general. The Delaware and Raritan Canal will receive detailed study.

TASK 3F

The objective of this task is the presentation of the analyses derived during the accomplishment of Task 3E in a clear and understandable form. Use will be made of comparative matrices to present all data in an objective manner. Discussions of the regional plans and considered strategies will be made and will include the reasons for consideration and rejection. Written information will be provided in a form suitable for the lay reader.

Sincerely,

Robert J. Haefeli, P.E.

sf

SUBTASK 3E

REGIONAL WATER SUPPLY DEVELOPMENT

TASK 3E - REGIONAL WATER SUPPLY DEVELOPMENT PROGRAMS

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SUBTASK 3E

REGIONAL WATER SUPPLY DEVELOPMENT

3E-1 INTRODUCTION

The purpose of this subtask is to combine individual potential water supply projects to form alternative development programs for the various planning regions. The individual projects were identified and evaluated in the preceding Subtasks 3ABC and D using the methodology described in Subtask 3G. The programs are sufficiently flexible to provide for the water needs until about the year 2020. The uncertain nature of long-range forecasting of supply/demand conditions, and the lack of detailed information about the many individual purveyors relative to their internal planning and system capabilities are recognized in preparing this subtask.

The analysis combined the technical, environmental, socio-economic, institutional (administrative, legal, financial and public issues that impact on the effectiveness of the existing and proposed projects in meeting regional water needs.

Region-wide constraints on water supply project selection and development are given due attention in this subtask. Such constraints include variations in future water demands as a result of varying land use, population and employment growth conditions; streamflow requirements for downstream quality and diversions; options for inter-state and intra-state source water development for New Jersey; water supply system interconnections; upgrading of existing source treatment and transmission facilities, ground water recharge, conjunctive use and water demand modifications.

The present program for acquisition of reservoir sites is reviewed in this subtask. Recommendations are made for immediate and long-range site acquisitions and for the reservation of certain water supply projects for potential development and use after the year 2020, or earlier if necessary, depending upon future supply/demand and other conditions as may be identified during on-going planning activities.

3E-2 Previous Evaluations

The methodology used in the Master Plan Study evaluating possible water supply development projects is detailed in the Subtask 3G report and briefly summarized in Section 3E-3 for the reader's convenience. Subtask 3ABC examined 125 possible projects and found that 65 of them were unrealistic, and that 60 of the projects were realistic and warranted more detailed evaluation in Subtask 3D. A list of the unrealistic projects is given on Table 3E-1 along with the primary reasons for their exemption from Subtask 3D evaluation. The realistic projects, with identification of those selected in Subtask 3D as preferred projects for the regional programs, are listed on Table 3E-2. That table also shows the subjective evaluation total score of each project as determined by using a matrix method in Step 2 (Subtask 3D), as described in detail in Subtask 3G and summarized in the following section.

Table 3E-3 presents basic information on yield, estimated construction, annual and per million gallon annual costs, and the evaluation matrix score for each of the preferred alternative projects as developed for Task 3D with some modifications where found desirable during the Task 3E regional analysis. These projects comprise the pool of water resources for selection of the regional source development programs in Task 3E. The estimated basic annual costs shown on Table 3E-3 for Projects #2, 3, 7 and 8 do not include State of New Jersey selling prices for water from the Spruce Run/Round Valley or Delaware and Raritan Canal systems. Estimated selling prices for such water are included in Tables 3E-8 and 3E-11.

TABLE 3E-1

UNREALISTIC WATER SUPPLY ALTERNATIVES

PROJECT NUMBER	PROJECT NAME	CRITERIA FAILED *
9	Delaware-Raritan Pipeline and Canal	E-I
11	Crab Island Dam and Reservoir	E-I
12	South River Tidal Dam/Recharge Pond (Middlesex Co.)	E-I-T
15	Flatbrook -Raritan High Flow Skimming	E-I-T
18	Bunnvale Reservoir	E
19	McCrea Mills Reservoir	E-I
20	Oldwick Reservoir	E
21	Big North Branch Reservoir	E-I
22	Chimney Rock Reservoir (East Branch)	E-I
23	Rocky Hill Reservoir (Bedens Brook)	E-I
24	Stony Brook Reservoir	T-I
26	Schooleys Mountain Reservoir	E-I
38	Oradell Pipeline	E-I
45	Whippany Reservoir (Troy Meadows)	T
47	Tourne Reservoir	T-I
49	Darlington Reservoir (Ramapo)	E-I
50	Harrisons Brook Reservoir	T-I
51	Corys Brook Myers Road Reservoir	E
52	Como Reservoir	E-I
53	Long Hill Reservoir (Great Swamp)	E-I
59	Sussex Mills Reservoir	I
61	Newton-West Reservoir	E-I-T
62	Kerrs Corner Reservoir	E-I-T
63	Paulina Reservoir	T-I
64	Huntsville Reservoir	T-I
68	Oxford Watershed	T
69	Wallpack Bend Reservoir	E-I
70	Pequest Reservoir	E-I-T
71	Greenwich Watershed	T
82	Pulaski Reservoir	T
83	Woodbourne Reservoir	T-I
84	Papakating Reservoir	T-I
85	Bennets Mills Reservoir	T-I
87	Crosswicks Reservoir	T-1
88	Deacons Reservoir	T-I
89	Rancocas Reservoir	T-I
90	Chews Reservoir	T-I
91	Pines Run Reservoir	T-I
92	Mantua Reservoir	T-I
93	Chestnut Branch Reservoir	T-I
94	Swedesboro Reservoir	T-I
95	Mullica Hill Reservoir	T-I
96	Major Run Reservoir	T-I
97	Alphano Reservoir	E-I-T
98	Nichomus Run Reservoir	T-I

TABLE 3E-1 (CONTINUED)

UNREALISTIC WATER SUPPLY ALTERNATIVES

PROJECT NUMBER	PROJECT NAME	CRITERIA FAILED *
99	Alloway Creek Reservoir	T-I
100	Stow Creek Reservoir	T-I
101	Cohansey Reservoir (Shiloh)	T-I
102	Carmel Reservoir	T-I
104	Penny Pot Reservoir	T-I
105	Merrill Creek Reservoir	T
106	Cool Run Reservoir	T-I
107	Indian Branch Reservoir	T-I
108	New Hampton Reservoir	E-I-T
109	North Branch Timber Creek Reservoir	T-I
110	Otter Brook Reservoir	T-I
111	Monangahela Reservoir	T-I
112	Dock Watch Hollow Reservoir	E-I
114	Rainey Road Reservoir	T-I
115	Vestry Road Reservoir	T-I
117	Glen Alpin Reservoir	T-I
118	Van Doran Mills Reservoir	T-I
119	Silver Lake Reservoir	T-I
133	South Jersey Ground Water	I
134	Sanford Plan	T-I

* E = Not meeting environmental constraints

T = Not meeting technical constraints

I = Not meeting institutional constraints

TABLE 3E-2

REALISTIC WATER SUPPLY ALTERNATIVES

PROJECT NUMBER	PROJECT NAME	SUBJECTIVE SCORE
1	Raritan-Passaic Pipeline (North Route, Main Stem Development)	54
2*	Raritan-Passaic Pipeline (South Route, Main Stem Development)	60
3*	Confluence Reservoir, Pump Station and Force Main	70
4	Delaware River Diversion to Raritan River	58
5	Delaware River Flood Skimming to Raritan River	53
6	Delaware River Flood Skimming to Raritan(Round Valley Expansion)	51
7*	Delaware and Raritan Canal Improvements	73
8*	Six Mile Run Reservoir	66
10	Delaware-Raritan Canal Optimization	73
13	Upper Raritan Pipeline	52
14*	Round Valley Reservoir Expansion	74
16	Hacklebarney Reservoir	60
17	Ravine Lake Reservoir	57
25	Bartley Reservoir	54
27	Two Bridges Reservoir (W/Myers Road; Passaic River FC Plan III)	59
28	Delaware River Diversion, Frenchtown - Two Bridges	43
29	Delaware River Diversion to Canoe Brook - Great Notch	57
30	Delaware River Diversion, Port Jervis- Pequannock	53
31	Delaware River Diversion, Tocks Island - Wanaque	50
32	Hudson River - Ramapo River Diversion (N.Y. Storage)	52
33	Hudson River - Ramapo River Diversion (Ramapo Storage)	52
34	Hudson River - Little Falls Continuous Diversion	48
35	Hudson River - Little Falls Diversion (N.Y. Storage)	50
36	Hudson River - Great Notch (N.J. Storage)	50
37	Delaware River Control - Transfer from Kensico	53
39*	Wanaque - Oradell Pipeline	63
40*	Two Bridges - Ramapo Diversion Project	63
41*	Monksville Reservoir with Ramapo Pump Station	67
42*	Great Notch Interconnection	61
43*	Washington Valley Reservoir	71
44*	Longwood Valley Reservoir	65
46	Dunkers Pond Reservoir with Wallkill River Diversion	53
48	Hardscrabble Reservoir	54
54	Greenwood Lake	60
55	Tocks Island Lake Project	57
56*	Hackettstown Reservoir	73
57	Flat Brook Reservoir	47
58	Flatbrook -Raritan Continuous Diversion	47
60*	Ross Corner Reservoir	68
65*	Shades of Death Reservoir	66
66*	Petersburg Reservoir	67
67	Honey Run Reservoir	61
72*	Franklin Reservoir	64
73*	Beaver Run Reservoir	66
74*	Sussex North Reservoir	65
75	(See Project 46)	58
76*	Upper and Lower Manasquan Reservoirs	68

TABLE 3E-2 (CONTINUED)

REALISTIC WATER SUPPLY ALTERNATIVES

PROJECT NUMBER	PROJECT NAME	SUBJECTIVE SCORE
77*	Hackensack River Optimization	64
78	New York City Diversion from Manhattan	57
79	New York City Diversion from Staten Island	57
80*	South River Ground Water Pumped Storage Diversion (Raritan Basin)	67
81	Weldon Brook Reservoir	57
86	Toms River Reservoir	57
103	South River Reservoir Project (Great Egg Harbor Basin)	56
113	Raritan-Passaic Pipeline	55
116	Frenchtown Reservoir	44
131*	Well Field in Wharton Tract (Southwest N.J. Supply)	51
132	Well Field in Wharton Tract (Southeast N.J. Supply)	51
135	Burlington County East Zone Well Fields	51
136	Alamatong Well Field and Recharge Basin (under construction)	-
137	Delaware River Diversion to Dunker Pond Reservoir	48
138*	Source-Source Interconnection, Delaware & Raritan Canal	56
139*	Interstate Transfer - PA to Camden	56
140*	Delaware River Intake, Camden Area	47
141*	Raritan-North Branch Pipeline	60
2A*	Raritan-Northeast Pipeline (Reinforcing Purveyor Systems)	64
113A	Raritan-Passaic Transfer (Tunnel to Dead River)	62
113B	Raritan-Passaic Transfer (Force Main to Dead River)	61

* = Preferred alternative project

TABLE 3E-3

PREFERRED ALTERNATIVE PROJECTS

Number	Project Name	Project Estimated Yield (MGD)[a]	Estimated Basic Cost of Project: Construction (1980 dollars) ($ Million)	Annual ($1,000)	Annual ($/MG)[b]	Evaluation Matrix Score[c]
Region 1:						
2	Raritan-Passaic Pipeline (South Route)	80	92.8	9,970	341	60
2A	Raritan-Northeast Pipeline (Purveyor Reinforcement)	80	73.8	8,731	299	64
3	Confluence Reservoir, Pump Station and Force Main	50	83.0	8,300	455	70
7	D&R Canal Improvements	25	3.7	316	35	73
8	Six Mile Run Reservoir	38	27.5	2,554	184	66
14	Round Valley Reservoir Expansion	27	23.0	1,620	164	74
39 & 40	Two Bridges/Ramapo Diversion and Wanaque-Oradell Pipeline	79	66.1	8,450	293	63
41	Monksville Reservoir and Ramapo Pump Station	25[d]	37.0	3,900	427	67
42	Great Notch Interconnection	-	NA	NA	NA	61
43	Washington Valley Reservoir	7	18.6	1,600	626	71
44	Longwood Valley Reservoirs	11	76.0	7,140	1,780	65
77	Hackensack River Optimization	7	NA	NA	NA	64
138	Source-Source Interconnection, D&R Canal	25	0.9	454	50	56
141	Raritan-North Branch Pipeline	31	18.1	5,300	472	60
Region 2:						
76	Manasquan River Reservoirs	35	33.6	5,600	438	68
Region 3:						
	Local Groundwater Projects As Required					
Region 4:						
	Local Groundwater Projects As Required					

TABLE 3E-3 (Continued)

PREFERRED ALTERNATIVE PROJECTS

Project Number	Project Name	Project Estimated Yield (MGD)[a]	Estimated Basic Cost of Project: Construction (1980 dollars) ($ Million)	Annual ($1,000)	Annual ($/MG)[b]	Evaluation Matrix Score[c]
Region 5:						
131	Wharton Tract Southwest Groundwater[e]	25	49.7	5,042	552	51
139	Philadelphia-Camden Pipeline[f]	25	6.3	3,800	416	56
140	Delaware River Intake, Delanco[g]	25	23.6	2,600	472	47
Region 6:						
60	Ross Corner Reservoir	20	19.6	1,980	271	68
56	Hackettstown Reservoir	40	47.0(h)	2,630	180	73
65	Shades Reservoir	27	38.8	3,560	361	66
66	Petersburg Reservoir	35	31.6	3,100	243	67
72	Franklin Reservoir	14	15.0	1,520	297	64
73	Beaver Run Reservoir	28	16.2	1,760	172	66
74	Sussex North Reservoir	52	39.0	3,960	209	65

Notes:

(a) Millions gallons per day, annual average based on project reports.

(b) Annual cost (1980 dollars) per million gallons based on indicated yields.

(c) Based on analysis of 22 subjective evaluation factors; costs excluded (see text and Subtask 3G).

(d) Yield may be impacted by Project #40.

(e) Wharton Tract demonstration project at modest 25 mgd abstraction/treatment/transmission to Camden area.

(f) Physical improvements required in Philadelphia system not identified and not included in analysis.

(g) 50 mgd installation to provide 26 mgd potable water for Camden and 24 mgd aquifer recharge at Camden well field during 7 months (November-May), and 5 months (June-October), well field supply to Camden during low flow period of Delaware River at Delanco. Low-flow augmentation of Delaware River not included in this conjunctive use project of the DRBC Level B Comprehensive Plan.

(h) Excludes Waterloo Village protection cost.

3E-3 Methodology

The Task 3 methodology for analyzing water supply project alternatives and selecting regional water supply management programs is fully described in the Subtask 3G report. However, for convenience and general information, the methodology is briefly described as follows:

A three-step methodology is developed based on the scope of work, evaluation factors for comparing projects subjectively, and estimated comparative costs of project construction and operation. Step 1 (Subtask 3ABC) is an inventory and initial screening of projects suggested by governmental agencies, purveyors, consultants and others for possible development. It also includes projects or modifications conceived by the study plan consultants or others that were not addressed in previous reports.

3E-3.1 Step One

In Step 1 the screening process determines which projects are realistic for developing additional water supplies to meet New Jersey's immediate and growing needs. The unrealistic projects are then discarded for reasons shown in Table 3E-1, and realistic ones are examined with more sophistication in the next step.

3E-3.2 Step Two

Step 2 (Subtask 3D) is an analysis of each realistic project based on the water supply objectives, source capabilities using a computerized streamflow model, and the project's estimated construction and annual costs. The analysis also includes a scored matrix for comparable subjective evaluation of each realistic project. Four major consideration categories are used in the matrix: technical, environmental, socio-economic, and implementation, with each category having weights to reflect its relative importance. A rating system from 0 to 3 is used to judge how well or poorly a project meets the objectives of each category. The definitions of the ratings are as follows:

Evaluation Factor Rating	Meaning
0	The project does not satisfy the category and adversely impacts the category.
1	The project satisfies the issues to a small degree and there are no apparent adverse impacts by the factor.
2	The project moderately satisfies the issues and adverse impacts are slight. This score is also used when adequate information about a project is not yet available for the evaluation; in this manner a project is not necessarily rejected because of unknowns.
3	The project fully satisfies the category issues.

Table 3E-4 shows a sample matrix and scoring using the categories, and weights applied in the study.

Dependable yield and capacity to meet needs were not used in the numerical evaluation since the projects exhibited sufficient merit in these respects in the initial review.

Secondary effects were not included, i.e., a project would not get points because its' implementation would cause an improvement in another location. For example, a project to relieve overdrafting an existing supply would not pick up points for improving streamflow unless the improved flow was where the project was.

Piggyback projects, such as those designed to deliver Tocks Island Lake Project water, would not get points for the TILP flood control merits.

In addition to scoring each project, the individual points were reviewed project by project to assure that the scores had been applied consistently.

If projects being compared have approximately the same unit cost, then the highest scored project would have the greatest priority for development. Project readiness to proceed would then carry substantial weight in determining the actual project for earliest construction. For example, if among two alternative projects one of them has design substantially completed and State approval that more advanced project could proceed even if the other alternative had a greater evaluation score.

It is emphasized here that the evaluation matrix methodology, or any other method of subjective comparison does not provide the ultimate answer to the question as to whether or not a particular project can be or will be built.

TABLE 3E-4

SAMPLE PROJECT EVALUATION SCORE SHEET - SUBJECTIVE FACTORS

Region: 1 Project: Hypothetical

SUBJECTIVE EVALUATION FACTORS:	Evaluation Factor Weight (%)	Rating	Score		Evaluation Category Weight (%)	Score
TECHNICAL (20%)						
Flexibility	35	3	105			
O&M	10	2	20			
Water Reuse	15	-				
Energy Intensity	30	1	30			
Proximity to Demands	10	2	20			
	100		175	÷ 3* = 58.3 x	20 =	11.7
ENVIRONMENTAL (30%)						
Water Quality	20	2	40			
Low Streamflow	20	3	60			
Ecology	20	2	40			
Sensitive Lands	20	2	40			
Cultural Resources	5	3	15			
Induced Growth	5	2	10			
Resource Commitment	10	2	20			
	100		225	÷ 3 = 75.0 x	30 =	22.5
SOCIO-ECONOMIC (20%)						
Physical Displacements	20	2	40			
Recreation	40	3	120			
Flood Control	5	1	5			
Power Development	5	-				
Employment/Economy	30	2	60			
	100		225	÷ 3 = 75.0 x	20 =	15.0
IMPLEMENTATION (30%)						
Decision-making	10	3	30			
Institutional	40	1	40			
Financial	20	2	40			
Legal	5	2	10			
Public Acceptance	25	2	50			
	100		170	÷ 3 = 56.7 x	30 =	17.0
TOTAL SCORE (Rounded):						66.2
					Say	66%

Note: Project evaluation score sheets for each of the projects analyzed in Subtask 3D are in appendix materials of that subtask.

*Division by 3 to provide ideal (perfect) total score of 100% for project.

It should be understood that only one factor could conceivably stop consideration of a project. For example, discovery of a rare and endangered species at the project site could make the ecology evaluation factor the supreme test of the project's acceptability. Or, an insurmountable or lengthy legal confrontation could result in another alternative taking precedence over a project that seemingly had higher priority or greater benefits.

The primary result of Step 2 is the determination of the most promising projects for construction within the planning period (by Year 2020). The remaining projects of the Step 2 analysis then become deferred projects which are placed in a "Water Bank" for potential water supply development after the end of the planning period (that is, beyond Year 2020).

3E-3.3 Step Three

Step 3 (Subtask 3E) then takes the preferred projects of Step 2 and examines them for adoptation to meeting regional needs during the planning period. The Step 3 result is a specific water supply development program recommending regional projects and a schedule of their implementation in order to meet longer range needs. All of the projects analyzed in Step 3 may not be needed before the end of the planning period, so those projects are added to the "Water Bank".

This three-step methodology is expected to be applied, with refinements where appropriate, in future on-going planning efforts for evaluation of potential projects as further water resource and other information and water demand projections are updated. Future planning may determine, test and apply more comprehensive methods of project evaluation, perhaps with greater use of computerized programs as more data becomes available and as additional evaluation capabilities develop.

3E-4 Water Supply Needs

New Jersey's water supply needs developed in Task 2 and presented in Subtask 3ABC and D reports have been reviewed and modified by the State. Table 3E-5 shows the projected additional needs for purveyor supplied potable water through the year 2020.

TABLE 3E-5

PURVEYOR WATER NEEDS (MGD)

	Projected Needs				
Region	1980	1990	2000	2010	2020
1	63	107	151	186	203
2	12	30	38	44	50
3	5	16	17	20	22
4	0	2	5	7	9
5	5	15	26	33	36
6	4	11	18	23	27
Total*	89	180	254	312	347

*Totals may not agree due to rounding.

Many factors can impact the indicated needs, most probably altering the time frame for occurrence. All trends, however, point to increased future requirements. While the highlights of the various factors are presented herein, the reader is invited to review other subtask reports for more complete discussion.

3E-4.1 Base Assumptions for Determining Water Supply Needs

There are many factors affecting the determination of water supply needs. These are discussed in detail in other outputs of the Master Plan study. In summary, the most significant factors are discussed as follows:

4.1.1 Lost or Unaccounted for Water

The needs presented in Table 3E-5 include substantial allowances (between 20 to 35%) for unaccounted for water based on the historic record. Primary factors contributing to unaccounted for water are: line losses and leaks, under-registration of meters, unmetered municipal uses, firefighting and water treatment filter backwash.

In a very "tight" system, the unaccounted for water might be as low as 12%. In older systems, higher rates generally prevail, and leakage is probably widespread in such systems.

Where under-registration occurs, repairing this would increase revenue, possible impacting sales temporarily. However, this water is supplied but not registered.

4.1.2 Conservation

The impacts of conservation are essentially felt in the long-term and can effect future demands. Short-term emergency response primarily offers flexibility in system management, whereas institutional changes such as code requirements for water-saving plumbing devices gradually change water demands as the application of such devices becomes more widespread.

Reduction of unaccounted for water and conservation measures were not assumed in this study. While reduction of unaccounted water and the development of conservation measures are important and desirable they are not under the control of existing institutions or in the case of reducing unaccounted for water, can be prohibitively expensive. For present planning purposes it is therefore assumed that present practices will continue. Any future improvement in the loss percentage or in more efficient use of water supplies will extend the life of the proposed plans and further defer the projects on the deferred list.

4.1.3 Contamination and Loss of Existing Supplies

The basic assumption is that existing supplies will continue to be available in undiminished volumes throughout the study period, except for certain groundwater supplies. These include certain shore area wells subject to increasing salinity and the Camden area well fields, discussed in Outputs 3D and 7C.

