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Comparative development saisability Study

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Franklin Township, New Jersey

Comparative Development Suitability Study

Louis Berger & Associates, Inc.
In Association With
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October 1984

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October 23, 1984

Township of Franklin
Municipal Building
475 DeMott Lane
Somerset, New Jersey 08873
Attention: Mr. Thomas J. Cafferty

Re: Comparative Development Suitability Study

Dear Sirs:

Louis Berger & Associates, Inc. is pleased to submit to Franklin Township its Comparative Development Suitability Study report. This document represents the culmination of our efforts at evaluating and comparing the suitability for development of some eleven sites located throughout the Township.

We appreciate the effort of the Township staff in assisting us toward preparing this study. We look forward to the opportunity to assist the Township in future endeavors.

Sincerely yours,

LOUIS BERGER AND ASSOCIATES, INC.

Robert J. Nardi
Project Manager

Encl.

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SECTION ONE: INTRODUCTION

SECTION ONE: INTRODUCTION

A. Purpose/Objectives of the Study

Local governments throughout New Jersey today face no more pressing issues than those surrounding land developments and rezonings within their jurisdictions. Is growth exceeding the capacity of local services and facilities? Will new development provide sufficient revenues to offset the cost of local services or be a drain on present taxpayers? Intentionally or otherwise, are some segments of the population excluded from the benefits of new growth or made to bear disproportionate burdens of growth? For environmental or other reasons, should development be limited? Are local housing and employment needs being met? Finally, how can a town meet its constitutional obligations without damaging its financial well-being or its quality of life?

As a means to begin addressing these questions Louis Berger & Associates, Inc., in association with Drs. Richard K. Brail, Michael R. Greenberg and Robert D. Hordon, was retained by Franklin Township to analyze the development suitability of eleven potential development sites located within the Township. The primary objective of the analysis was to determine the relative suitability of each site for different levels of development. The analysis was conducted on the basis of seven factors covering an array of environmental and public service considerations. These factors emerged during initial discussions between the Consultant and Township officials as the critical determinants for the assessment of development suitability in Franklin Township. On the basis of these discussions the decision was made to analyze the development suitability of each site both individually (on a site-by-site basis) as well as collectively (for all eleven sites on a comparative basis) against those factors listed below:

- Transportation
- Municipal Services
- Air Quality
- Water Quality
- Ecology
- Geology and Soils
- Hydrology

B. Organization of the Report

This report is organized around four sections with Section Two summarizing the methods employed in conducting the study, Section Three presenting the actual suitability assessment and analysis for each study site, and Section Four the findings and conclusions.

SECTION TWO: ANALYTICAL METHODS

SECTION TWO: ANALYTICAL METHODS

A. Summary of Methods

The comparative development suitability analysis conducted for Franklin Township follows procedures established by the Consultant for analyzing development impacts and requirements and assessing the significance of such impacts within the context of environmental/planning constraints and opportunities. The methods employed are summarized below and diagrammed in Figure 1.

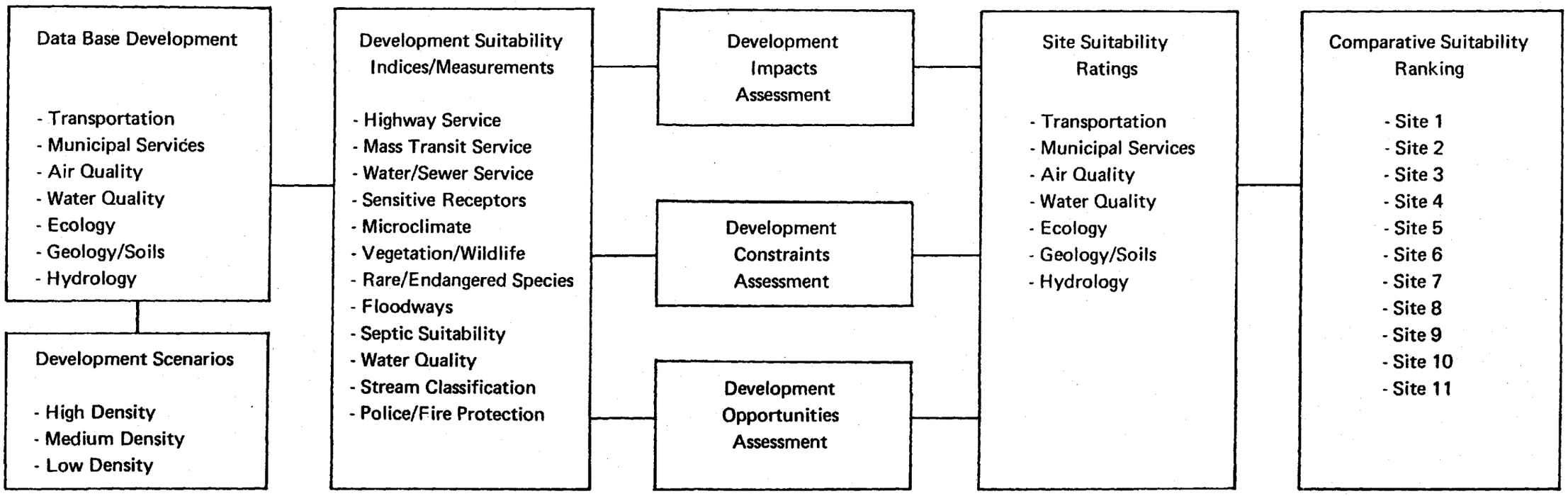
1. Data Base Development

Through field surveys, discussions with local planning and engineering agency officials, and a review of available secondary source information, a data base was established for each factor studied focusing specifically upon the eleven development sites, Franklin Township in general and adjacent communities as appropriate. Included within the data base were:

- An inventory of Township roads including present operating characteristics (number of lanes, speeds, traffic volumes, location of signalized intersections, planned improvements, etc.)
- Air quality data gathered from nearby State of New Jersey operated continuous air quality monitoring stations, the location and concentration of sensitive air quality receptors, as well as locations where microclimate and topographic differences may influence air quality.
- Water supply distribution and sewage collection system infrastructure including location of such infrastructure, available capacities and constraints, along with planned improvements.
- Police and Fire Department capabilities and resources in the form of manpower, facilities, and other support systems data.
- An inventory of ecological factors including vegetation, wildlife, and wildlife habitats particularly involving rare, threatened or endangered species. Consideration included species diversity and density, nesting areas, and food and water supplies.
- Soils and geologic factors including area geology and soils which present special development considerations.
- Hydrology including floodplain delineation along principal stream corridors.
- Water resources considerations including drainage basin boundaries, receiving streams, and water quality within principal streams and water bodies.

FIGURE 1

PROJECT FLOW DIAGRAM



2. Development