4.1.4 Wastewater Reuse

No project is contemplated to directly use effluent of a wastewater treatment plant as a source of water. Indirect use, through discharge to a waterway that serves downstream as a source of water is not ruled out.

4.1.5 Instream Transmission

Instream transmission is used wherever feasible to provide undiminished, and even augmented, streamflows from reservoir releases to the point of diversion. It also permits full water resource development of the river basin upstream from the diversion.

Only where significant exposure to pollution or loss of head occurs will the stream channels not be used.

4.1.6 Surpluses

Generally, use of reported purveyor system surpluses to satisfy widespread regional needs is not contemplated as a solution. These surpluses are reserved for local supply. In some cases the reported surpluses must be reserved for firm system capacity. Opportunities exist for transfer of some surplus water (Passaic Valley Water Commission, Elizabethtown Water Company, Middlesex Water Company, and Trenton, for example) to systems having deficits.

4.1.7 Shortfalls

Several purveyors are currently overdrafting surface supplies beyond reported safe yields. Projects to correct these conditions are included as immediate needs.

3E-4.2 Conjunctive Use

Combined use of two water supply sources, either simultaneously or alternating in time, is the broad definition of conjunctive use. An example of surface water/ground water conjunctive use is the existing practice of the Sayreville Water Department to pump from the tidal South River when flow and quality conditions permit, into ground water recharge lagoons. There are many opportunities for new application of this type of conjunctive use, such as the City of Camden developing Delaware River water from a Delanco intake for well field recharge and for direct use after treatment.

Desalting brine or sea water to supplement fresh surface or groundwater supplies is another conjunctive use method. Desalination on a major scale has not been found to be economical in New Jersey. The processes are extremely energy intensive, not only for operation but also in the manufacture and supply of the many mechanical-electrical equipment components. If fuel costs continue to rise faster than other costs, desalination will continue to be uneconomical in New Jersey unless the process efficiency can be improved markedly.

Conjunctive use permits possible cost-savings from smaller, less expensive reservoirs supplemented by wells. It allows an effective means to overcome excessive ground water pumping by use of surface storage or direct stream diversion to "rest" or recharge aquifers.

Conjunctive use of surface and ground waters for both small and large water supplies is appropriate where adequate source information and physical - economic conditions permit.

3E-4.3 Water Quality and Protection

Maintaining streamflows below reservoirs and water supply intakes is an important planning consideration. Adequate dry season low flows are essential not only for sustaining fish and other aquatic life, wildlife and recreation, but also to maintain minimum flows for nature to assimilate oxygen depleting wastewater and non-point source pollutants. It is also necessary to provide sufficient downstream flow for other water users, municipal and privately-owned water suppliers, industries, etc. The stream-flow simulation model used to assess the ability of existing purveyor systems and future source development, considered low flow and downstream user needs.

Instream transmission is the use of a stream to convey water instead of a parallel raw water pipeline. However, it should be recognized that water supply quality may be better protected with a pipeline. An example of existing cost-effective instream transmission is the Raritan River between the Round Valley/Spruce Run complex and the Elizabethtown Water Company treatment plant in Bound Brook. Another is the use of the Pompton-Passaic River system channel between the NJDWSC Wanaque Reservoir and the Little Falls treatment works of the Passaic Valley Water Commission for conveyance of water supplies released from the reservoir.

The Delaware and Raritan Canal Improvement project #7 would include dredging sediments in order to increase the canal carrying capacity and remove some heavy metals and other contaminants that impact the water quality. A detailed report on canal quality has been prepared for the State by a Rutgers University team.

Stream and ground water quality protection by use of "buffer zones" is being practiced to a substantial extent through flood plain zoning and Green Acres acquisitions, as examples. Further protection of this nature for stream corridors has been recommended in the various Section 208 Area-wide Water Quality Management Planning Programs. It is expected that the "buffer zone" protective method will be widely used throughout the State for stream corridors and for well fields.

Ground water quality and protection are extensively discussed in the Subtask 7C report and appendices. It described the hydrogeology of the principal aquifers of New Jersey and the availability of ground water. Additional sections include salt-water intrusion, regions where the ground water reservoir is stressed by pumping, and effects of ground water pumpage on surface water.

For an abbreviated perspective of some concerns and recommendations, the following excerpts are cited from that report:

> "Constraints on the future use of this resource will be caused by the impact of pumpage on streamflow, the severity of contamination from man's activities, and the economic and institutional feasibility of transporting ground water from undeveloped aquifer areas to water-short localities.
>
> "In some areas of heavy pumpage, such as eastern Monmouth and Ocean Counties, the development of surface-water sources to supplement ground water supplies will be necessary. Other overstressed areas, such as western Camden and northeastern Middlesex Counties, can be served by regional well fields located outside of the heavy demand centers.

"Urbanization and industrial activities have degraded ground water quality and will continue to limit the development of ground water resources. The discovery of heavy metals and organic chemicals in ground water supplies has forced the restriction and closing of public supply and domestic wells. Much of this contamination is related to land disposal of industrial waste and leaks and spills of petroleum products.

"... the continuing threat to public health from ground water contamination, and the potential loss over the next 20 years of an estimated 40 to 50 mgd of existing, potable ground water supplies due to local over-development and water quality degradation.

"Properly engineered sites for the land disposal of industrial waste must be developed immediately in both the northern and southern portions of the state.

"Future regional ground-water resource investigations should incorporate a number of land use/water-quality relationships.

"The state's ground-water monitoring activities must be completely restructured to answer critical water-supply and water-quality questions.

"New Jersey must provide adequate funding and staff commitments to assure that its ground-water resources can be properly managed and protected.

"Funds are urgently needed to prepare for and confront issues that will impact ground-water availability and quality, such as industrial and municipal waste management, the control and elimination of existing environmental abuses, and the development of regional ground-water supplies."

3E-4.4 Drought Effects and Modeling

The size of reservoirs and their reliability of supplying water under varying streamflow and demand conditions were estimated using a simulation model.

As detailed in the outputs of Amendment 1 - Task B and Subtask 5A, the statistical reliability of supplying water at the year 1976 demands is estimated for the existing source developments of each of the 25 major purveyor systems in the State. Those estimates are made by applying the Corps of Engineers HEC-5 computer simulation model to monthly conditions over the 50-year historical period (1928-78), which includes the two most severe droughts (in the 1930's and 1960's) and a number of lesser droughts (1976-77, for example).

The monthly streamflows and reservoir operating conditions of that 50-year historical period resulted in more monthly supply shortages in almost all cases, than did synthetic, random hydrologic conditions tested by the model. Therefore, the historical source conditions were determined as justifiable for purposes of this study.

The simulation analysis applied to existing source development facilities shows that 9 of the 17 major purveyor systems in Region 1 cannot meet their water demands equivalent to those of the year 1976 in all 600 months of the 50-year period. Therefore, these nine do not have 100% source reliability under the modeled conditions. Among the 9 systems in Region 1 that have significant deficits based on the modeling are those of the Hackensack Water Company, Jersey City and Newark, all of which are supplied from surface water sources.

In the other five planning regions of the State, the major purveyor systems were determined to be capable of meeting their 1976 demands at the 100% level of reliability under conditions of the modeled 50-year historical period.

The monthly, 50-year modeling simulation (Amendment 1 - Subtask 3C) was also applied to nine of the preferred future alternative projects and five watersheds (Subtask 7B) under varying water demand conditions. The resulting dependable yields (100% level of reliability) agree favorably with estimates of previous studies and are within accuracy limits of the estimating procedures and the given data.

It is emphasized that the previous studies generally used a much shorter period of analysis (the 1930's and 1960's drought) and in some cases, daily streamflow and reservoir release conditions. Differences in yield estimates of the simulation modeling and the previous studies are discussed in the modeling outputs of this Master Plan study.

Selection of water supply projects comprising the regional source development programs presented later in this report included consideration of project capabilities to provide the projected water needs of the region. Since water source yields are based on drought supply capability, it is expected that these programs would assure adequate water supply during drought periods without demand modification.

The determination of regional scenarios for water supply developments to meet the needs, is based on the dependable yields (100% level of reliability) from the Master Plan 50-year modeling simulation or from previous modeling, whichever yield is the lower for a specific project in order to provide a conservative approach for purposes of Subtask 3E regional analyses.

3E-5 INTERSTATE RIVERS

3E-5.1 Delaware River

The Delaware River is presently a major source of potable water for New Jersey. Direct abstraction occurs at the Bull's Island intake for the Delaware and Raritan Canal and at the City of Trenton intake. Indirect use through groundwater withdrawals occurs throughout the basin. It is not these present uses that are under discussion when consideration of development of the Delaware River is made. Details of various plans may be found in the output of Subtask 3D. Highlights of these plans follow.

Improvements in Delaware & Raritan Canal

This waterway is now used to withdraw up to 75 mgd from the river, most of which is exported from the river basin into Region 1. Present hydraulic restrictions limit actual annual average use to 47 mgd. Projects involving improved carrying capacity and balancing storage are in the preferred category.

The State's continual right to uncompensated withdrawals of Delaware River water for out of basin use is a point of controversy under the jurisdiction of the United States Supreme Court. Reservoir storage may be required in the future to provide compensating releases to the Delaware.

Tocks Island Lake Project (TILP)

Programs involving withdrawals of up to 300 mgd are anchored to Tocks Island or equivalent programs. Such an impoundment would be required to assure the necessary withdrawals plus releases to maintain minimum flows at the Trenton gage.

In its October, 1979 Level B Study, the Delaware River Basin Commission, an entity established by interstate compact among New Jersey,

New York, Pennsylvania, Delaware and the Federal Government, has developed three options involving Tocks Island;

> "Projects in the DRBC Comprehensive Plan --
>
> For the Mixed Objective Plan it is proposed to...
>
> retain the Tocks Island Lake Project in the DRBC Comprehensive Plan for consideration after the year 2000, and to approve inclusion of the middle Delaware River in the Comprehensive Plan as a scenic and recreational river at least until the year 2000..."
>
> "The National Economic Development Plan would be to keep Tocks in the Comprehensive Plan for construction by the year 2000."
>
> "The Environmental Quality Plan would be to drop Tocks now from the Comprehensive Plan and designate that section as a National Scenic and Recreational River."

The DRBC Level B Study final draft report states: "... The Mixed Objective Plan constitutes the most practical combination of policies, programs and projects of the other two plans and is the most likely basis for the final recommended plan by the Commission."

Many projects deal with distribution of the yield of TILP. The substantial bulk of that water would be marketed in Region 1. Projections indicate that the 2020 need in Region 1 is 203 mgd, about 2/3 of that possible from the project. However, Region 1 needs can be met without recourse to this project through the study period by available alternative projects.

Alternative Delaware River Withdrawals

Other major and minor projects have been advanced for consideration using Delaware Basin water. These include high flow skimming and impoundments on major tributaries. Where water is destined for export out of the basin, compensating releases would be called for unless part of the existing 100 mgd allotment could be transferred.

Not included in this category are projects for use within the basin such as an alternate supply for the city of Camden. Different regulations prevail for in-basin use of Delaware River water.

3E-5.2 Hudson River

The Hudson River presently contributes little to the water supply picture in New Jersey. The portion of the river serving as State boundary is a saline tidal estuary. There is a large potential for development of the upper reaches of the river as relatively little use has been made of it. New York City takes its water supply from the Croton System, the Catskill Rivers and the upper reaches of the Delaware. Much of the Hudson and its tributaries are not regulated.

Main Stem Projects

The NEWS Study, done under the auspices of the U. S. Corps of Engineers, includes projects utilizing Hudson River water for New Jersey. Since all these require the active cooperation of New York, institutional problems are abundant.

The projects are sized from 250 mgd to 500 mgd for New Jersey with coincident New York yields up to 800 mgd. The large capital investment required makes shared use mandatory to obtain unit costs competitive with alternates. (See Appendix 3D-II for discussion of projects 32, 33, 34, 35, 36 and 37.)

As a consequence, there are no institutional and financial possibilities for New Jersey to unilaterally pursue a Hudson River water supply.

Wallkill River

Over 200 square miles of the northern portion of Region 6 are in the Wallkill River Basin, which is part of the Hudson River drainage area. Proposed projects include both local use projects and those developed to export water to Region 1. All projects require letdowns to maintain minimum streamflows as required by both New York and New Jersey.

3E-5.3 Both or Neither River

The needs forecast for the State of New Jersey over the study period are of a magnitude (346.6 mgd in 2020) that it would be unnecessary to construct major projects on the rivers within the time frame. Since identified Hudson or Delaware River projects are generally of the 300 mgd size, it would not be necessary to support systems on both rivers.

3E-5.4 Planning Strategy

The strategy recommended for this Plan of water resources development calls for utilizing interstate waters insofar as possible while reserving intrastate water for future and, as yet, undetermined needs. However, since interstate water projects require extended periods of negotiation, review and planning, it follows that during the next few years water from within the State must be utilized until such time as the interstate water can be developed and brought on line. (Reference: Subtask 3D, pp. 30-36).

3E-6 REGIONAL PROGRAMS FOR SOURCE DEVELOPMENT

3E-6.1 Region One (Northeastern New Jersey)

Immediate development of new major water supply projects in Region I is necessary in order to overcome an estimated existing shortfall of 63 mgd and to provide for increased future needs. The preferred alternative projects in this region have a combined potential that can satisfy the needs through the year 2020 and for some time beyond. Therefore, Region One has flexibility of source development among alternative projects that offers two basic scenarios (combinations of projects) for meeting regional needs.

The immediate regional priority must be the elimination of the shortfall in supply. Water supply systems of Newark, Jersey City and the Hackensack Water Company are presently using water in excess of their safe yields. The most direct way to provide these systems with the necessary additional supplies is to construct the Two Bridges-Oradell Pipeline Project (#39, #40) being sponsored by the North Jersey District Water Supply Commission (NJDWSC) and the Hackensack Water Company. Although already approved by the State Water Policy Council, the project is under litigation. A lengthy delay in settling the case or a Court rejection of the project, would prevent the NJDWSC and Hackensack from supplying the sorely needed water in the near future. In that event, a viable alternative, but more expensive and institutionally complex, would be immediate construction of the Raritan-Passaic-Hackensack South Pipeline Project (#2) that would divert Raritan River Basin water to the northeast. A cheaper alternative is to reinforce purveyor systems (Project #2A) for use of some Raritan River water in the northeast part of Region 1, requiring arrangements for inter-purveyor transfer.

Therefore, the Two Bridges-Oradell Project and the Raritan Pipeline Project each form a base for water supply development scenarios in Region One. Alternatives which may be substituted within the scenarios are discussed in the following section. Ultimately, beyond the year 2020, development of all available water supply sources may become necessary, but the scenarios discussed here deal only with the planning period, 1980 to 2020.

Appropriate distribution of water supply projects is of great importance if Region One needs are to be met in a cost-effective manner. The region is about 70 miles long from north to south, and 50 miles wide. It is highly developed, particularly in the east. Water works facilities extend from upland water supply sources to the developed areas. To reduce costs, it is preferable to locate source developments close to the water demand centers, in proximity to existing systems, or to utilize instream transmission capabilities of rivers where appropriate.

Because attempts to match needs on a purveyor-by-purveyor basis, or on a county-by-county basis are inexact and can only approximate the complex regional planning situation, water needs are estimated for three geographical areas within the region. The three areas are:

North - Bergen, Passaic, Essex, Hudson and the northern half of Union County

West - Morris, the northern half of Somerset and those portions of Sussex and Hunterdon Counties in the region.

South - Middlesex, the southern halves of Union and Somerset, and those portions of Monmouth and Mercer Counties within the region.

While it is anticipated that local individual and community supplies will be developed to some extent in all areas of the region, the magnitude of such local supplies cannot be estimated confidently at this time. Therefore, the planning scenarios presented in this report exclude the effect of the local supply developments in meeting total regional water needs.

Three principal surface water sources are used in the Region 1 programs: the Passaic River, the Raritan River, and the Delaware River (up to an average of 100 mgd diverted through the Delaware and Raritan Canal). The various plans differ in the amount of water taken from each river, the time when projects begin operation, and their sequence of development.

A general location map of the source projects in the prime scenarios for Region One development is shown on Figure 3E-1. A description of the recommended and alternative programs follows.

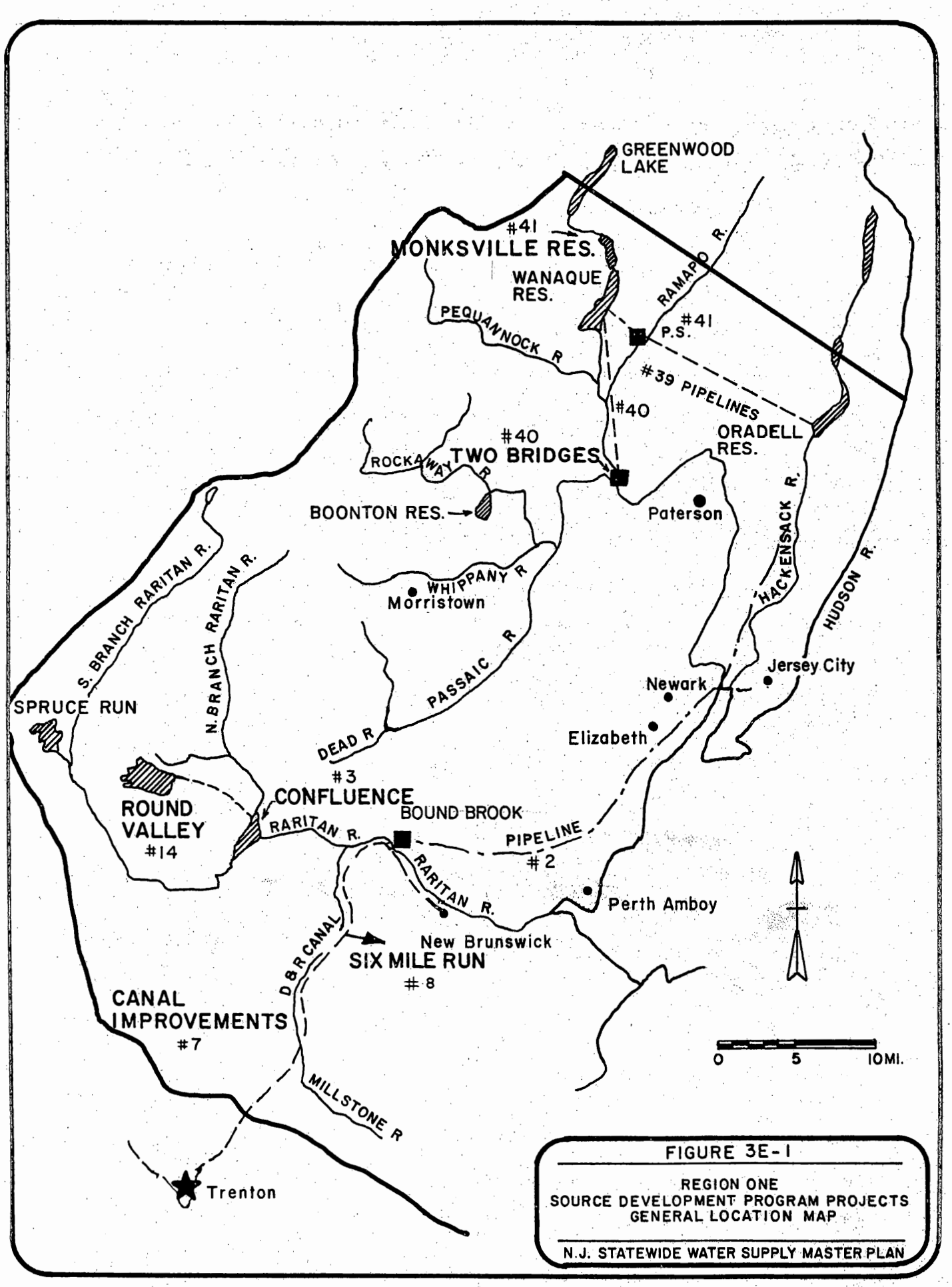


FIGURE 3E-1

REGION ONE
SOURCE DEVELOPMENT PROGRAM PROJECTS
GENERAL LOCATION MAP

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

6.1.1 Recommended Scenario - The recommended projects for Region One and their sequence of development are shown on Table 3E-6. The program is illustrated graphically on Figure 3E-2 in relation to the estimated needs for each of the three areas.

North Area - The Two Bridges/Oradell Pipeline Project should be undertaken as soon as the legal obstacles are overcome and preferably placed into operation by year 1985. A general location map of the project is shown on Figure 3E-3. The project yield of 79 mgd would be developed from additional Ramapo River pumping, pumping from the confluence of the Passaic and Pompton Rivers, and utilizing Wanaque Reservoir storage. Project water would be shared about equally by the NJDWSC and the Hackensack Water Company. Implementation of the Great Notch interconnection would allow large-scale transfer capability of project water as needed to four major water supply systems in this area: Hackensack Water Company, the Passaic Valley Water Commission, Newark and Jersey City. By 1995 additional treatment capacity of about 20 mgd would be provided for the Two Bridges project water.

Growing North Area needs would require a further source to be operable by 1995. It is recommended that water from the Raritan River Spruce Run-Round Valley system provide the additional water. In order to do this, instream transmission would be utilized for release from that system to the vicinity of Bound Brook where water would be withdrawn, treated and pumped to the northeast.

The diversion would be near or at the existing Elizabethtown Water Company's Raritan-Millstone Filter Plant. An intake and treatment capacity averaging 20 mgd would be required by 1995. Finished (treated) water would be pumped from there for a distance of approximately 22 miles to the Newark area with connection to water supply systems en route and from the Newark

TABLE 3E-6

Region 1 - Recommended Source Development Program

Sources and Projects	Initial Operation (year)	Estimated Construction Cost (1980 dollars, millions)
North Area:		
Passaic and Ramapo Rivers		
Two Bridges-Ramapo Diversion and Wanaque-Oradell Pipeline	1985	$ 66.1
*Treatment Facility (20 mgd)	1995	13.0
Subtotal:		$ 79.1
Raritan River (Spruce Run-Round Valley Surplus with Diversion from Bound Brook Area to Newark Area)		
Pumping Station and Pipeline	1995	$ 22.1
*Treatment Facility (20 mgd)	1995	13.0
Pumping Station Expansion	2005	2.1
*Treatment Facility Expansion (20 mgd)	2005	10.6
Subtotal:		$ 47.8
Total, North Area:		$126.9
West Area:		
Raritan River (Spruce Run-Round Valley Surplus with Diversion from Lamington/ North Branch Confluence Northward)		
Pumping Stations, Force Mains and Terminal Storage	1985	$ 14.4
*Treatment Facilities (20 mgd)	1985	13.0
Pumping Station Expansion	1995	1.3
*Treatment Facilities (7 mgd)	1995	5.6
Pumping Station Expansion and Additional Terminal Storage	2005	2.4
*Treatment Facilities (4 mgd)	2005	3.5
Total, West Area:		$ 40.2

*Anticipated ancillary facilities.

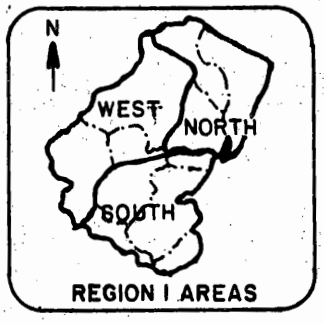
TABLE 3E-6 (Continued)

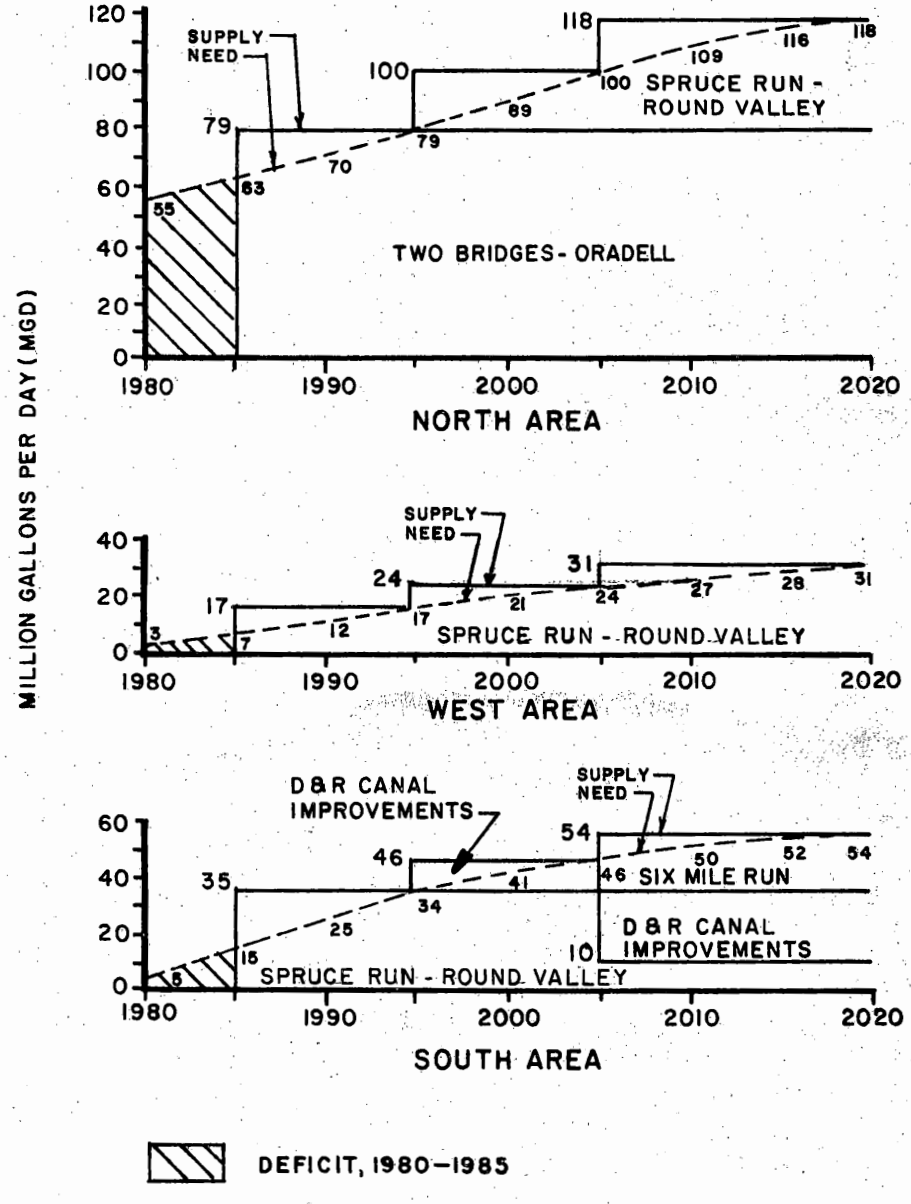
Sources and Projects	Initial Operation (year)	Estimated Construction Cost (1980 dollars, millions)
South Area:		
Delaware and Raritan Canal System		
Canal Improvements	1985	$ 3.7
*Pumping Station, Force Main and Treatment (20 mgd)	1985	18.9
Six Mile Run Reservoir	2010	27.1
Subtotal:		$ 49.7
Raritan River (Spruce Run-Round Valley Surplus with Diversion from Manville Area to D&R Canal)		
Pumping Station	1990	$ 1.1
*Treatment (20 mgd) and Pipeline	1990	17.8
Pumping Station Expansion	2000	1.1
*Treatment (14 mgd) and Pipeline	2000	11.9
Subtotal:		$ 31.9
Total South Area:		$ 81.6
Total, Region 1:		$248.7

*Anticipated ancillary facilities.

FIGURE 3E-2

REGION I
RECOMMENDED
SOURCE DEVELOPMENT PROGRAM





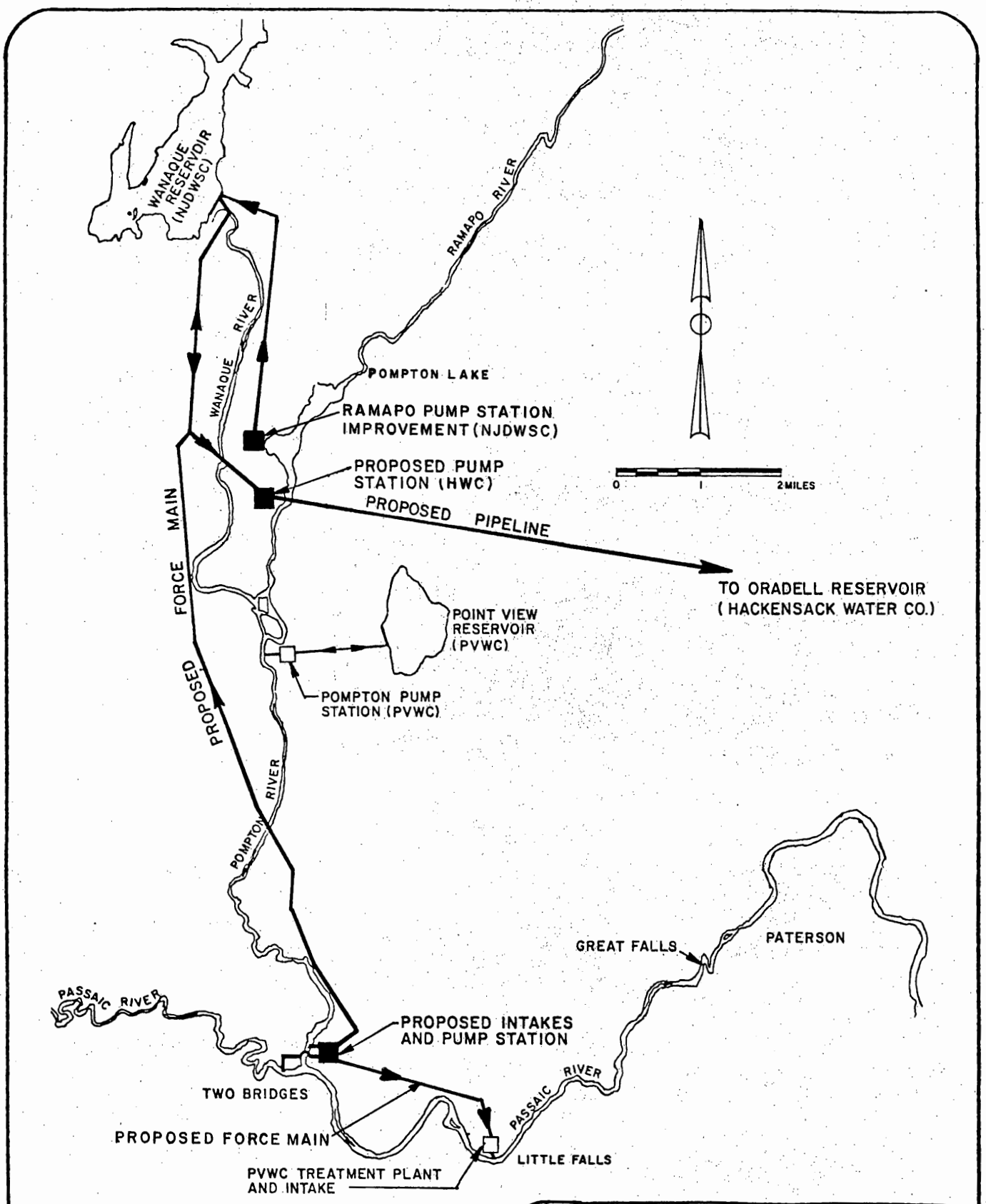


FIGURE 3E-3

TWO BRIDGES - RAMAPO DIVERSION AND WANAQUE ORADELL PIPELINE PROJECTS

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

area to other northeastern communities. A general location map of the project is shown on Figure 3E-4.

The combined sources of the Two Bridges/Oradell project from the northern part and the Raritan water from the northern part of the North Area would provide two-way regional supply which, together with appropriate interconnections and existing supplies, would have substantially greater flexibility of operation than presently possible among the area's purveyors.

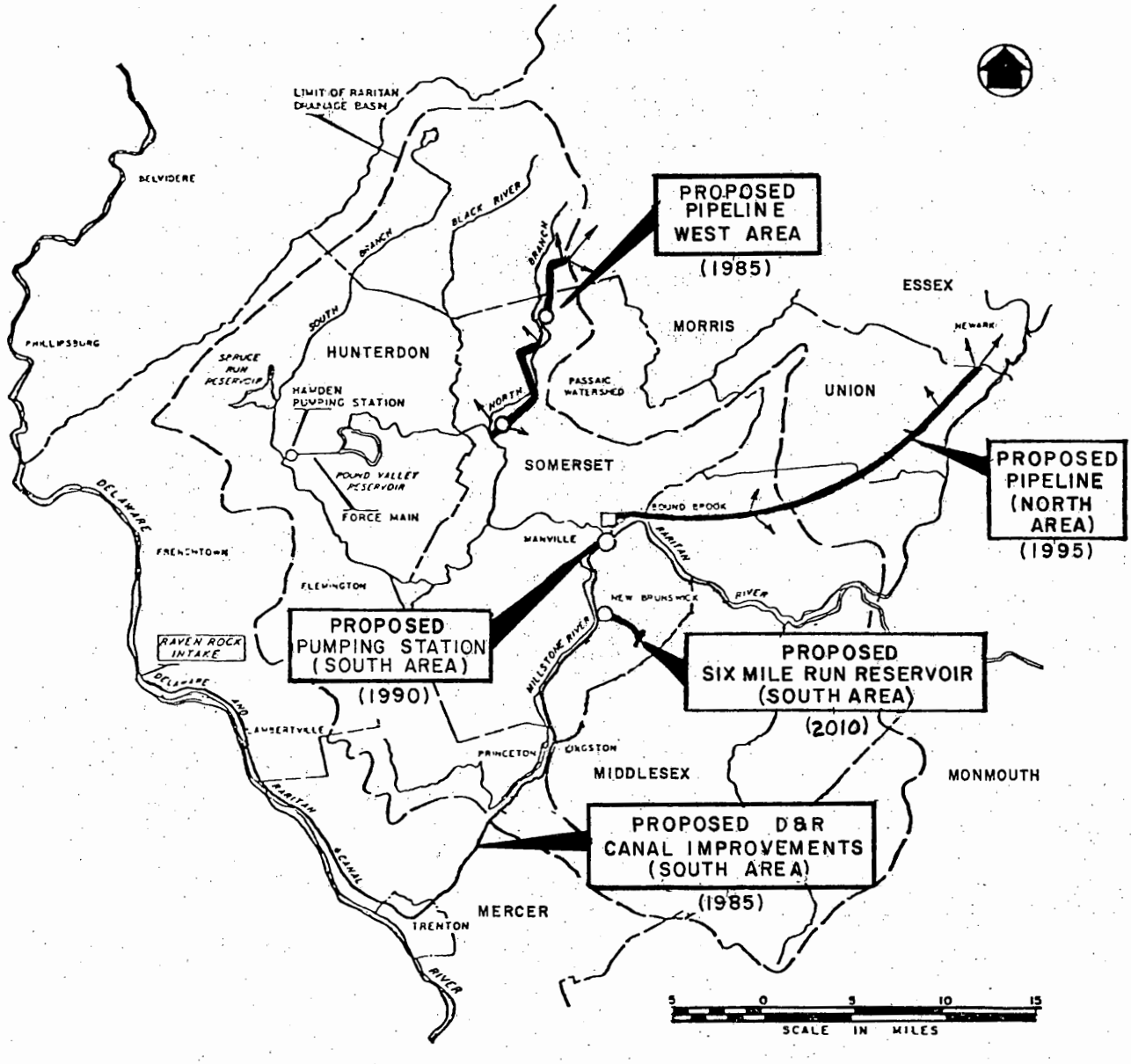
By the year 2005 expansion would be required of the Bound Brook treatment facility to a total of 40 -mgd capacity and pumping capability to about 50 mgd peak flow.

For present planning purposes, the project costs shown on Table 3E-6 for Raritan River supply to the North Area are based on construction of a single, 54-inch diameter pipeline for the Bound Brook-Newark area conveyance. It also assumes that the Bound Brook intake, treatment plant and pumping facilities would comprise a new water works and not an expansion of the existing Elizabethtown Water Company facility. However, significantly reduced construction and operating costs may be achieved by means of staged construction based on expanding the Elizabethtown Water Company's Raritan-Millstone facilities.

Also, the necessity of constructing a single, large pipeline from that vicinity to the Newark Area may possible be obviated, or at least deferred, by means of purveyors (Elizabethtown Water Company, Commonwealth Water Company, Elizabeth and Newark, as examples) reinforcing their conveyance capabilities in stages as needs dictate. The possibility also arises that smaller, multiple pipelines for conveying the Raritan water to systems in the North Area may be more economical than by constructing the single, large pipeline.

FIGURE 3E-4

RECOMMENDED DEVELOPMENT RARITAN RIVER AND D&R CANAL



LEGEND

- O INTAKE PUMPING STATION
- □ TREATMENT PLANT
- → CONCEPTUAL PIPELINE OR CONNECTION TO DEMAND CENTER

The transmission methods and transfer arrangements must be worked out by the affected purveyors with State planning coordination in order to establish the design and operating criteria for the initial operation in 1995 and the longer-term requirements.

The combination of 79 mgd from the Two Bridges/Oradell Pipeline project and 39 mgd of some 80 mgd available from the Raritan River, with appropriate intakes, pumping stations, treatment, transmission and transfer facilities, would meet North Area needs estimated to grow to about 118 mgd by the year 2020.

The additional Ramapo River pumping portion of the Two Bridges/Oradell Pipeline Project would provide about 17 mgd of the total 79 mgd by pumping to the Wanaque Reservoir. Construction of the Ramapo Pumping Station improvements for this supply appears to be prudent as an initial step in the project's development if acceptable to the NJDWSC, the Water Policy and Supply Council and other interested parties. Therefore, early operation of the pumping improvements could provide some early relief to the water supply deficit situation in the North Area of Region 1.

West Area - This part of Region 1 has greater distances between urbanized centers and less dense population than the other two areas of the region. Therefore, there are generally smaller water utilities and fewer opportunities for supply interconnections in this area, and local water supply development is relied on extensively. Such development includes small-scale withdrawals from headwater areas of the major streams, local groundwater systems, and small, existing impoundments. There are many individual water supply systems and relatively few water utilities in the West Area.

This area has substantial potential for land use development. While some of the water needs will be met by local development, there is an immediate need for new water supplies from expanding water utility systems. These supplies can be provided by limited use of water currently unused but available from the Spruce Run/Round Valley system on the Raritan River. Existing facilities have adequate capacity to withdraw immediate needs for a significant portion of the West Area from the Raritan, and treat, deliver or transfer the water through other systems. As the water needs increase in the future, the purveyors systems would require expansion to provide the additional treatment and delivery capacity. The Elizabethtown Water Company could provide this service from their Bound Brook plant in conjunction with the Commonwealth Water Company, the South Morris County Municipal Utility Authority (SMCMUA) and other purveyors in the area, provided that appropriate arrangements can be made among the affected purveyors with State planning coordination. However, until this possibility can be investigated in detail and confirmed, the recommended West Area program would utilize surplus Spruce Run/ Round Valley water with the following facilities starting no later than 1985.

The Spruce Run/Round Valley/North Branch pumping and pipeline system shown on Figure 3E-4 will have an initial average capacity of 17 mgd for immediate needs of the West area. The intake and pumping station will be constructed at or near the confluence of the Lamington River and the North Branch of the Raritan River. This station will utilize releases from the Round Valley Reservoir outlet pipe at Whitehouse Station, and runoff from the Lamington and North Branch drainage areas upstream of the pumping station. A 48-inch diameter force main will convey raw water about 7 miles to the existing Ravine Lake impoundment on the North Branch near Peapack-Gladstone. From there another pumping station and 48-inch diameter force main will boost the water another 7 miles to the Mendham area at the ridgeline of the Raritan and Passaic River basins. A terminal storage tank will be required at the end of the force main and water will be treated by receiving water utilities. About 7 mgd of additional pumping capacity will be needed by 1995. By 2005 pump station capacity will be increased by 7 mgd and a ground storage tank added at the pipeline terminus. Each tank would have about 5MG capacity.

Further development of the Alamatong Well Field may be considered for some of the local needs, even if reimbursement to the State for reduced flow at Bound Brook is required. Well field operation reduces surface flow in the Lamington River which contributes to Raritan River base flow at Bound Brook, and would necessitate equal releases from the Round Valley/Spruce Run complex. Obtaining water from a "Passaic Pool" through the facilities of Jersey City, Newark or the NJDWSC may also prove to be feasible.

South Area - This area can meet its estimated water needs for the next 40 years by use of the Delaware and Raritan Canal system, and Raritan River water.

The location and size of the individual facilities used herein for the South Area's source development are necessarily conceptual in nature because of the complexity of existing water supply systems, still unknown elements of potential groundwater development in the southeast part of the area, and the extent of detailed planning and coordination among effected parties that would be needed in order to provide a final facilities plan for implementation. There are many options for the physical arrangements, and the South Area program described here establishes a strong basis for subsequent detailed planning and implementation. With this proviso, the source development plan for the South Area is as follows:

By 1985 the Delaware and Raritan improvements will be completed to provide 25 mgd additional capacity. The improvements include dredging sediments, removing obstructing vegetation, and rehabilitating control gates and structures. The DEP already has preparations underway to accomplish this project. Treatment of the additional South Area water supplies would be accomplished by expanding existing plants and/or by constructing new treatment facilities.

The South Area would supplement its supply by about 1990 from Round Valley/Spruce Run/Raritan River water by constructing a pumping station near Manville with discharge to the Delaware and Raritan Canal. The initial average capacity will be about 16 mgd with expansion to a total of 25 mgd capacity by the year 2000. With the earlier Canal improvements, and a 90-inch diameter conduit recently completed in the Canal bed for a relocation project of Route 18 by the State Highway Department, adequate capacity will be available in the Canal to convey any required raw water

supplies southeastward for withdrawal and treatment by purveyors expanding their facilities in the New Brunswick area, such as by the New Brunswick Water Department and the Middlesex Water Company.

The Six Mile Run Project will be needed to supplement South Area supplies by about 2010 when all but 10 mgd of the available Spruce Run/Round Valley water will be in the North and West Areas as shown on Figure 3E-2. The project includes a dam on the Six Mile Run in Franklin Township with the reservoir extending into North Brunswick Township. A pumping station will be constructed downstream at the Delaware and Raritan Canal with a force main to be built between the Canal and Reservoir. High-water flow from the Canal will be pumped into the reservoir for storage and controlled releases back to the Canal. This pumped storage system has a maximum potential yield of about 28 mgd. The Six Mile Run drainage area at the dam has a yield of about 10 mgd; therefore, the total potential yield of the project is 38 mgd.

Much of the Monmouth County portion of Region 1 and the southeastern part of Middlesex County rely on groundwater supplies. These supplies may be augmented or replaced to some degree, by the Delaware and Raritan Canal water if necessary. Also, there is a possibility that some of the canal water may be conveyed to the northern part of Monmouth County in Region 2 if groundwater supplies there become seriously impacted by salinity intrusion or other forms of contamination.

The South River Groundwater Pumped Storage Diversion Project #80 is considered herein as a local project. Present use of South River by the industrial Duhernal Water System and by the Borough of Sayreville could be expanded by a relatively small, but locally significant amount. One method would install an appropriate tidal control structure at the South River Pumping Station of Sayreville in order to avoid salinity in the surface water.

The South Area has been growing rapidly in both population and economic activity. Present indications are that the area will continue its dynamic expansion. The water supply opportunities and needs will demand a highly flexible source development program as outlined above.

Cost Summary - The recommended source development program for Region 1 would have an estimated total construction cost of about $249 million at the 1980 cost level (ENR Construction Cost Index = 3100). Of this amount, about $116 million would be invested by 1985 as shown on the capital investment schedule of Table 3E-7. These estimated construction costs include project developments, treatment and conveyance to connections with water supply systems near major demand centers for purveyor system storage, distribution and delivery to their customers. These costs include estimated construction contracts, land acquisition, 25% for engineering and contingencies, plus 10% for financial, legal and administrative costs.

These costs do not include capital investments that purveyors would make for improving and extending their distribution system storage and water mains and the cost of providing adequate connections and interconnections.

TABLE 3E-7

REGION 1 - ESTIMATED CAPITAL INVESTMENT SCHEDULE
Recommended Source Development Program
(Millions of 1980 Dollars)

	1980 1985	1985 1990	1990 2000	2000 2010	2010 2020	Total
North Area	$ 66.1	$ -	$ 48.1	$ 12.7	-	$126.9
West Area	27.4	-	6.9	5.9	-	40.2
South Area	22.6	18.9	13.0	27.1	-	81.6
Total:	$116.1	$ 18.9	$ 68.0	$ 45.7	-	$248.7

Table 3E-7 combines the construction costs of the basic and ancillary facilities listed in Table 3E-6 to provide the total capital investment costs anticipated in various time periods in order to supply water to areas near receiving purveyor systems. The Table 3E-7 costs and the following estimated annual costs are also used to compare the Region 1 recommended scenario costs with those of the alternative scenario presented later in this report.

The estimated annual costs of the Region 1 recommended source development program for supplying the new water supplies to purveyor systems for their distribution to customers would vary with time and area because of the varying times and amounts of investment and water use during the 40-year planning period.

Based upon the project development schedule and estimated water needs presented earlier, Table 3E-8 shows the estimated average annual costs in dollars per million gallons at different times for each of the three planning areas of the region.

TABLE 3E-8

REGION 1 - ESTIMATED ANNUAL COSTS
Recommended Source Development Program
(Average $/MG, 1980 Dollars)

	1985 1990	1990 2000	2000 2010	2010 2020
North Area	$320	$380	$390	$380
West Area	975	710	635	605
South Area	465	480	450	555
Weighted Total:	$415	$450	$440	$460

The estimated annual costs include debt service retirement of capital investments at 7% interest over a 40-year bonding period, operation and maintenance. The cost of chemicals, materials, pumping energy (at 4¢/Kwhr plus a demand charge) and labor are included in the operation and maintenance costs. Also, Tables 3E-8 and 3E-11 include, for projects that utilize water from the Spruce Run/Round Valley System or the Delaware and Raritan Canal System, estimated prices for such water sales by the State Department of Environmental Protection based on current information that is subject to modification in the future.

6.1.2 Alternative Scenario - The recommended Region 1 source development program described in Section 3E-6 may be impeded by legal obstacles regarding the Two Bridges/Oradell Pipeline project. In that event, prompt construction of the project may not occur and the following program appears to be the most viable alternative as a result of regional analyses performed in Subtask 3E. This alternative program would have major dependence on Raritan River water for the North Area. The projects comprising this alternative and their sequence of development are listed on Table 3E-9, and illustrated on the graph of Figure 3E-5 relative to estimated water needs in the three areas of the region.

North Area - The Raritan/Passaic/Hackensack South Pipeline project (#2) would be constructed under a crash program for initial operation by the year 1985. The pipeline would extend from Bound Brook to the vicinity of the Meadowlands. Also, immediate design and construction for operation by 1985 would be necessary for river intake, treatment and pumping facilities in addition to the pipeline and its connections to purveyor systems along the route. This work, together with improved interconnection capacity among purveyors in much of the North Area, would be necessary for overcoming the estimated shortfall of 63 mgd in 1985 and meeting the total estimated need of 70 mgd in the area by 1990 and 79 mgd by 1995.

The pipeline would be utilized by purveyors along and near the pipeline route, including the major deficit purveyors of Newark, Jersey City and the Hackensack Water Company who could provide some of their upland supplies to other needy systems in the area.

TABLE 3E-9

Region 1 - Alternative Source Development Program

Sources and Projects	Developed Capacity (mgd)	Initial Operation (year)	Estimated Construction Cost (1980 dollars, millions)
North Area:			
Raritan River (Spruce Run-Round Valley Surplus with Diversion from Bound Brook Area)			
Treatment Facility	80	1985	$ 37.2
Pipeline	112	1985	53.9
Pumping Station	96	1985	6.4
Subtotal:			$ 97.5
Ramapo River-Wanaque System			
Monksville Reservoir with Ramapo Pumping Station	25	1995	$ 37.1
Raritan River (Spruce Run-Round Valley System with Diversion from Bound Brook Area)			
Round Valley Expansion	27*	2010	$ 23.0*
Total, North Area:			$157.6
West Area:			
Raritan River (Spruce Run-Round Valley Surplus with Diversion from Bound Brook Area)			
Treatment Facility (Temporary use of North Area facilities in Bound Brook Area)	10*	1985	*
Pipeline	36	1985	$ 15.9
Pumping Station	20	1985	1.6
Round Valley Expansion (shared with North Area)	*	2000	*
Subtotal:			$ 17.5*

TABLE 3E-9 (Continued)

Sources and Projects	Developed Capacity (mgd)	Initial Operation (year)	Estimated Construction Cost (1980 dollars, millions)
Delaware and Raritan Canal			
Six Mile Run Reservoir (shared with South Area)	*	1990	*
Treatment Facility	20	1990	$ 13.0
Treatment Facility	10	1995	7.5
Pumping Station	5	1995	1.0
Pumping Station	5	2005	1.0
Subtotal:			$ 22.5*
Whippany River			
Washington Valley Reservoir	7	2010	$ 18.6
Total, West Area:			$ 58.6*
South Area:			
Delaware and Raritan Canal			
Improvements	25	1985	$ 3.7
Treatment Facility	20	1985	13.0
Pipeline	22	1985	4.8
Pumping Station	22	1985	1.1
Six Mile Run Reservoir	38*	1990	27.5*
Treatment Facility	20	1995	13.0
Pipeline	22	1995	4.8
Pumping Station	22	1995	1.1
Treatment Facility	20	2005	13.0
Pipeline	22	2005	4.8
Pumping Station	22	2005	1.1
Total, South Area:			$ 87.9*
Total, Region 1:			$304.1

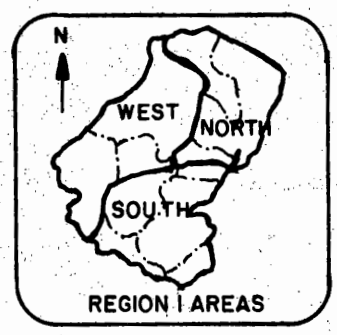
*Portion shared with another area. Shared project costs are recovered by user charges in proportion to water consumption quantity.

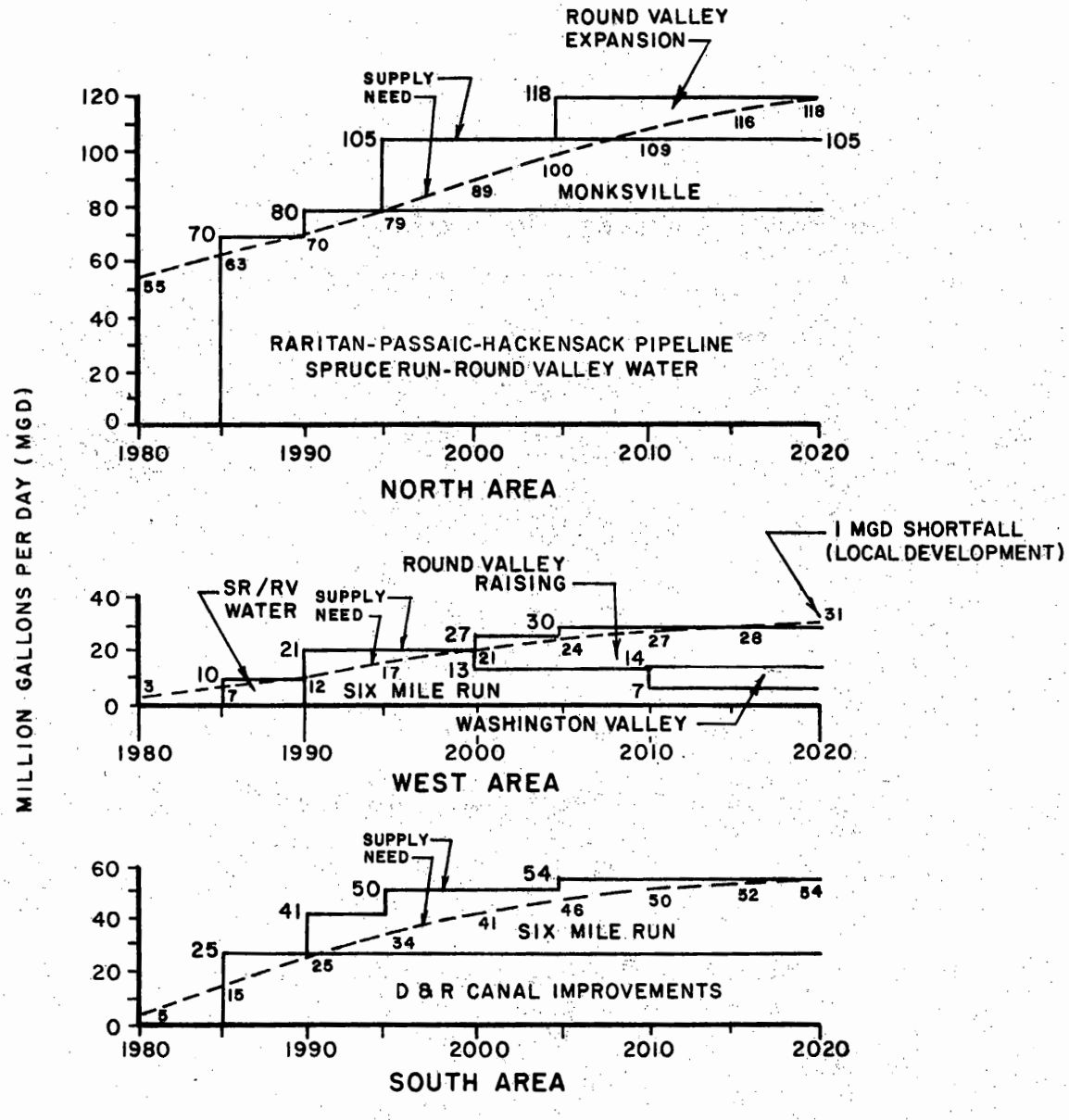
FIGURE 3E-5

REGION 1

ALTERNATIVE

SOURCE DEVELOPMENT PROGRAM





Reinforcement of existing purveyor systems (Project #2A) is a strong alternative to Project #2. The reinforcement project would provide treatment, pumping and transmission by the Elizabethtown Water Company from Bound Brook to other water utilities north of there. Internal system modifications for transmitting and distributing the water probably would be needed by a number of the utilities (Newark, for example) between Bround Brook and the Meadowlands area.

By 1995, the Monksville Reservoir and Ramapo Pump Station project would be constructed by the NJDWSC to supplement the Raritan River water used in the North Area. The Monksville site is upstream from Wanaque Reservoir and would yield up to about 25 mgd from a combination of direct streamflow to the reservoir, pumping from the Ramapo releases from the Wanaque storage reservoir, and the PVWC operation of its Point View Reservoir and Pomption River Pumping Station. The Monksville project would serve NJDWSC participants and provide additional water for transfer to other water utilities.

By 2005 additional source capacity needed for the North Area would be provided by construction of the Round Valley Expansion project and the intake, treatment and pumping facilities, which would have been initially operated in 1985. Transmission of up to about one-half of the 27-mgd Round Valley Expansion yield to the northeast would be through the Raritan-Passaic pipeline earlier provided.

West Area - In the alternative program, the West Area would rely on 10 mgd of the available 80 mgd Spruce Run/Round Valley surplus from 1985 until 1990 when all of that surplus would be needed in the North Area. Starting by 1990 Six Mile Run Reservoir water would be used for the West, followed by the Round Valley Expansion project by the year 2000 and the Washington Valley Reservoir by 2010.

The Raritan water for the West Area would be withdrawn and treated by expansion of the Elizabethtown Water Company's Millstone-Raritan plant. Transmission would be through existing and reinforced pipelines of Elizabethtown and other systems as the needs develop. West Area user charges would provide the revenues needed for treatment, pumping and transmission to their water utility systems.

The Washington Valley Reservoir project is in the South East Morris County Municipal Utilities Authority service area and operation, treatment and conveyance would most likely be provided by that agency. Construction and annual costs used in this study include the reservoir and its treatment.

South Area - In this alternative the South Area's additional needs would depend on completion of the Delaware and Raritan Canal Improvement project by 1985 followed by the Six Mile Run Reservoir project by 1990. No other significantly large source would be needed before the year 2020. Intakes, treatment, pumping and transmission facilities would be similar to those described in the recommended program for the South Area.

Cost Summary - The alternative source development program for Region 1 would have an estimated total construction cost of about $304 million at the 1980 cost level (ENR Construction Cost Index = 3100). Of this amount, about $151 million would be invested by 1985 as shown on the capital investment schedule of Table 3E-10. The estimated annual costs are on Table 3E-11. These costs were determined as described for the recommended program.

TABLE 3E-10

REGION 1 - ESTIMATED CAPITAL INVESTMENT SCHEDULE
Alternative Source Development Program
(Millions of 1980 Dollars)

	1980 1985	1985 1990	1990 2000	2000 2010	2010 2020	Total
North Area	$ 97.5	-	$ 37.1	$ 23.0	-	$157.6
West Area	30.5	-	8.5	19.6	-	58.6
South Area	22.6	$ 27.5	18.9	18.9	-	87.9
Total:	$150.6	$ 27.5	$ 64.5	$ 61.5	-	$304.1

TABLE 3E-11

REGION 1 - ESTIMATED ANNUAL COSTS
Alternative Source Development Program
(Average $/MG, 1980 Dollars)

	1985 1990	1990 2000	2000 2010	2010 2020
North Area	$470	$485	$460	$455
West Area	745	925	830	680
South Area	510	510	550	560
Weighted Total:	$505	$545	$535	$515

6.1.3 Substitute Programs

The alternative development program for Region 1 is based on the presumption that the Two Bridges/Oradell Pipeline project could not be built in a timely manner. If the Delaware and Raritan Canal use should be curtailed by legal action of another State having interests in Delaware River diversions, it would be possible to turn to other projects within New Jersey, but the costs and implementation schedule for meeting water supply needs would be seriously affected. Some of the possible substitute projects are:

The Confluence Reservoir, Pump Station and Force Main Project (#3) in Region 1 could provide 50 mgd. This project is substantially more costly than the Round Valley Expansion Project (#14), as indicated on Table 3E-3. Also, in the Subtask 3E regional cost analysis, the Confluence Reservoir project for water supply was determined to be significantly more expensive than the Round Valley Expansion selected for the alternative program.

However, there is a potential benefit of the Confluence project by using it also as a hydro-electric project by pumped storage between Round Valley and the Confluence Reservoirs. This possibility is under study by DEP and consultants. Results of that study by about the end of 1980 may indicate that the multi-purpose concept for the Confluence project would demand higher priority than if it developed only for water supply.

The Beaver Run, Franklin and Sussex North Reservoir Projects in the Wallkill River drainage area of the Hudson River Basin could provide a combined yield of at least 73 mgd for export to Region 1, provide releases to New York State, and have water available for local needs. These projects are energy intensive for pumping out of the basin to Region 1; therefore, they require water sales at a substantially greater cost than for example, the Delaware and Raritan Canal water.

These three reservoir projects could be used at some time after 2020 to meet needs in Region 1 and in their local areas. If it should become necessary to compensate Delaware River flow for the 100 mgd diversion to the canal, there are impoundment sites within the Delaware River Basin which could be developed for that purpose.

6.1.4 Great Notch Interconnection

Four large water suppliers own and operate major transmission facilities in close proximity to each other in a part of the Township of Little Falls, Passaic County known as Great Notch. These facilities are owned and operated by the NJDWSC, the Passaic Valley Water Commission, and the Jersey City and Newark Water Departments. Substantial water transfer is made among these systems at their Great Notch interconnections; however, increased capability and flexibility for transfer operations is necessary not only for their own customer requirements but also to permit additional water supply to many smaller systems.

It is recommended that detailed planning, and design be started in order to determine the specific physical and operational requirements for improving the Great Notch interconnections (Project #42) and prepare for construction immediately thereafter. Conditions and requirements should be determined for both emergency and continuous transfer through interconnections at Great Notch. It is presently anticipated that the necessary improvements will include, new or modified pipe, valves, pumping and storage facilities, operation guidelines and manuals, and appropriate controls and instrumentation.

The planning design and land acquisition for the improved major water exchange facilities in the Great Notch area are estimated to cost $4.2 million at present cost levels. Construction cost estimates would not be available until the planning and design work is completed.

3E-6.2 Region Two

Region Two consists of the entire Ocean County and most of Monmouth County. Those portions of Monmouth lying in the Millstone and South River Basins generally in an arc from the southwest to the north of Freehold are in Region One. Over 90% of Monmouth County's needs are associated with the area in Region Two.

The region is approximately 70 miles from north to south and up to 30 miles wide, but most of the developed land and water demands originate in a relatively narrow band between the Garden State Parkway and the Atlantic Ocean. Table 3E-5 shows an existing (1980) need of 12 mgd, 30 mgd in 1990, increasing to 50 mgd by the year 2020. These needs include allowances for unaccounted for water equal to those currently prevailing in the region. Impacting these annual average needs are the peak seasonal demands created by the large influx of people to the seashore in the summer.

In analyzing available options for major projects only the Upper and Lower Manasquan Reservoirs, project #76, can meet immediate regional needs. Ground water supplies are presently overtaxed in Monmouth and northern Ocean Counties. There is an immediate need for the Manasquan River Project. Land aquisition by the State has been completed and a "crash" program should be initiated to construct and put the project into operation as soon as possible. This is a two reservoir system. The lower impoundment would create a 100 million gallon reservoir on the main stem of the Manasquan River near Allaire State Park at the head of tidewater. This reservoir would permit a sustained yield of 10 mgd to be developed. The second reservoir would be an off-river pumped storage facility to receive seasonal excess flows. This reservoir would be near Oak Glen, have a five billion gallon storage capacity and offer a sustained yield of 25 mgd. The combined yield is 35 mgd. This water requires conventional treatment. While a treatment facility at each of the two reservoir sites

has been investigated, the urgent need for both reservoirs to be constructed immediately, makes a single treatment plant at the lower reservoir the most probable arrangement. The total estimated project cost is $33.6 million.

By about 1995 the Region 2 needs will begin to exceed the Manasquan Reservoir Project yield. Local ground water supplies, particularly in central and southern Ocean County, would be adequate for the subsequent needs. Some existing wells are overstressing aquifers in some parts of the region and any new wells must be planned, located, operated and protected in a rational and prudent manner so as not to cause further problems with the aquifers.

The success of the Manasquan Project depends upon wide subscription to its output. Benefits will accrue to ground water users in its service area who are not direct customers because of the lessening of stress conditions in the aquifers. The proposed reservoir project requires firm purchase commitments from purveyors and adequate transmission/distribution systems. It is essential for the overall welfare of the region that this water be used in the more populated regions of south Monmouth and north Ocean Counties, and that new well supplies be developed in the more isolated areas such as southern Ocean and western parts of both counties.

Region Two, particularly in the Bayshore Area (Raritan Bay) may eventually need supplemental supplies of surface water from the Raritan River system of Region One. This need has not manifested itself yet and may not if the aquifers are not overstressed. On-going investigations and groundwater modeling (discussed in Subtask 7C) are of great significance for proper development of subsurface supplies for Region 2.

Until the Manasquan River Project becomes operational, wells must be relied upon. New wells may provide an apparent surplus capacity when the reservoir project comes on line. Peak seasonal demands caused by summer vacationers can be met from these wells while base loads would be met from the new surface supply.

3E-6.3 Region Three

There is an estimated need of 5 mgd in 1980 in the Atlantic and Cape May County area. The needs are estimated at 16 mgd by the year 1990 and 22 mgd by 2020 (Table 3E-5). These needs are based upon State population and water use estimates (1979) assuming a medium growth pattern as recommended by the State. The estimate reflects anticipated impacts of casino and shore recreation activities.

Ground water resources in Region Three have sufficient potential to supply regional needs for the foreseeable future, and through the year 2020 if the presently estimated growth projections hold true. It is on this basis that new large well field projects and surface water developments are not recommended for the region during the next 40 years. However, if existing threats to ground water quality, such as from landfills near the Atlantic City mainland well fields, are not controlled, new major wellfields may be required.

Proper well development on a local level, however, is necessary and it is essential that efforts be made to avoid localized overpumping, such as has occurred in the Cape May area. New well fields will most likely be located farther from demand centers than at present. This will require longer transmission systems at increased cost, with some potential benefit available by using the transmission pipelines in conjunction with interconnections between water utility systems.

As reported in Task 3D, the realistic Region 3 projects available for future considerations are:

The South River Reservoir Project (#103) is on a tributary of the Great Egg Harbor River. The reservoir, two miles southwest of Lake Lenape, would be filled by natural streamflow of the tributary and by pumping from the Great Egg Harbor River to yield 69 mgd. The estimated capital cost is $32 million with annual costs of $3 million. The estimated cost per million gallons based on a 69-mgd yield is $120. These costs are at the 1980 cost level.

The Well Field in Wharton Tract Project (#132) in southeast New Jersey would consist of 23 wells installed in stages along the lower regions of the East and West Branches of the Wading River. The estimated project yield is 22 mgd. An intercepting pipeline would deliver water from the wells to a central point where a booster pumping station would then deliver the water to a transmission aqueduct. The estimated capital cost for this project is $28.4 million and the annual cost $3 million. The estimated cost per million gallons based on 22 mgd is $374.

The Burlington County East Zone Well Fields Project (#135) would include construction of two dams, one each on the Batsto and Wading Rivers. Fifty-eight wells would be installed to obtain the increased supply from the ground water aquifer and river infiltration. Water will be transmitted by aqueduct to coastal areas of Burlington and Atlantic Counties. The projected yield from this alternative is 113 mgd. The capital cost of this project is $126 million. Operational and maintenance costs are unavailable.

Growth conditions and forecasted water needs should be monitored and reexamined frequently and sites for the above-mentioned potential regional projects should be protected and preserved for future water supply development.

3E-6.4 Region Four

Cumberland and Salem Counties depend almost entirely on ground water for purveyor-supplied water. As shown on Table 3E-5, present supplies are adequate for the 1980 needs. The future needs are expected to be relatively small: increasing from about 2 mgd in 1990 to about 9 mgd by the year 2020. Self-supplied water is extensive, primarily from the Delaware River in the Tidewater area and from ground water inland.

The widely distributed needs of the two-county region can be met adequately by ground water development in appropriate locations if the self-supplied and purveyor-supplied ground waters are carefully monitored, and protected from contamination and new well developments are planned and operated to avoid adverse impacts in the ground and surface waters. The region's ground water situation and potential are discussed in the Subtask 7C report.

The Maurice River Basin offers a potential 6-mgd yield by stream diversion without the need for a storage reservoir. Detailed discussion of this is given in the Subtask 7B study report on watershed resource management. Such development would cost about $374,000. In comparison the study estimates that a 6-mgd well field development, at 1 mgd per well, would cost about $900,000 which would be more than twice the cost of the surface water development, however, groundwater development provides opportunities for accommodating needs in widely distributed areas.

3E.6.5 Region Five

This region, comprising all of Burlington, Camden and Gloucester Counties has an existing (1980) need of about 5 mgd. The needs are projected to grow to 15 mgd by 1990 and about 36 mgd by the year 2020. (Table 3E-5).

In addition to these needs, however, is the potential problem of salinity or other contamination in some well fields that require early relief by substitute supplies alone or in combination with groundwater recharge.

In this respect, the City of Camden may have to replace up to 10 mgd of its well supply in the near future. Overdrafting has lowered the water table to such an extent that poor quality Delaware water is reaching the wells by induced flow. Therefore, these wells are being subjected to quality impacts from the Delaware River which is highly vulnerable to contamination. In many other areas, aquifers are also subject to contamination from ground surfaces. The final draft report of the DRBC Level B Comprehensive Planning Study estimates that by the year 2000 the Camden wellfield water table will drop to 100 feet below sea level at an annual water use growth rate of 1% and to 160 feet at a 3% rate if no corrective action is taken.

Therefore, the City of Camden has an urgent need for water supply to supplement and help protect its groundwater sources. This need, and future needs, can be met by constructing the Delaware River Intake at Delanco Project (#140). This project would have a 25 mgd yield with an intake and treatment plant at Delanco about 10 miles northeast of Camden, and a transmission pipeline to the City's well field and distribution system. Other communities in the area could utilize this project also. The estimated construction cost of the Delanco Intake Project is $23.6 million.

Releases to the Delaware River from storage upstream of the diversion could provide sufficient flow augmentation to assure a dependable water supply to Camden and relieve overstressed groundwater sources. The Hackettstown Reservoir and other potential storage projects that could augment low flows in the Delaware River are discussed in the Region 6 recommended program later herein.

There are two other alternatives: development of groundwater from the Wharton Tract together with transportation and treatment (Project #131), and an interconnection with the City of Philadelphia across the Betsy Ross Bridge (Project #139).

The Philadelphia connection has been evaluated in this study as the least favorable project of the three. The other two appear to offer more acceptable solutions to Camden's needs. The outcome of the environmental impact evaluation in the sensitive pinelands of the Wharton Tract is uncertain. Similarly, the advisability of creating an inlet on the tidal Delaware without ancillary studies of salinity, upriver let down requirements, or alternative locations is questionable.

For both the Wharton and Delanco projects, broadening the participation to more purveyors would significantly reduce the unit costs involved. In addition, if the City of Camden ceases to over pump its groundwater source, other groundwater users in the vicinity would benefit. The resolution of these issues should be determined quickly by specific study.

Gloucester and Burlington Counties, as well as the rural portions of Camden County, require only development of local groundwater to meet their needs through the study period. Groundwater reserves are extensive in these areas.

3E-6.6 Region Six

This region consists of the entire Delaware River Basin Area in New Jersey north of Burlington County, plus the Wallkill River Basin. The existing need for additional supplies is about 4 mgd. The needs are expected to increase to about 11 mgd by 1990 and to about 27 mgd by the year 2020. These needs are relatively modest in comparison to the extensive water resource capabilities of the region.

Ground and surface water resources are very limited in Mercer and Hunterdon Counties. However, excess capacity in the Trenton municipal system can serve some of the needs of the area by extending transmission mains to centers of need. The Delaware River and the D&R Canal are available for in-basin use. Local sources and the Delaware River can be used for Warren County.

Considerations of a State-wide nature affect the water development in Region 6. The maintenance of flow in the Delaware River and diversion through the Delaware and Raritan Canal may require the construction of facilities to provide compensating letdowns in periods of low natural flows in the Delaware.

As discussed in the chapter on interstate rivers, during the next few years water from within the State must be utilized until such time as the interstate water can be developed and brought on line. A special case of an early potential for utilizing interstate waters and providing the necessary releases to mitigate any possible adverse impact for the Delanco diversion is the Hackettstown Reservoir Project which could provide a dependable yield of 40 mgd. This resource is in the Allamuchy State Park on the Musconetcong River about three miles upstream from Hackettstown.

The Hackettstown Reservoir has been considered for development for many years and the 1980 Level B Comprehensive Development Plan of the DRBC includes the project to assist in providing low flow augmentation of the Delaware River. It appears from work of the "good faith" committee of the Delaware River States that interstate agreement for construciton of the Hackettstown project could be achieved quickly.

With regard to local water supply needs, a study of the Musconetcong River Basin showed that sufficient supply can be diverted from the run-of-the-river to meet the year 2020 needs without recourse to a reservoir storage project. However, the Hackettstown Project could aid in preventing intrusion of saline tidal water from Delaware Bay upstream to Camden where groundwater quality is largely dependent upon the river's quality and would provide an adequate and reliable water supply for the Hackettstown area. Recreational opportunities from the Hackettstown Reservoir is an important additional benefit. The estimated construction cost of the Hackettstown Project is $47 million. This excludes the cost of protecting Waterloo Village. The DRBC Level B plan indicates that low flow augmentation of the Delaware River could also be provided by developing one or more storage reservoir sites in Pennsylvania. The DRBC estimated the Pennsylvania sites are at a lower cost per million gallons of flow than estimated for Hackettstown.

Therefore, a number of considerations and options for Delaware River streamflow augmentation and water supply for Camden must be weighed that are beyond the concerns of this study.

A decision to proceed with the Hackettstown Reservoir Project at this time is largely a matter of policy for the State. The Shades and Petersburg Reservoirs are possible alternatives for Delaware River flow augmentation but

these two projects require substantial pumping; therefore, they have higher cost per unit of water yield ($/mgd) than the Hackettstown project which would have gravity storage and would not require pumping.

The Wallkill River system in Sussex County is presently little developed and immediate needs within the area are small. The river has a reported potential yield of about 97 mgd, but that yield appears to be overestimated. A net yield of 75 mgd from the system is suggested for planning purposes. This large potential may be developed only by pumped storage. It is necessary to retain availability of identified sites to realize this potential, probably for supplying Region 1 in the distant future. Since out-of-basin use of the Wallkill System would also require additional pumping over basin divides, such energy intensive steps should not be taken until other measures are fully developed. Also, the Wallkill River is tributary to the Hudson River in New York State, and requirements between the States have not been clarified.

Local water supply needs in the Wallkill Basin are expected to be 5 mgd by 2020. If a reservoir becomes necessary, the Beaver Run Reservoir site appears most suitable. This site has potential for later expansion if desired, to about 28 mgd for water supply and streamflow augmentation.

The Merrill Creek Reservoir project (#105) is not for potable water supply development, but it would serve to replace water in the Delaware River diverted for cooling purposes in the generation of electric energy. The Merrill Creek project is included in the DRBC Level B Comprehensive Plan as an electrical utility project for maintaining a minimum flow of 3,000 cfs at Trenton. The utility companies are expected to finance, build and operate the project.

3E-6.7 Deferred Acceptable Projects

Projects that are classed as preferred but not selected for regional programs within the Master Plan time frame include the following:

Longwood Valley Reservoirs #44 - This project has been rated favorably as a water supply project; however, because of high development costs, alternative methods of achieving an equivalent output are preferred. Several modes of development have been proposed for Longwood Valley. The project can use both an upper and lower reservoir for a pumped storage power project in addition to water supply, a lower reservoir for only water supply, or use both reservoirs for only water supply. The maximum dependable water supply yield is about 11 mgd. With development of the recommended or alternative scenario, water from this project would not be needed until after the year 2020, but if possible, the site should be kept in public ownership to allow for the ultimate development. Further studies are warranted, including investigation of streamflow augmentation possibilities at a reduced project scope, use of the water for local supplies and reexamination of power development and project estimated costs.

Shades Reservoir #65 - The primary purpose of this pump storage facility would be to provide compensatory letdowns to the Delaware River if required in the future by the U.S. Supreme Court to offset water withdrawn from the basin by the Delaware and Raritan Canal. Reservoir water would be released to the Pequest River.

Both the Hackettstown Reservoir #56 and the Petersburg Reservoir #66 would perform similar functions. Hackettstown, on the Musconetcong River is the larger, and would also serve as a local water supply. The Petersburg project is near and similar to the Shades project, and those projects are expected to operate in tandem. It is considered unlikely that all three of these reservoirs would be needed in the near future. The

Hackettstown and Petersburg projects have significantly lower cost than the Shades project.

Hackensack River Optimization #77 - When first proposed, this project in its entirety was anticipated to yield 15 mgd on a dependable basis. Certain aspects of the project have been constructed by the Hackensack Water Company, reducing the future potential yield of the project by about 50 percent. It does not appear cost-effective to implement the last stages of the project because of the high unit costs and energy intensiveness of storage and pumping systems that would be required. Either the Two Bridges/Oradell Pipeline or the Raritan/Passaic/Hackensack Pipeline projects are preferred to relieve water short conditions in the Hackensack area.

3E-7 SENSITIVITY OF PROGRAMS TO GROWTH CONDITIONS

This part of the Task 3E report assesses the flexibility of the proposed regional water supply programs to meet changes in demand due to unanticipated high or low growth conditions. The analysis is based on a comparison of needs* by region as they would vary under the high, middle and low range forecasts of freshwater use prepared under Task 2A and subsequently adjusted by the State. The comparison of needs under different growth conditions is then juxtaposed against the proposed regional programs. Flexibility is determined by the number and timing of decision points concerning the implementation of specific water supply projects. Those programs that permit periodic reassessment of demand and needed supply are considered better able to respond to unanticipated growth conditions than those that have only a limited number of decision points.

Of particular importance in this analysis was the relationship of the expected yields of the proposed programs to demands created under "trend-breaking" growth conditions. This term was used in the Task 2B/2C report to describe potential changes in land use or economic activities that could significantly alter baseline projections of regional population, industrial activity and water demand. Some of the information in the Task 2B/2C Report has been updated from 1977 as part of this task.

*The middle range needs projections used are those given in the "Interim Output, Suggested 5-Year Program - Water Supply," December 1979. The high range is 10% above, and the low 10% below the middle range needs shown on Table 3E-5.

3E-7.1 Region 1

This region alone will account for almost 60 percent of the anticipated fresh water needs of the State in 1990, 2000, and 2020 (middle-range forecasts). Both the recommended and the alternative programs will meet the middle (and, of course, low-range) growth forecasts.

As described in the Task 2B/2C report land use development in the Hackensack Meadowlands and the Pequannock Watershed could serve to disrupt growth trends for the region if for some reason either area developed at a pace currently unforeseen. The source of data for the forecasted growth of the former area is the Meadowlands Commission's Master Plan published in 1972. Representatives of the Commission's staff confirm that the plan still is valid and that it has undergone only minor changes over the intervening period. This is also true for the population and employment projections included in the plan.

The impact of development of the Pequannock Watershed is still somewhat difficult to estimate with confidence because the zoning changes necessary to permit more intensive development of the area must be obtained piecemeal and these changes have encountered serious opposition from the affected localities. The population projections used to estimate residential water needs do assume a fairly high growth rate for those counties, parts of which make up the Pequannock Watershed. For example, a 32 percent increase between 1975 and 2000 is forecasted for Morris County's population (to 520,000 in 2000). Passaic County is expected to grow by 11 percent over the same period (to 520,000 in 2000); and the population of Sussex County is expected to increase by 66 percent (to 164,300 in 2000).

As already noted the proposed supply programs can meet the anticipated demands for the middle and high range forecasts. Unless growth in the Pequannock area greatly exceeds the estimate of 12,000 additional residents

over the next 30 years (The Pequannock Watershed Conservation and Development Plan, 1975), the Region 1 program should be able to accomodate this increase. Because the recommended and alternative Region 1 programs both depend on several different sources of supply, and because the projects' development is to be phased over a period of 25 years, they are flexible enough to be altered if the growth outlook changes substantially.

If water needs rise according to the high growth rate forecast, about 223 mgd of new supplies will be needed by the year 2020, compared to the proposed development program capability of 213 to 215 mgd. Therefore, the high trend would require developing about 10 mgd more source capability than the medium trend. According to the information on Table 3E-3, the Round Valley Reservoir Expansion Project #14 appears to be the most cost-effective available alternative for that additional supply which would be needed by about year 2010 with the high trend growth.

Also, for the high trend needs in the North Area, the use of available water from the Round Valley/Spruce Run system could be started by about year 2000 instead of the recommended program's year 2005 in order to avoid a shortfall during that period. Similarly, if the high growth rate occurs, the alternative program would start use of Confluence water by 2000 instead of year 2005 as is forecast with the middle growth rate.

The high and low growth trends would not affect the programs for the West Area of the region except for slight adjustment of the dates when additional intake and treatment capacity would be necessary. In the South Area, the schedule for increased use of Six Mile Run water from year 2000 could be advanced or retarded depending upon the actual needs and growth forecasts of that time.

3E-7.2 Region Two

The proposed water supply source development program for this region consists of immediate construction of the Manasquan Reservoirs project supplemented by local development in other areas of the region as required. The 35 mgd yield of the reservoir project is sufficient until about year 2010 under the low growth condition, until about 1995 with middle range growth, and approximately 1993 if the high rate occurs. After those years, local ground water is expected to provide the balance of the water needs: 10 mgd with low growth, 15 mgd with middle range growth and 20 mgd at the high rate.

In the event that sufficient ground water can not meet those supplemental needs without excessive stress on aquifers, possibilities for the additional supply would be some water from the Delaware and Raritan Canal system and/or some ground water from southeastern Middlesex County and the western part of Monmouth County in Region 1 through appropriate transmission and treatment facilities that would become necessary for such transfers.

3E-7.3 Region 3

Task 2B/2C highlighted the advent of casino gambling to Atlantic City as a possible trendbreaking condition. It appears that the population growth forecasted for Atlantic County, even under the middle range projection, sufficiently reflects the anticipated effects of the casinos on the water demand in the area.

Until the first casino opened in 1978, population in the City had been on the decline for over a decade. In addition, many hotels had closed their doors due to diminishing patronage. Despite the success of the three new casinos built over the last two years and the expected frantic pace of construction over the next five years or so, the net number of new hotel rooms is not great. (However, the occupancy rate has probably increased.) This is due to the significant amount of demolition of old hotels, and residential and commercial properties required to make room for the new buildings. For the same reason the permanent residential population has probably not grown significantly as yet.

Also, although there is evidence of significant development pressure in other communities in Atlantic and Cape May Counties -- only partially related to the changes in Atlantic City -- land use development in much of the region has been restrained recently by environmental protection requirements of the Coastal Facilities Review Act and the Pine Barrens Review. Compatability of new development with the established environmental goals are likely to result in continued constraints on growth.

The demand projections for the region appear, then, to adequately consider anticipated growth in Atlantic County. (A 61 percent increase in population in Region 3 is projected to occur between 1975 and 2000 under the middle range forecasts.)

3E-7.4 Region Four

The proposed program for Cumberland and Salem Counties calls for local well development to meet the incremental demand of 9 mgd expected by 2020 under middle range growth conditions. If low range growth conditions develop, the number of local wells to be constructed can be scaled down to more closely reflect lower demand than expected under the middle range projections. The high range growth condition is expected to require needs for only about 10 mgd by 2020.

Other factors that might affect water demand in Region 4 are a new Delaware River crossing south of the existing twin bridges at Deepwater, and development along the coast. At this time, a new bridge seems unlikely for the foreseeable future, because of its great expense in comparison to recent estimates of relatively low traffic volumes for such a crossing thereby eliminating the one stimulus to "trendbreaking" growth in the region. Constraints on development in the coastal zones of the region are also likely to prevent unanticipated growth above that which can be accommodated by locally-developed water sources.

3E-7.5 Region Five

The three alternative projects for Camden and possibly other communities using either a Delaware River Intake at Delanco, the Wharton Tract or Philadelphia water could be developed for the needs of any of the three growth rate conditions, ranging from 33 to 40 mgd from the low to high conditions. The remainder of the region would depend largely on new ground water development to meet their needs.

The alternative projects as presently envisioned, would provide about 25 mgd for needs of the City of Camden. With additional users, the selected project would be designed for greater capacity with consequent economies of scale. With an expanded project, the new ground water requirements would be reduced accordingly, with less potential for stressed aquifers.

3E-7.6 Region 6

The program for Region 6 recommends two projects, the Hackettstown Reservoir and the Beaver Run Reservoir, with other regional needs to be met by local ground water developments and local use of Delaware River Water.

This program would be adequate to supply required needs ranging from 24 to 30 mgd by the year 2020, under the respective low to high growth conditions.

If currently anticipated local well development takes place, available capacity by 1990 will be 4.6 times anticipated demand, by 2000 capacity will be 2.8 times demand and, in 2020, it will be 1.9 times demand as estimated under the middle range forecasts.

3E-8 REANALYSIS OF SITE ACQUISITION DECISIONS

The Task 3D report covered the site selection acquisition extensively in Section 3D-5, and the reader is referred to it.

Fundamental to any reservoir project is having title to the necessary lands. Where a need is anticipated to develop in the future, preserving a site now will prevent it from being lost for reservoir use. This can be done by outright purchase of land, options or development rights.

It is not recommended that all potential sites be acquired at this time, but that certain near-term use sites be acquired, and others reserved. The status of other sites should be monitored to allow the State to take appropriate action as may become necessary in the future.

Properties that are in excess of water supply needs should be relinquished and not be an encumberance on the State's water supply funding.

Projects related to the Wharton Tract and Round Valley expansion require no land takings; these properties now being in the State's hands. Any lands needed for D&R Canal refurbishment (excluding Six Mile Run) are relatively minor in nature and steps to obtain them should be taken as soon as necessary.

Table 3E-12 shows recommended actions for realistic projects. The indicated acquisition status and approximate acreage are from State information. Estimated costs of site acquisitions are being updated by the State. Table 3E-13 lists sites that should be considered for acquisition in the event preferred sites are not available. At a minimum of five-year intervals, the availability of sites should be reviewed and decision made to strike the site, acquire it, or continue no action for its acquisition.

TABLE 3E-12

RECOMMENDED PROGRAM FOR STATE ACQUISITION OF WATER SUPPLY SITES

Project Number and Name	Acres	Acquired To Date	Remarks
76 - Manasquan Reservoirs	1,356	100%(1)	Hold until used
3 - Confluence Reservoir	688	95%(1)	Complete acquisition immediately
8 - Six Mile Run	3,128	90%(1)	Complete acquisition immediately
56 - Hackettstown	1,436	45%(1)	Complete as either State park or reservoir site
12 - South River Tidal Dam	600	6%(1)	Not needed as water supply project
27 - Two Bridges/Myers Road	3,391		Not needed as water supply project
74 - Sussex North	1,270	-	Acquire site in timely manner
72 - Franklin	1,400	-	Acquire site in timely manner
73 - Beaver Run	1,525	-	Acquire site in timely manner
60 - Ross Corner	1,330	-	Acquire site in timely manner
66 - Petersburg	715	-	Subject to State determination
43 - Washington Valley	750	100%(2)	Owned by Morris MUA
44 - Longwood Valley	670(Reservoir)		Substantially owned by Jersey City
41 - Monksville	500(Reservoir)	90%	Publicly owned - State Park. Hold until needed
65 - Shades	800	100%(2)	Located in Jenny Jump State Forest
67 - Honey Run	4,425	-	Reinvestigate obtaining after 1990
103 - South River	5,200	-	Reinvestigate obtaining after 1990 or in trend-breaking situation
16 - Hackelbarney	NA	100%(2)	In State Park

(1) Data date 1976 - owned by State of New Jersey for water supply.

(2) Owned by public entity.

TABLE 3E-13

OTHER POTENTIAL SITE ACQUISITIONS

Project Number and Name	Remarks
17 - Ravine Lake	-
25 - Bartley Reservoir	940 acres
46 - Dunkers Pond	-
48 - Hardscrabble	1,500 acres
81 - Weldon Brook	Local supply
86 - Toms River	840 acres
116 - Frenchtown	2,200 acres

Rights-of-Way acquisitions for pipelines are more flexible than for reservoirs and alternate routes are often acceptable. Many pipelines can be constructed in existing public lands or rights-of-way such as along roadways. Land easements without ownership are possible to construct and maintain pipe.

Surveys of the route for the Raritan-Passaic-Hackensack Pipeline, Project #2, should be undertaken as soon as possible to establish needs for land. Other rights-of-way can be deferred until specific needs develop.

Existing routes such as along the old New York Susquehanna and Western Railroad bed in northwest New Jersey suggested as part of a Dunkers Pond project have a potential use as a supply route in the future.

3E-9 WATER RESOURCES BANK PROJECTS

The 65 realistic water supply alternatives listed on Table 3E-2 comprise a valuable "Water Resources Bank" that has the potential for meeting New Jersey's water needs far in the future, long beyond the year 2020. Many of these projects are dependent on the same source; therefore, they could become unrealistic and deleted from the list if the source is utilized by another project. For example, if the Raritan-Passaic Pipeline #2 is implemented to full potential capacity of the Raritan River water supply, then alternatives #1 and #2A would be dropped from the Water Resources Bank.

Projects would also be deleted from the list if future planning determines that the particular project is no longer considered feasible or it is not needed for water supply.

Until such time that deletion from the list can be justified, the Water Resources Bank project sites should remain in consideration for potential water supply development. It is suggested that County Planning Boards assist the Division of Water Resources in the site preservation and review process.

Projects included in the recommended regional programs are included in the "Water Resources Bank" until they are actually developed.

SUBTASK 3F

PRESENTATION AND SUMMARY

OF

REGIONAL WATER SUPPLY DEVELOPMENT

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TASK 3F - PRESENTATION AND SUMMARY

OF

REGIONAL WATER SUPPLY DEVELOPMENT PROGRAMS

3F-1 INTRODUCTION

1.1 Needs

Under drought conditions such as occurred in New Jersey in the 1960's, the State would experience a shortage (shortfall) of about 89 million gallons per day (MGD) at the present level of water consumption. By the year 2020 the shortfall would total about 347 mgd according to projected demands and the presently developed source capacity.

About 70 percent of the water demands and approximately an equal amount of the present shortfall occurs in the heavily populated and highly industrialized northeast which the State designates as Region 1 for purposes of water supply planning. The balance of the Statewide demands and shortfall is in four of the other five planning regions. The exception is in the Salem and Cumberland County area which comprises Region 4, but even there the growing demands will soon exceed the developed source capacity. By the year 2020, the estimated New Jersey needs will increase to about 347 mgd with the five other regions of the State having 41 percent of that need.

Clearly, new source development is urgently needed Statewide. Prudent and timely water supply improvements can avoid serious restrictions and economic losses when the next drought comes.

1.2 Regional Program Planning

Since a major portion of the total regional demand for purveyor-supplied water is supplied by the 25 largest purveyor systems in the State, regional programs for development of new resources may appear to focus primarily on

delivering water to these purveyors. However, the intent of each regional program for development of new resources is to provide water for all areas having a demonstrated need.

It is anticipated that local individual and purveyor supplies may be developed to some extent in all six planning regions, but the magnitude of such development cannot be confident at this time. Therefore, the regional programs exclude the effect of local development in meeting total regional water needs.

The recommended regional programs are described in the attached Subtask 3E output and the physical program elements of the programs are summarized herein with respect to the program projects, their estimated costs and timing, and site acquisition.

An immediate and intensive major capital improvement effort for water resources development is necessary in order to get projects operational to overcome the water supply deficits by 1985 if possible. Substantial but less intensive on-going effort will be needed after that to meet the growing water demands by project expansions and additional projects.

The Task 3E output also discusses methodology for developing the programs, determining water needs, and interstate water resources of the Delaware and Hudson Rivers. Further, that task provides alternatives to regional programs, and discusses program sensitivity to low and high-growth rate conditions compared to the medium-rate used for the program planning. Also, it presents a re-analysis of site acquisition decisions and guidance for establishing a "Water Resources Bank" of potential projects for future development even for beyond the 2020 horizon of the present study.

The strategy recommended for this Plan of water resources development calls for utilizing interstate waters insofar as possible while reserving intrastate water for future and, as yet, undetermined needs. However, since interstate water projects require extended periods of negotiation, review and planning, dependence upon water resources from within the State will be required until such time as the interstate water can be developed and brought on line.

3F-2 RECOMMENDED REGIONAL PROGRAMS

2.1 Region One (Northeastern New Jersey)

Immediate development of new major water supply projects in Region 1 is necessary in order to overcome an estimated existing shortfall of 63 mgd and to provide for increased future needs. Water supply systems of Newark, Jersey City and the Hackensack Water Company are presently using water in excess of their safe yields. The recommended and most direct way to provide these systems with the necessary additional supplies is to construct the Two Bridges-Oradell Pipeline Project (#39, #40) being sponsored by the North Jersey District Water Supply Commission (NJDWSC) and the Hackensack Water Company. Although already approved by the State Water Policy Council, the project is under litigation. A lengthy delay in settling the case or a Court rejection of the project, would prevent the NJDWSC and Hackensack from supplying the sorely needed water in the near future.

In that event, a viable alternative, but more expensive and institutionally complex, would be immediate construction of the Raritan-Passaic-Hackensack South Pipeline Project (#2) that would divert Raritan River Basin water to the northeast. That pipeline project is discussed in Task 3E in an alternative program for Region 1. To reduce costs, it is preferable to locate source developments close to the water demand centers, in proximity to existing systems, or to utilize instream transmission capabilities of rivers where appropriate.

Because attempts to match needs on a purveyor-by-purveyor basis, or on a county-by-county basis are inexact and can only approximate the complex regional planning situation, water needs are estimated for three geographical areas within the region and the regional development plan addresses these three areas.

North - Bergen, Passaic, Essex, Hudson and the northern half of Union County

West - Morris, the northern half of Somerset and those portions of Sussex and Hunterdon Counties in the region.

South - Middlesex, the southern halves of Union and Somerset, and those portions of Monmouth and Mercer Counties within the region.

Three principal surface water sources are used in the recommended Region 1 program: The Passaic River, the Raritan River, and the Delaware River via the Delaware and Raritan Canal. The recommended projects for Region 1 and their sequence of development are shown on Table 3F-1. The program is illustrated graphically on Figure 3F-1 in relation to the estimated needs for each of the three areas.

North Area - The Two Bridges/Oradell Pipeline Project should be undertaken as soon as the legal obstacles are overcome and preferably placed into operation by year 1985. The project yield of 79 mgd would be developed from additional Ramapo River pumping, pumping from the confluence of the Passaic and Pompton Rivers, and utilizing Wanaque Reservoir storage. Project water would be shared about equally by the NJDWSC and the Hackensack Water Company. Implementation of the Great Notch interconnection would allow large-scale transfer capability of project water as needed to four major water supply systems in this area: Hackensack Water Company, the Passaic Valley Water Commission, Newark and Jersey City.

Growing North Area needs would require a further source to be operable by 1995. It is recommended that water from the Raritan River Spruce Run-Round Valley system provide the additional water. In order to do this, instream transmission would be utilized for release from that system to the vicinity of Bound Brook where water would be withdrawn, treated and pumped to the northeast.

The diversion would be near or at the existing Elizabethtown Water Company's Raritan-Millstone Filter Plant. Finished (treated) water would be pumped from there 22 miles by pipeline to the Newark area with connections to water supply systems en route and from the Newark area to other northeastern communities.

TABLE 3F-1

Region 1 - Recommended Source Development Program

Sources and Projects	Initial Operation (year)	Estimated Construction Cost (1980 dollars, millions)
North Area:		
Passaic and Ramapo Rivers		
Two Bridges-Ramapo Diversion and Wanaque-Oradell Pipeline	1985	$ 66.1
*Treatment Facility (20 mgd)	1995	13.0
Subtotal:		$ 79.1
Raritan River (Spruce Run-Round Valley Surplus with Diversion from Bound Brook Area to Newark Area)		
Pumping Station and Pipeline	1995	$ 22.1
*Treatment Facility (20 mgd)	1995	13.0
Pumping Station Expansion	2005	2.1
*Treatment Facility Expansion (20 mgd)	2005	10.6
Subtotal:		$ 47.8
Total, North Area:		$126.9
West Area:		
Raritan River (Spruce Run-Round Valley Surplus with Diversion from Lamington/ North Branch Confluence Northward)		
Pumping Stations, Force Mains and Terminal Storage	1985	$ 14.4
*Treatment Facilities (20 mgd)	1985	13.0
Pumping Station Expansion	1995	1.3
*Treatment Facilities (7 mgd)	1995	5.6
Pumping Station Expansion and Additional Terminal Storage	2005	2.4
*Treatment Facilities (4 mgd)	2005	3.5
Total, West Area:		$ 40.2

*Anticipated ancillary facilities.

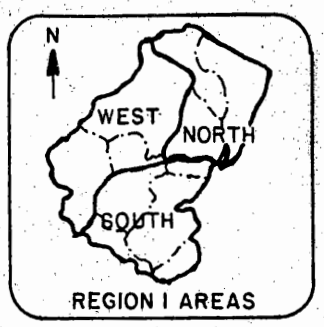
TABLE 3F-1 (Continued)

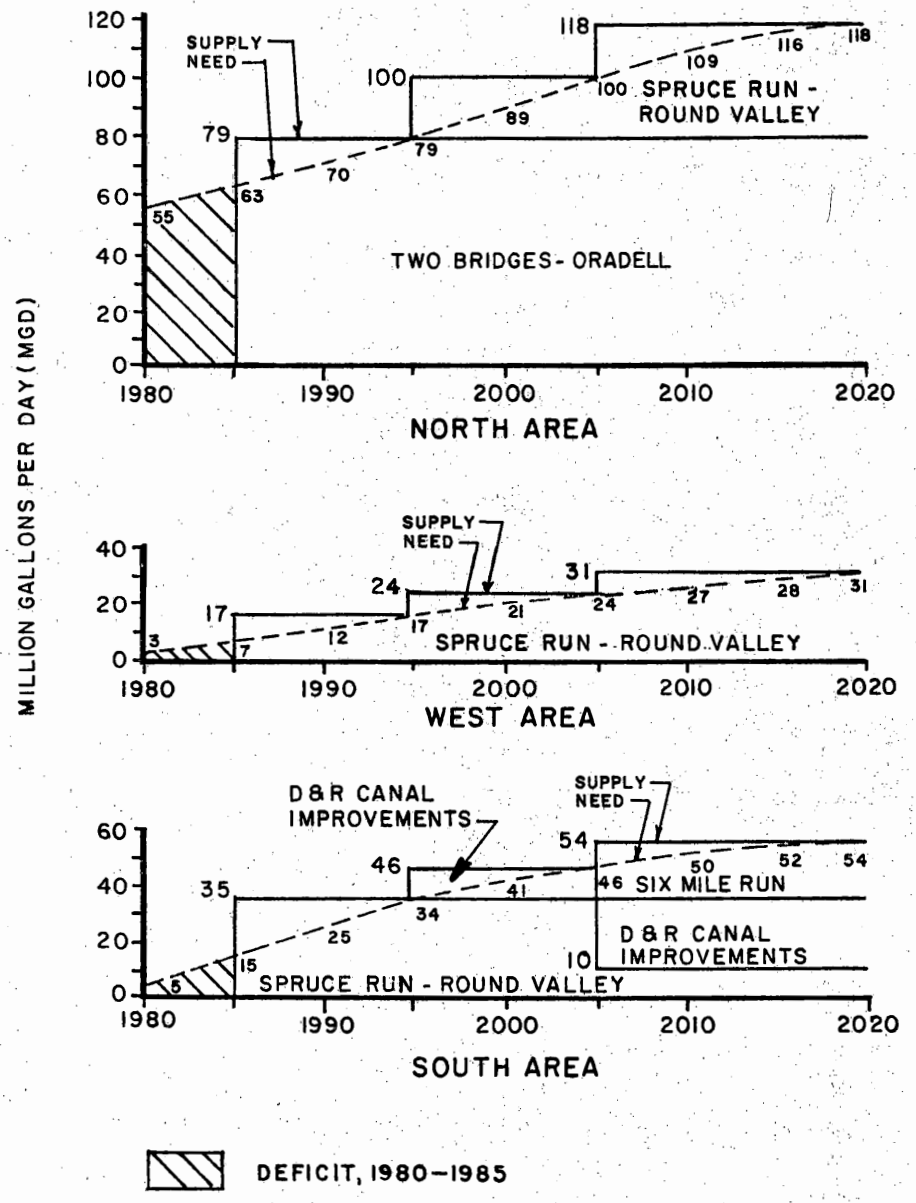
Sources and Projects	Initial Operation (year)	Estimated Construction Cost (1980 dollars, millions)
South Area:		
Delaware and Raritan Canal System		
Canal Improvements	1985	$ 3.7
*Pumping Station, Force Main and Treatment (20 mgd)	1985	18.9
Six Mile Run Reservoir	2010	27.1
Subtotal:		$ 49.7
Raritan River (Spruce Run-Round Valley Surplus with Diversion from Manville Area to D&R Canal)		
Pumping Station	1990	$ 1.1
*Treatment (20 mgd) and Pipeline	1990	17.8
Pumping Station Expansion	2000	1.1
*Treatment (14 mgd) and Pipeline	2000	11.9
Subtotal:		$ 31.9
Total South Area:		$ 81.6
Total, Region 1:		$248.7

*Anticipated ancillary facilities.

FIGURE 3F-1

REGION 1
RECOMMENDED
SOURCE DEVELOPMENT PROGRAM





The combined sources of the Two Bridges/Oradell project from the northern part and the Raritan water from the southern part of the North Area would provide two-way regional supply which, together with appropriate interconnections and existing supplies, would have substantially greater flexibility of operation than presently possible among the area's purveyors.

For present planning purposes, the project for Raritan River supply to the North Area in addition to the Bound Brook-Newark area conveyance would have an intake and pumping facility comprising a new water works in the Bound Brook area. The existing Elizabethtown Water Company treatment facility could be expanded for this project.

Also, other possible cost-saving options should be considered in detail at that time, such as Elizabethtown Water Company, Commonwealth Water Company, Elizabeth and Newark, as examples reinforcing their conveyance capabilities in stages as needs dictate, and smaller, multiple pipelines which may be more economical than by constructing the single, large pipeline.

The transmission methods and transfer arrangements must be worked out by the affected purveyors with State planning coordination in roder to establish the design and operating criteria for the initial operation in 1995 and the longer-term requirements.

West Area - While some of the water needs will be met by local development, there is an immediate need for new water supplies from expanding water utility systems. These supplies can be provided from the Spruce Run/Round Valley system on the Raritan River. The Elizabethtown Water Company is in a good location to treat this supply for the West Area by expansion of their Bound Brook plant and transmit the finished water in conjunction with other purveyors, to the West Area, provided that appropriate arrangements can be made among the affected purveyors with State planning coordination. However, until this possibility

can be investigated in detail and confirmed, the recommended plan for the West Area starting no later than 1985 would have an intake structure and pumping station at the confluence of the Lamington River and the North Branch of the Raritan River and a raw water pipeline from there northward generally following the North Branch into Morris County. A booster pumping station would be provided at or near Ravine Lake and ground storage would be at the end of system near Mendham. The two pumping stations would require expanded capacity by about 1995 and again in about the year 2005. Ground storage capacity at the end of the system would be expanded by about 2005.

The cost-effective conveyance to the West Area may be by several pipelines or branch lines, or by reinforcement of purveyor transmission pipelines, rather than by means of the one pipeline route presumed for this study. Here again, State-coordinated planning with the effected purveyors will be necessary in order to develop the most preferable location and arrangement of project facilities and operation.

South Area - This area can meet its estimated water needs for the next 40 years by use of Raritan River water and the Delaware and Raritan Canal system, together with continued use of present surface and groundwater supplies.

The location and size of the individual facilities for the South Area's source development are necessarily conceptual in nature at this time, primarily because a great deal of detailed planning and coordination among effected parties would be needed to provide a final facilities plan for implementation.

Subject to modification by such detailed work in the near future, the planning concept would have the South Area depend initially on the Delaware and Raritan Canal System with the D and R Canal Improvements Project completed by 1985. The improvements will increase the canal's carrying capacity by about 25 mgd.

Ancillary facilities for using the new supplies in the South Area will require either expansion of treatment and conveyance capacity in existing purveyor systems, such as in the Princeton, North Brunswick and New Brunswick areas, or new plants and pipelines as assumed for this regional planning. Therefore, such ancillary facilities as new treatment plants and conveyances would be needed by about 1985 and again by 1990 and 2000.

Additional supply needed by 1990 would be provided by a pumping station in the South Bound Brook-Manville area with an intake on the Raritan River and discharge to the adjacent D and R Canal. Increased pumping capacity will be required here by the year 2000.

The Spruce Run/Round Valley system water needs of the North and West Areas will increase such that the Six Mile Run Project will be required for the South area by about 2010, as shown on Figure F-1. The project includes a reservoir on Six Mile Run and a pumping station at the D and R Canal with a force main to the reservoir.

Costs - The recommended source development program for Region 1 would have an estimated total construction cost over the next 40 years of about $249 million at the 1980 cost level (ENR Construction Cost Index = 3100). Of this amount, about $116 million would be needed by 1985. An estimated capital investment schedule and annual costs are presented in Task 3E for the three areas of Region 1.

In addition the Great Notch Interconnection Project #42 is recommended for an immediate planning and design phase estimated to cost $4.2 million, with subsequent construction at an estimated cost to be determined during the planning and design. Resulting capacity and flexibility improvements to existing transfer facilities of the NJDWSC, the PVWC and the Newark and Jersey City Water Departments would also permit additional supplies to many smaller water companies.

2.2 Region Two (Ocean County and most of Monmouth County)

In Region 2 the existing (1980) need of 12 mgd is expected to be about 20 mgd by 1985, 30 mgd by 1990, and increase to about 50 mgd by the year 2020. Impacting these annual average needs are the peak seasonal demands created by the large influx of people to the seashore in the summer.

The Upper and Lower Manasquan Reservoirs (Project #76) is recommended for meeting the regional needs. Ground water supplies are presently overtaxed in Monmouth and northern Ocean Counties and there is an immediate need for the Manasquan River Project which has a 35 mgd yield. Land acquisition by the State has been completed and a "crash" program should be initiated to construct and put the project into operation as soon as possible.

This is a two reservoir system with a lower impoundment on the main stem of the Manasquan River near Allaire State Park at the head of tidewater. The second reservoir would be an off-river pumped storage facility near Oak Glen.

While a treatment facility at each of the two reservoir sites has been investigated, the urgent need for both reservoirs to be constructed immediately makes a single treatment plant at the lower reservoir the most probable arrangement. The Manasquan Project estimated cost is $33.6 million.

The estimated regional needs of 50 mgd by 2020 exceed the yield of this project by 15 mgd. Local ground water supplies, particularly in central and southern Ocean County, would be adequate for this additional water. Some existing wells are overstressing aquifers in some parts of the region and any new wells must be planned, located, operated and protected in a rational and prudent manner so as not to cause further problems with the aquifers.

2.3 Region Three (Atlantic and Ocean Counties)

There is a present need of 5 mgd of additional water supplies in Region 3. The needs are estimated to be 16 mgd by the year 1990 and 22 mgd by 2020, based upon State population and water use with a medium growth pattern. The estimate reflects anticipated impacts of casino and shore recreation activities.

Ground water resources in Region 3 have sufficient potential to supply regional needs for the foreseeable future, and through the year 2020 if the presently estimated growth projections hold true. It is on this basis that new large well field projects and surface water developments are not recommended for the region during the next 40 years. However, new major wellfields may be required if existing wells become contaminated.

With continued reliance on existing wells and future local well developments, it is essential that efforts be made to avoid localized over-pumping.

If a large new source development does become necessary in the long-term, there are three alternatives:

- South River Reservoir Project (#103) on a tributary of the Great Egg Harbor River, (yield 69 mgd). The estimated construction cost is $32 million.
- Well Field in Wharton Tract Project (#132) along the lower regions of the East and West Branches of the Wading River (yield 22 mgd). The estimated construction cost is $28 million.
- The Burlington County East Zone Well Fields Project (#135) including two dams, one each on the Batsto and Wading Rivers (yield 113 mgd). The estimated construction cost is $126 million.

Growth conditions and forecasted water needs should be monitored and reexamined frequently, and sites for the above-mentioned potentional regional projects should be protected and preserved for future water supply development.

2.4 Region Four (Cumberland and Salem Counties)

This Region depends almost entirely on ground water for its purveyor-supplied water. Present supplies are adequate, and future needs are expected to be relatively small: increasing from about 2 mgd in 1990 to about 9 mgd by the year 2020. The widely distributed needs of the two-county region can be met adequately by surface and ground water development if proper precautions are taken to protect water quality and to locate and develop the additional supplies.

The Maurice River Basin offers a potential 6-mgd yield by stream diversion without the need for a storage reservoir. Such development would cost about $374,000 and would be substantially cheaper than a well field development for that yield.

2.5 Region Five (Burlington, Camden and Gloucester Counties)

This region has an existing (1980) need of about 5 mgd projected to grow up to 15 mgd by 1990 and about 36 mgd by the year 2020.

The City of Camden has an urgent need for water supply to supplement and help protect its groundwater sources. This need, and future needs, can be met by constructing the Delaware River Intake at Delanco Project (#140) for an average supply of 25 mgd. The intake and treatment plant would be at Delanco and a transmission pipeline would convey the finished water to the City's well field and distribution system. Other communities in the area could utilize this project.

Releases to the Delaware River from storage upstream of the diversion could provide sufficient flow augmentation to assure a dependable water supply to Camden and relieve overstressed groundwater sources. The Hackettstown Reservoir and other potential storage projects in the Delaware River Basin could augment low flows in the Delaware River.

There are two other alternatives: development of groundwater from the Wharton Tract together with transportation and treatment (Project #131), and an interconnection with the City of Philadelphia across the Betsy Ross Bridge (Project #139). The Philadelphia connection is the least favorable. The other two appear to offer more acceptable solutions to Camden's needs.

The outcome of environmental impact evaluation in the sensitive pinelands of the Wharton Tract is uncertain. Similarly, the advisability of creating an inlet on the tidal Delaware without ancillary studies of salinity, upriver let down requirements, or alternative locations is questionable. The resolution of these issues should be determined quickly by a specific study.

Gloucester and Burlington Counties, as well as the rural portions of Camden County, require only development of local groundwater to meet their needs through the study period. Groundwater reserves are extensive in these areas.

2.6 Region Six (Delaware River Basin Area in New Jersey north of Burlington County, plus the Wallkill River Basin)

The existing 4 mgd need is expected to increase to about 11 mgd by 1990 and 27 mgd by the year 2020. These needs are relatively modest in comparison to the extensive water resource capabilities of most of the region. Water resources are very limited in Mercer and Hunterdon Counties, but Trenton can serve some of the needs. Also Delaware River and the D&R Canal are available for in-basin use. Local sources and the Delaware River can be used for Warren County.

Considerations of a State-wide nature affect the water development in Region 6, such as maintenance of flow in the Delaware and diversion from the river by the D&R Canal, which may require compensating flows to the Delaware. The Hackettstown Reservoir Project could provide a dependable yield of 40 mgd and the releases to mitigate any possible adverse impact for the Delanco-Camden diversion from the Delaware River. The Hackettstown Reservoir site in the Allamuchy State Park could also provide local water supply of about 5 mgd and recreational benefits if the site is fully developed.

The DRBC Comprehensive Development Plan includes the project to assist in providing low flow augmentation of the Delaware River and it appears that interstate agreement for construction of the Hackettstown project could be achieved quickly.

The DRBC Level B plan estimates that developing one or more storage reservoir sites in Pennsylvania could also provide low flow augmentation of the Delaware River.

Therefore, a number of considerations and options for Delaware River streamflow augmentation and water supply for Camden must be weighed that are beyond the concerns of this study.

A decision to proceed with the Hackettstown Reservoir Project at this time is largely a matter of policy for the State. The Shades and Petersburg Reservoirs are possible alternatives for Delaware River flow augmentation but these would require substantial pumping and higher cost than the Hackettstown project.

The Wallkill River system in Sussex County is presently little developed and immediate needs within the area are small. The river has a large potential yield that should be reserved for long-term needs of the State.

For local water supply in the Wallkill Basin near Hamburg and Franklin in Sussex County, construction of Beaver Run Reservoir to provide about 5 mgd by 1990 or 1995 is recommended. The Beaver Run project has potential for later expansion for water supply and streamflow augmentation.

The proposed Merrill Creek Reservoir project (#105) is not for potable water supply development, but it would replace Delaware River water diverted for cooling purposes in the generation of electric energy. The Merrill Creek project is included in the DRBC Plan for maintaining a minimum flow of 3,000 cfs at Trenton. The utility companies are expected to finance, build and operate the project.

NEW JERSEY
STATEWIDE WATER SUPPLY MASTER PLAN

HAVENS AND EMERSON, INC.
PARSONS, BRINCKERHOFF, QUADE & DOUGLAS, INC.
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3-1188-03-1

February, 1980

Letter of Transmittal:

This document represents our draft submission of TASK 3G - Plan Selection Methodology For Water Supply Projects.

In order to orient the reader to the requirements of the contract, the following is excerpted directly from the Scope of Work: -

TASK 3.G.

"The purpose of this Task is the development of a methodology and approach for analyzing and reaching a decision on a preferred water supply management program and evaluating the consequences of those decisions."

"The suggested methodology, including possible use of the computer screening program will be reviewed by the Expert Advisory Council. While the large number of external constraints almost mandates a repetitious evaluation process most efficiently done by computer analysis, other less sophisticated approaches will be considered."

Sincerely,

Peter W. Doe, P.E.
Project Manager

sf

NEW JERSEY WATER SUPPLY MASTER PLAN

STATE OF NEW JERSEY
WATER SUPPLY MASTER PLAN

TASK 3. WATER SUPPLY DEVELOPMENT STUDIES

SUBTASK 3G. RECOMMENDED PLAN SELECTION METHODOLOGY

SUBTASK 3G - RECOMMENDED PLAN SELECTION METHODOLOGY

SUMMARY

This report presents a recommended methodology for analyzing water supply project alternatives and selecting regional water supply management programs. Upon starting the Master Plan study an initial methodology was developed as the plan of work for Task 3, Water Supply Development Studies. The initial methodology was refined as Task 3 progressed, based upon experience gained performing the task and comments received regarding the several Task 3 reports. Further modification with increased sophistication and detail will be necessary and beneficial during future planning and implementation efforts. The recommended methodology provides guidance for continuing State planning.

A three-step methodology is suggested based on the scope of work, evaluation factors for comparing projects subjectively, and estimated comparative costs of project construction and operation. Step 1 is an inventory and initial screening of projects suggested by governmental agencies, purveyors, consultants and others for possible development. It also includes projects or modifications conceived by the study plan consultants or others that were not addressed in previous reports.

In Step 1 the screening process determines which projects are feasible for developing additional water supplies to meet New Jersey's immediate and growing needs. The unfeasible projects are then discarded from further analysis. The feasible projects are examined with more sophistication in the next step.

Step 2 is an analysis of the feasible projects based on the water supply objectives, source capabilities and water needs, estimated construction and annual costs, and on a subjective comparison of various evaluation factors. A stream network analysis is performed with computer methods to estimate source yield capabilities. The subjective evaluation factors include four major categories: technical, environmental, socio-economic and implementation considerations which are explained in this report. The primary result of Step 2 is the determination of the most promising projects for construction within the planning period (by Year 2020). The remaining projects of the Step 2 analysis then become deferred projects which are placed in a "Water Resources Bank" for potential water supply development after the end of the planning period (that is, beyond Year 2020).

Step 3 then takes the preferred projects of Step 2 and examines them for adoption to meet regional needs during the planning period. The Step 3 result is a specific water supply development program recommending regional projects and a schedule of their implementation in order to meet longer range needs. All of the Step 2 projects may not be needed before the end of the planning period, so those projects become the higher priority projects in the "Water Resources Bank".

This three-step methodology is applicable to on-going planning efforts for evaluation of potential projects as further information becomes available and when water demand projections are updated. Refinements to the methodology are anticipated for the future, with greater use of computerized programs where appropriate additional data and programming techniques become available, and as more detailed evaluation is warranted.

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SUBTASK 3G - RECOMMENDED PLAN SELECTION METHODOLOGY

3G-1 INTRODUCTION

A methodology is developed for evaluating and reaching decisions on preferred water supply management programs for the State of New Jersey. Illustration of the use of the methodology is provided by the other interim reports on Task 3, Water Supply Development Studies.

Evaluation factors are identified considering water supply planning objectives, needs, issues and types of projects. Alternative selection methodologies are surveyed for usefulness to the Master Plan. A selection methodology is developed and described in narrative and schematic forms. Relationships with other planning tasks are identified. Application of the methodology to continued State planning is discussed.

The various references made to Tasks and Subtasks relate to the outputs of the present Master Plan Study.

3G-2 ALTERNATIVE SELECTION METHODOLOGIES

Twelve alternative selection methodologies used in other studies were reviewed for their applicability to this Master Plan. Table 3G-1 lists these methodologies. They date back to 1960 and as recently as 1977. The table briefly mentions outstanding features of each methodology and indicates the value of each for New Jersey state-wide water planning. Common to many of these methodologies is a stepped (phased) evaluation process, an evaluation matrix, and streamflow simulation modelling by computer methods. These are applied in the Master Plan work of Task 3, Water Development Studies.

A stepped evaluation process systematically reduces the number of alternative solutions for further consideration and permits a manageable, methodical planning effort. This process is particularly appropriate for the Master Plan because of the great number of alternatives (over 125) initially available for consideration. An evaluation matrix provides an organized method for comparing alternative projects on a common basis. Streamflow or ground water simulation modelling by computer programs is useful for determining historical and existing water resource flows and yields and the dependability and reliability of additional water supplies that can be developed by various new projects.

TABLE 3G-1

ALTERNATIVE SELECTION METHODOLOGIES

	Study or Author	Description of Selection Methodology	Application for New Jersey
1.	Delaware River Basin 1960 Corps of Engineers	Preliminary screening of reservoir sites based on worth-cost ratios. Deterministic hydrologic input. Water supply, recreation, flood control, hydropower. Recommended plan adjusted by operational considerations.	Fair. Good for screening sites.
2.	Wilkinson 1962	Modification of Corps 1960 methodology by ranking based on benefit-cost ratios computed for each site at its level of maximum net benefits.	Fair.
3.	Lindsley and Franzini Water Resources Engineering 1964	Screen and evaluate costs and benefits of individual projects. Combine in alternative programs for analysis by computer simulation of basin hydrology.	Good. Computer simulation of basin hydrology.
4.	Fiering 1967	Analytical optimization of basin using long synthetic flow sequences. Analysis of least cost solution for given reliability of supply. Several problems.	Good. Synthetic hydrology.
5.	Jacoby and Loucks 1972	Linear programming model of basin, Multi-purpose benefit-cost analysis for reservoir systems.	Fair. Basin modeling.
6.	North Atlantic Regional Study (NARS), Corps of Engineers, 1972	Evaluates monetary costs and non-monetary benefits and costs for 17 major needs and 3 objectives: Environmental Quality, National Income, and Regional Development. Multi-purpose.	Fair. Evaluation matrix.
7.	Denver Water Study 1974 (Eagle-Piney-Colorado Basins) PBQD, Forrest and Cotton	Computerized operational analysis of four schemes for storage and transmission. Historic hydrologic records supplemented by synthetic hydrology. Planning decision matrix used to assign values to selection criteria.	Good. Computerized optimization of basin or Region using historic and synthetic hydrology.
8.	Tocks Island Lake Project and Alternatives, URS/ Madigan-Praegar with Conklin & Rossant 1975	Multi-purpose analysis of direct monetary benefits and costs and simple matrix analysis of positive/ negative indirect factors.	Fair. Evaluation matrix.

TABLE 3G-1

ALTERNATIVE SELECTION METHODOLOGIES
(Continued)

Study or Author	Description of Selection Methodology	Application for New Jersey
9. Fiering 1976	Analytical optimization of basin. Determine equivalent capacity of reservoir systems. Input discrete inflow probability distribution or synthetically generated flow sequences. Joint or separate optimization of reservoir sites.	Excellent. Computerized optimization of basin or Region hydrology using historic and/or synthetic hydrology.
10. Minimum Acceptable Service Standards (MASS) Delwyn Davies 1977	Deficiency defined by nature, extent, frequency, cost of remedy. Compare to MASS. Rank by benefit/cost ratio.	Fair. Benefit/Cost index.
11. Northeastern United States Water Supply Study (NEWS), Corps 1977	For New York metropolitan region, 100 projects were reduced to 44 feasible projects based on 8 considerations, which were reduced to 16 due to cost, environmental and institutional constraints. Addition of 4 projects led to evaluation of 20 in regional programs by decision trees showing costs only. Water supply only.	Excellent. Screening & evaluation techniques.
12. Arizona State Water Plan, Arizona Water Commission 1977	Evaluation of projects to meet multi-purpose goals considering cost, environment, legal and institutional constraints.	Fair. Multi-purpose analysis available mid-1978.
13. Procedures for the Evaluation of Engineering Alternatives 1977	Evaluation procedure applied to a water importation project, Ventura, California for analyzing non-quantifiable parameters. Allows for technical rating of alternatives by the Engineer and weighing of evaluation criteria by political and social groups via a Technical Advisory Committee, a Public Awareness Committee and a Policy Committee. (McDonald, Barney & Jones, Water Resources Bulletin, AWRA, Vol. 13, No. 3, June 1977, pp 583-589)	Excellent. Screening & evaluation techniques.
14. Public Participation in Environmental Statements 1977	Five-step approach for completing an environmental matrix utilizing a study team, public questionnaires and a computer program to simplify arithmetic manipulations allowing several numerical arrays. (S. Fusco, ASCE Jrnl, Water Res. Planning & Mgmt Div. WR1, March 1980, pp 123-129)	Excellent approach for screening & evaluating environmental matrix.

3G-3 THE PLAN SELECTION METHODOLOGY

The plan selection methodology concept is shown on Figure 3G-1 and is further described by Figure 3G-2, Table 3G-2 and the following narrative. The methodology is both a decision tool for continuing State planning, and also a refinement of the work plan methodology initially developed as a guide for Task 3 activities. That work plan reflected the contract scope of work and task interrelationships, and formed the basis for this plan selection methodology that was applied to the various Task 3 work items in the manner as discussed in the various Task 3 reports. Recommendations for future improvements to the methodology are given at the end of this report.

The methodology is a three-step evaluation of potential major water resource development projects. Step 1 is used to examine all known ideas for such projects, and results in discarding from this study effort those projects which are not feasible under present conditions. Step 2 analyzes the feasible projects on a comparable basis by use of a detailed evaluation matrix. This analysis determines the preferred alternative projects. These promising alternative projects are then subjected to hydrologic simulation modelling to estimate the reliability of the additional water yields that would result from project construction. Step 3 formulates and evaluates combinations of the preferred projects to determine recommended water supply programs for each planning region.

3G-3.1 Step 1 - Project Inventory and Initial Screening

3.1.1 Inventory Available Projects (Subtask 3A) - Water supply planning studies, feasibility reports, and other documents are collected and examined to identify available projects. The principal Subtask outputs are a list of references, a project list, project location maps and cost information as reported in the available project reference material.

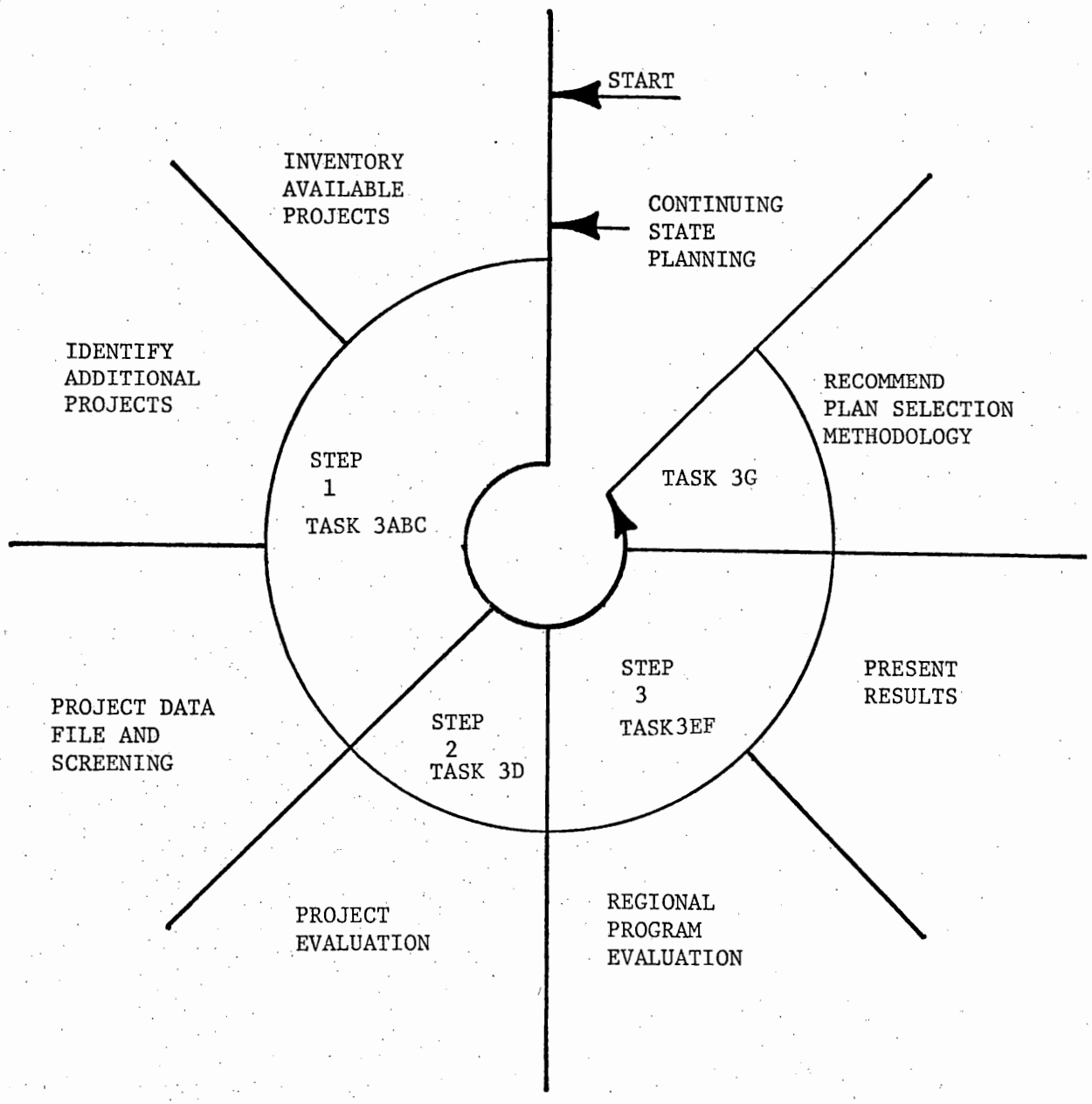

Figure 3G-1

PLAN SELECTION METHODOLOGY CONCEPT

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

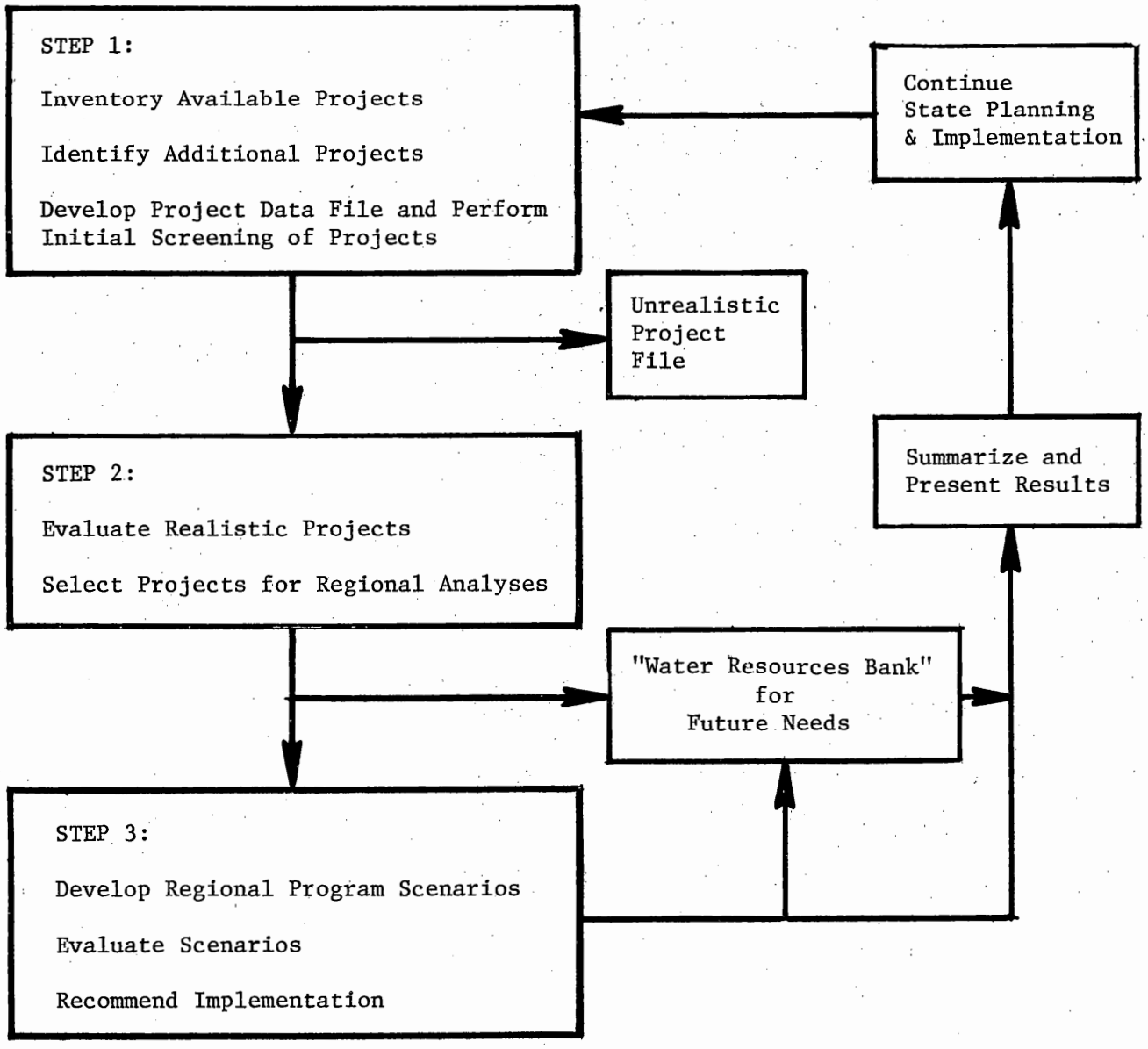

Figure 3G-2

PLAN SELECTION METHODOLOGY
FLOW SHEET

N.J. STATEWIDE WATER SUPPLY MASTER PLAN

TABLE 3G-2

PLAN SELECTION METHODOLOGY

STEP	ACTIVITY	INPUT	OUTPUT
	Initial Methodology		Plan of Work
1	Inventory available projects Identify additional & modified projects Develop project data file Perform initial screening of projects	Water supply plans, feasibility & other reports Available data base Questionnaires Projected water demands & needs Meetings with State, purveyors & others	List of references Project list, location maps, costs and data Dependable yield data Project screening of realistic & unrealistic projects
2	Project Evaluation	Step 1 output Section 208, 303e plans Available environmental data Streamflow modelling Public participation	Updated cost estimates Evaluation matrix including criteria for cost, technical environmental, socio-economic & implementation considerations Modelled dependable yields List of preferred projects for regional analysis List of references
3	Regional Program Evaluation	Step 2 output All other tasks Public participation	Alternative regional programs Evaluation analysis Regional water supply program recommendations List of "Water Resources Bank" projects Site acquisition program recommendations Summary report for public information

Project locations and the maps are based on the State's Land Oriented Data System (L.O.R.D.S.) maps. Projections of purveyor water supply needs are made based on the information and results of the data base (Task 1) and the needs assessment (Task 2).

3.1.2 Identify Additional Projects (Subtask 3B) - Sources of additional water supply projects include the major water purveyors and other task outputs. Major water purveyor's preferences for projects to meet their water supply needs are determined from questionnaire responses from purveyors and meetings with many of them (Task 1). Other task outputs identifying additional alternatives include Conservation Plans (Task 6) and Watershed Resource Management Activities (Task 7).

3.1.3 Project Data File and Screening (Subtask 3C) - Project description sheets are prepared from the reference material, and data pertinent to the evaluation are recorded. Costs are as reported.

A screening process is used to examine the project information in order to determine feasibility under present and foreseeable conditions. Screening criteria have five evaluation categories: project costs, yields, and compatibility with existing facilities costs; technical considerations; environmental impacts; socio-economic considerations; and implementation issues. Projects which fail any of these criteria are considered not feasible for further planning; however such projects are not totally abandoned for all time; they are credited to a "Water Resources Bank" -- a file of potential water resource projects that can be drawn on if future conditions and water supply needs warrant.

As additional information becomes available, such as for a newly conceived project or for a previously identified project, the inventory file is updated. Changing conditions and new information about a project may justify its reevaluation and possibly result in a change of its status.

3G-3.2 Step 2 - Project Evaluation

The feasible projects are given a more detailed and comparative evaluation in Step 2.

3.2.1 Streamflow Simulation Modeling (Task B of Amendment No. 1) - Modeling analyzes the existing water supply facilities and current demands, alternative future water resource development projects, and watershed management planning basins. The modeling uses the Corps of Engineers HEC-5C digital computer program. (The procedures, input data, constraints and results of such modeling for this Master Plan study are detailed in the reports on Task B and Subtasks 3C and 5A). Modeling results are considered in the project evaluation particularly with respect to the dependable yields and probabilities of water shortages determined for the modeled alternative projects. (This study modeled nine potential regional projects and five watershed management planning basins.)

3.2.2 Project Evaluation (Subtask 3D) - Feasible projects from Step 1 are then evaluated in considerable detail using evaluation factors described later. The subjective factors, those that cannot be quantified, are put in a matrix format. An arithmetic rating system is applied in the matrix to give comparable scores for each project. The evaluation factors and the scoring system, as discussed later, consider water supply objectives, issues and needs. The quantifiable factors -- project costs and water supply yields -- are considered as an evaluation category distinct from those of the subjective factor matrix. Comparison of all evaluation categories among alternative projects is then made to determine those projects which appear to be the most preferable for regional analysis in Step 3 (Subtask 3E).

The highest scoring projects will usually become the higher priority projects for implementation, but the Step 3 work determines the best combination of projects and their implementation schedule for meeting regional needs.

It is important to note that even if the overall evaluation score of a candidate project is higher than alternative projects, the failure of the project to satisfy an evaluation factor may warrant that project's rejection or modification.

Projects passing the Step 2 testing are then subjected to regional program evaluation of Step 3. Projects not passing are then credited to the "Water Resources Bank," with higher priority than those banked from Step 1 for reconsideration as may be warranted in the future.

3G-3.3 Step 3 - Regional Program Evaluation (Subtask 3E)

Within each planning region various combinations (scenarios) of preferred alternative projects from Step 2 are then evaluated in Step 3 for their capability to meet the region's water supply needs and streamflow requirements. Flexibility of regional scenarios to meet the needs in a timely, cost-effective manner (such as by means of staged development), can be a major reason for selecting a particular project. Also, the most preferred scenario should be capable of providing a variety of unforeseen future conditions, such as changes in economic growth trends, modifications to streamflow requirements, changes in water demand trends, increased conjunctive use of ground and surface waters, and other conditions presently indeterminate. Interaction among projects in each regional scenario and the identified capabilities of existing facilities and interconnections are considered in the evaluation.

For each planning region the most preferred scenario of projects (regional source development program) and their implementation schedule is determined. Regions threatened with existing or projected near-term water supply shortfalls will require immediate construction of at least one major source development project. After determining the regional program and schedule, a site acquisition program is prepared as another output of Subtask 3E.

Projects that are examined in this subtask but which are not in the recommended regional development programs, are credited to the "Water Resources Bank" for highest priority withdrawal if needed. A project in the recommended scenarios conceivably may be confronted by obstacles that preclude its construction in a timely manner, (e.g., an endangered species or archaeological find). In that case the "Water Resources Bank" could provide viable alternative projects.

3G-3.4 Presentation of Results (Subtask 3F)

The analysis and results of the Step 3 evaluations (Subtask 3E) are reported in a form suitable for the lay reader. This report facilitates public understanding and review of the regional water supply plans and the strategies considered in determining those plans. Comparative evaluation matrixes and reasons for acceptance and rejection of regional projects are given.

3G-4 DETERMINATION OF EVALUATION FACTORS

Considerations for evaluating water supply alternatives and programs are numerous and of varying significance. Criteria must be carefully chosen in order to evaluate project potential for meeting Statewide water supply planning objectives and to provide a basis for acceptance of proposed programs by decision makers. This section examines the Master Plan objectives and presents evaluation factors appropriate to the program selection methodology.

3G-4.1 Planning Objectives

Water supply planning objectives for the State of New Jersey are detailed in the plan of study; in summary, the objectives are to:

1. protect the vital, natural water resource,
2. allocate diversion rights in an equitable and resource conscious manner,
3. assure high quality potable water,
4. carry out these activities without delay,
5. assure adequate water supply,
6. enable State water utility operations to become self-sustaining,
7. overcome financial deficits associated with existing State water utilities,
8. consolidate institutional and financial management of State water utilities,
9. enable State policy makers to have a thorough understanding when making regulatory and investment decisions,
10. annually guide the State's water supply management program,

11. conduct the water supply planning and management programs in a manner that incorporates active public participation,

12. maintain or enhance the quality of life including environmental and socio-economic considerations,

13. provide for future water supplies at fair costs both to purveyors and their customers,

14. favor structural alternatives which are flexible to changing conditions and policy and which minimize the foreclosure of future options, and

15. minimize adverse impacts on or interference with transportation networks, utility operations and local autonomy.

The water supply planning objectives must be achieved within a complex system of constraints imposed by the varied interests including the public, purveyors, municipal and county governments, industry, other State departments, neighboring States, and the Federal government. Evaluation of alternative projects must consider these constraints. Identification of each interested party and its particular objectives will be necessary in subsequent detailed planning efforts.

3G-4.2 Water Supply Needs and Issues

Purveyor water demands for counties and water supply planning regions are developed (in Subtask 2A) based on population and employment projections for low, middle, and high growth rates, and per capita water intake.(1) Then, a range of purveyor water supply needs is estimated (in Subtask 3A) based on this demand plus distribution losses and existing deficits.(2) Analysis of identified issues (in Subtasks 2B and 2C) indicates that the purveyor water supply needs for the middle growth rate should be used for the Statewide planning.

(1) Data revised by DEP

(2) Demand in excess of dependable yield of resources

Major regional water supply planning issues are studied and ranked (Subtasks 2B and 2C) for priority within each region under four categories: water quality, institutional, potential "trend breakers" and water supply. These issues are considered in preparing the Subtask 3G evaluation criteria.

3G-4.3 Types of Alternatives for Meeting Water Supply Needs

Alternatives for satisfying water supply needs can be characterized as structural or non-structural. Structural alternatives are new and expanded physical projects, like reservoirs, wells, pumping stations, transmission pipelines and tunnels, interconnections among water supply systems and treatment plants, and may involve several projects working together to meet needs.

Non-structural alternatives include State or local policy and regulation concerning: land use and growth, water conservation and reuse, point source discharge limitations, diversion rights, and other subjects. Non-structural alternatives may be intended to reduce needs, increase supply, or improve distribution of water.

3G-4.4 Evaluation Factors

The selection of the various factors for evaluating water supply planning alternatives is based on the previously described planning objective issues identified (Subtasks 2B and 2C). The evaluation factors are used to determine relative impacts of alternatives. This planning stage does not warrant complete detailed environmental and socio-economic impact analyses such as required by State and Federal agencies for grant-aid approvals. Therefore, only those factors are included in this methodology which are particularly relevant to identified issues or which commonly have major affects on water supply decisions. Flexibility for adding or

modifying evaluation factors and their more detailed study in the future is a feature of the methodology.

The evaluation factors are classified under five major categories: costs and water supply yields, other technical considerations, environmental impacts, socio-economic considerations, and implementation concerns. Project costs and yields can be estimated in a quantitative manner. However, determination of evaluation factors in the other four categories are subjective (qualitative) since information about them cannot be quantified readily, if at all. Therefore, these subjective factors are treated differently in the analysis of alternative projects than the cost and yield factors. This report presents a weighting and scoring method for analyzing the subjective evaluation factors in a matrix format. The following is a brief description of all evaluation factors: (Note that various factors include structural or non-structural considerations.)

3G-4.4.1 Project Costs

4.4.1.1 Construction Cost - Cost estimates (in Subtasks 3D and 3E) for water supply project construction include estimated construction contract costs and land acquisition costs. Also included, is a 25% contingency for engineering and unforeseen construction items and 10% for financial, legal and administrative costs. Construction cost estimates from available reports are updated to 1980 dollars. Where cost estimates are not available from reports, and as a check on updated costs, cost curves such as from the NEWS study, are used for the cost estimates. The project cost estimates are to be refined in subsequent detailed engineering study and design.

4.4.1.2 Annual Cost - This is the sum of the annual costs of operating and maintaining the required new or modified facilities, and amortizing capital improvement bonds using equal annual payments of principal and

interest for convenience. Then applying the water supply yield of the project, the average cost in dollars per million gallons per day is determined for comparing alternative projects.

Operation and maintenance costs include the annual average costs of labor, materials, chemicals and energy. For the present estimates, the NEWS study type of cost curves are used. Pump energy costs are four cents per kilowatt-hour, the approximate prevailing rate at the beginning of 1980.

Amortization costs are calculated from the estimated total construction cost using an interest rate of 7%* over a 40-year period (the usual bonding term for New Jersey governmental capital financing). The resulting capital recovery factor is 7.50%, so the equal annual amortization payments would be 0.075 times the estimated total construction cost.

The estimated annual costs determined in future on-going planning will necessarily apply energy and interest rates prevailing at that time. Also, the preliminary and detailed engineering studies required before projects can be constructed, will use more extensive cost analysis than justified for the present master planning.

3G-4.4.2 Technical Considerations

4.4.2.1 Dependable Yield - The drought of record, which is the 1960's drought, is the current basis for estimated dependable yields, until daily flow simulation modeling is applied to long-term records (50-year), using the HEC-SC model for entire river basin operational studies and guidance. (Fifty years of simulation totals more than 18,000 days and, therefore, a great amount of data preparation and computer time.) Yield limitations are identified such as competing water uses of projects and stream flow requirements for both low flow water quality protectiona and downstream users. Dependable yields for alternatives in selected basins are subject to

*Approximate rate prevailing at time of the Master Plan Study analyses. Future analyses should use whatever interest rate is appropriate then.

refinement in the future detailed planning and engineering phases of project development.

4.4.2.2 Capacity to Meet Needs - Water supply needs and dependable yields are compared to assess the degree to which needs are satisfied by the alternative water supply projects.

4.4.2.3 Flexibility - This factor relates to the ability of a project to meet a variety of future conditions and to have potential for phased development. Uncertainties of demand projections warrant investment decisions which are sound for a wide range of future conditions. Ability of projects to economically serve lower demands initially and to expand to meet projected and unforeseen demands are considered as being highly important.

4.4.2.4 Operation and Maintenance Simplicity - This considers the simplicity of operation, required O & M staff and training and maintenance requirements. Alternatives in selected basins are also evaluated for their ability to operate with existing water supply facilities.

4.4.2.5 Reuse Potential - This refers to an alternative's potential for indirect reuse of water (as described by the Subtask 6A report on Conservation).

4.4.2.6 Energy Intensity - This technical factor considers the secondary impacts of project energy requirements, such as the country's dependence on foreign supplies of fuel and the diversion of energy from other needs of society to water supply. All other things being equal, a water supply project having little or no pumping requirements is favored over an alternative project needing substantial pump energy.

4.4.2.7 Proximity to Demands - Preference is given to source projects that supply water close to existing purveyor systems, either by reason of the project including necessary transmission to purveyors, providing in-stream conveyance to water supply intakes, or because the source is very close to an available receiving system.

3G-4.4.3 Environmental Impacts

This category includes evaluation factors of the Governor's Executive Order 53 on general policy guidelines for environmental impact statements. These factors are more specific to environmental conditions than to socio-economic conditions which are considered separately in the next category. This separation aids the evaluation by reducing the number of factors in a single category. Project descriptions (Subtask 3D) include summary information on environmental and socio-economic concerns described in previous studies to various degrees of detail. For most of the projects, in-depth assessment of environmental and socio-economic studies must be anticipated in the on-going planning efforts.

4.4.3.1 Water Quality - This factor considers water supply limitations imposed by unsatisfactory or threatened water quality of surface and ground waters. Such limitations may result from poor handling, storage and disposal practices of hazardous wastes; ground water and low streamflows that are easily contaminated; point and non-point source pollution; and land use changes and induced growth which concentrate human activity. Evaluation of surface water quality includes consideration of minimum streamflow requirements along with existing diversions and existing discharges (Amendment #1 and Subtask 3B simulation modeling). The PL92-500 Section 208 and Section 303e river basin studies are major sources of information on water quality and its management.

The existing and projected water quality is reflected by the water use classification and its limitation rating based upon water quality modeling studies for surface water and by reported water quality for ground water. However, prior to any firm commitments to a specific project, extensive source water quality testing should be performed where testing has not been done for toxic substances.

The assessment of suitability of the source water quality herein is only a screening of comparative water quality among sources.

4.4.3.2 Streamflow Augmentation - This evaluation factor considers the ability of surface water projects to sustain and augment flows (particularly seasonal low flows), for downstream water quality protection and enhancement, and for protection of ground water aquifers that are hydraulically connected to the surface water. When evaluating ground water projects, judgment is made on the general impact that lowering of the ground water table may have on the stream flows. Modifications in streamflow quantity and quality may be desired in the future as a result of urbanization increasing the rapidity of stormwater runoff and diminishing ground water recharge. Also, streamflow modification may be desired to replace surface water flows and reduced ground water recharge resulting from large sewage collection systems and trunk sewers bypassing waters that otherwise would supply streams, lakes and aquifers.

4.4.3.3 Ecology - This evaluation factor relates to the impacts of project construction and operation on terrestrial and marine plant and animal life.

4.4.3.4 Sensitive Lands - These are wetlands, flood plains, coastal zones, prime agricultural lands, the Pine Lands, and other identified land that

may be highly sensitive to alteration by project construction and operation. The sensitive lands evaluation factor relates only to the potential direct impacts of the project under consideration. The indirect impacts are considered in subsequent factors.

4.4.3.5 Cultural Resources - This factor is for evaluation of project impact on known archeological and historical relics and landmarks. The appropriateness of protecting artifacts and historic ruins and relocation of historical structures is considered in this factor.

4.4.3.6 Induced Growth - This factor is for evaluating the potential disruption or conflict with a community's existing local planning policies from too rapid or unmanageable growth. For example, construction and operation of a water source project may in some circumstances, result in strong pressures by land use development interests in a rural area such that the characteristics of the area would be altered significantly, to the chagrin of the local residents desiring retention of a pastoral setting.

4.4.3.7 Resource Commitment - The irretrievable use of land, materials, chemicals and energy for the actual construction and operation of a project is considered here. This evaluation factor also includes regard for the general extent of woodlands and farmlands that may be affected as a result of project land clearing or site land area requirements.

3G-4.4.4 Socio-Economic Considerations

4.4.4.1 Physical Displacements - Project construction may necessitate relocation of homes, other buildings, roads, bridges, rail and power lines and underground utilities. The degree of such displacements is applied with this evaluation factor.

4.4.4.2 Recreation - Opportunities for recreational enjoyment of reservoir and well field projects are considered here. Project sites may have high potential for camping, picnicking, hiking,cycling, fishing, boating, swimming and sightseeing. Project locations near high population areas usually have greater recreational usage than more distant sites. Multiple use of a facility such as for both water supply and recreation adds to the net benefit of a project and helps offset higher costs if the need for multiple use is high. However, planning and designing for multiple-use of a reservoir requires allocation of reservoir storage volume to various competing uses, such as assigning the lowest portion for sedimentation, a higher portion for water supply, an even higher part for hydro-electric power and the uppermost volume for flood storage. Recreational use and its facility planning, therefore, requires consideration of variations in reservoir water surface elevations. The variations may be large.

4.4.4.3 Flood Control - Surface water impoundments have the ability to store excess water during flood periods, reduce peak flood flow discharge rates and thus reduce the downstream impact of floods. Many factors must be considered in determining if a reservoir will significantly impact flood control efforts including the type of reservoir (on stream or off), capacity of the reservoir and operating schedule.

The significance of flood control in selecting a water supply reservoir option for implementation is generally low. But it is dependent upon the need for flood control, and whether or not a significant portion of the reservoir storage capability is allocated to flood storage.

4.4.4.4 Power Development - A reservoir may present opportunities for hydro-electric power development in addition to water supply if sufficient additional reservoir inflow and storage capacity is available. The power development evaluation factor gives some credit to projects which may have power potential by raising the dam to provide power storage capacity. Credit is also given to water supply impoundment projects that appear to have significant opportunities for generating power from water supply releases that otherwise would be unused. Quantifying possible power potential for a project is a detailed, sophisticated engineering effort which may be justified for some projects.

4.4.4.5 Employment/Economy - This evaluation factor relates to the amount of employment that would be generated directly for project operation and construction, and indirectly for the manufacture, energy needs and delivery of project materials and equipment. Application of this evaluation factor in initial planning is limited to judgement. More detailed study could provide a rough estimate of employment numbers and economic value of the project construction and operational needs.

3G-4.4.5 Implementation

4.4.5.1 Decision Making - This considers the general adaptability of alternative projects to certain water supply management policies that provide major directions in decision making. Three primary policies for such major directions (described in Subtask 3D) in priority order are:

(1) Develop intrastate water supplied as the principal near term strategy.

(2) Keep open the Hudson River fresh water supply options because of their potentially large benefit, and

(3) Beware of the possible responsibility on the Delaware River Basin waters and the need to develop northwest water as a response to their consideration.

4.4.5.2 Institutional - This evaluation factor refers to potential institutional arrangements for implementing projects (as detailed in Task 8). Also included is consideration of project sponsorship whereby purveyors and/or governmental agencies are strongly supporting the project. Thus, its potential for implementation would be greater than an alternative water supply development that does not have strong advocacy.

4.4.5.3 Financial - Overall financial feasibility of a project and the general interest of financial institutions to support the project are considered in this factor. Evaluation of these considerations is strictly subjective in early planning stages, becoming more dependable as indicators of financial acceptability after more detailed project study and inquiries to financial interests are made. (Concepts for financial arrangements are discussed in Task 9.)

4.4.5.4 Legal - This evaluation factor refers to legal issues (Task 10) which may constrain project development significantly. Other potential legal issues relative to land acquisition, diversion rights and water allocations are considered for each project.

4.4.5.5 Public Acceptance - This reflects the level of public acceptance of a project from past reactions or recent information from the Master Plan public participation process (Task 11). Public acceptability of a project involves an indication of the public's willingness, not only to have a project constructed, but also to pay for the project in some manner.

3G-5. USING THE EVALUATION MATRIX

3G-5.1 Weighting Evaluation Categories and Factors

The categories and factors discussed earlier are assigned weighted values in order to recognize their varied importance to water resource project development and operation. Each project is rated independently on each evaluation factor and in accordance with a scoring system yielding an overall numerical score for each project. The scores are used as an aid for comparing projects and in determining implementation priorities.

Evaluation weights can be determined from a consensus of various interest groups regarding importance of issues. Other persons and methods of determining weights will most likely arrive at different weighting values because of a variety of possible viewpoints.

Category weights are estimated by considering the perspective of various "interest groups": the urban water customer, the rural water customer, the water utility industry, the politician and the planner/engineer. These perspectives are then judged to get an overall viewpoint from which weighting values are assigned to each evaluation category. Also, future planning may modify the categories and factors used in this study. The methodology is adaptable to changing opinions and to more sophisticated analysis that may be warranted in the future.

3G-5.2 Scoring and Interpreting the Matrix

A scoring system is applied to each evaluation factor such that weighted values multiplied by scores result in project ratings for comparing alternatives. The scoring system is as follows:

Score	Meaning of Score
0	The issues of the particular evaluation factor are not satisfied by the alternative project, and they are adversely impacted to a severe degree.
1	The alternative barely meets the evaluation factor issues, and adversely impacts them to a moderate, yet significant degree.
2	The evaluation factor issues are moderately satisfied by the project, and adversely impacted to a slight degree. This score is also used when adequate information about a project is not yet available for otherwise quantifying an evaluation factor; in this manner a project is not necessarily rejected because of unknowns.
3	The project fully meets the evaluation factor needs and adverse impacts are insignificant.

Table 3G-3 is an evaluation form applied to a hypothetical project using the selection methodology. (A summary of subjective evaluation scores for each of the realistic alternative projects analyzed in the Master Plan study is presented in Subtask 3D - Appendix IV and the completed evaluation form for each is filed in the DEP.) In the sample, the hypothetical project has an averall score of 67 percent. This indicates that the scoring of the 22 evaluation factors on the whole is moderately satisfied by the project and adverse impacts are relatively slight. (A rating of 3 for every evaluation factor would have resulted in a total score of 100%; a rating of 2 would give 66.7%; and a rating of 1 would give 33.3%.) The overall score of the project is then compared with scores of alternative projects. If two or more projects being compared had approximately the same unit cost, then the highest scored project would appear to have the greatest priority for development. Project readiness to proceed would then carry substantial weight in determining the actual project for earliest construction. For example, if among two alternative projects one of them has design substantially completed and State approval, that more

TABLE 3G-3

SAMPLE PROJECT EVALUATION SCORE SHEET - SUBJECTIVE FACTORS

Region: 1 Project: Hypothetical

SUBJECTIVE EVALUATION FACTORS:	Evaluation Factor Weight (%)	Rating	Score		Evaluation Category Weight (%)	Score
TECHNICAL						
Flexibility	35	3	105			
O&M Simplicity	10	2	20			
Water Reuse	15	-				
Energy Intensity	30	1	30			
Proximity to Demands	10	2	20			
	100		175	÷ 3 = 58.3 x	20 =	11.7
ENVIRONMENTAL						
Water Quality	20	2	40			
Low Streamflow	20	3	60			
Ecology	20	2	40			
Sensitive Lands	20	2	40			
Cultural Resources	5	3	15			
Induced Growth	5	2	10			
Resource Commitment	10	2	20			
	100		225	÷ 3 = 75.0 x	30 =	22.5
SOCIO-ECONOMIC						
Physical Displacements	20	2	40			
Recreation	40	3	120			
Flood Control	5	1	5			
Power Development	5	-				
Employment/Economy	30	2	60			
	100		225	÷ 3 = 75.0 x	20 =	15.0
IMPLEMENTATION						
Decision-making	10	3	30			
Institutional	40	1	40			
Financial	20	2	40			
Legal	5	2	10			
Public Acceptance	25	2	50			
	100		170	÷ 3 = 56.7 x	30 =	17.0
TOTAL SCORE (Rounded):						66.2
					Say	66

advanced project could proceed even if the other alternative had a greater evaluation score.

It is emphasized here that the evaluation matrix methodology, or any other method for comparative scoring of subjective factors does not provide the ultimate answer to the question as to whether or not a particular project can be or will be built. It may only take failure of one factor to stop consideration or construction of a project. For example, discovery of a rare and endangered species at the site could make the ecology evaluation factor the supreme test of project acceptability. Or, an insurmountable or very lengthy legal confrontation could result in another alternative taking precedence over a project that seemingly had higher priority or greater benefits.

Further, it is reiterated that a matrix approach to the evaluation and comparison of normally non-quantifiable characteristics of physical projects is necessarily highly judgmental, with results dependent upon the particular attitudes and concerns recognized by the evaluators.

The following discussion of ongoing planning includes some guidance for additional refinement and sophistication of plan selection methodology, particularly as concerns possibilities for future increased participation of interest groups, governmental agencies, politicians, and the general public.

3G-6 ON-GOING PLANNING

The methodology is designed to provide a logical, standardized basis for present and on-going planning and to assist in making water supply decisions. Also, the methodology is readily adaptable to refinement, more comprehensive analysis, and modification of detail as future on-going planning requires. Alternative project inventory materials are updated as more reliable or more complete information becomes available. New projects are added to the inventory and their evaluation is performed at the appropriate time. Evaluation factors are tailored as necessary to reflect future changes in objectives, needs and issues. The evaluation process is used for revised projects or for added projects.

Experience gained in performing project evaluations and related planning tasks will enable the refinement of this methodology to meet the practical requirements for a continuing planning process. Comments received from reviewers, including the public, are considered in making evaluation refinements and arriving at project recommendations.

As part of the on-going planning process, the methodology may be modified in the future to include additional evaluation factors and techniques as may be developed or determined by the State, or suggested by methodologies evolving from planning efforts of others. For example, the Water Resources Council, Washington DC has been developing proposed evaluation techniques for their Standards and Principles of Project Review relative to federal agency proposals for Congressional authorization of water resources development projects.

An excellent method for determining and weighing evaluation criteria for alternative projects is presented in Reference 13, Table 3G-1, "Procedures for the Evaluation of Engineering Alternatives." In summary, the procedures are similar to those described and used in the current Master Plan study with the exception that the cited procedures applied additional time, personnel and funds to establish and administer three committees: Policy, Public Awareness, and Technical Advisory, to assist in the evaluation of alternatives. Each of these committees has specific functions relative to one or more of the following: establishing evaluation criteria, determining evaluation parameter weights or importance, rating the parameters, reviewing and commenting on the evaluation results, and selecting the most preferred alternative project. This method appears worthy of consideration on a region-by-region basis for the future ongoing work of planning and implementing alternative water resources projects.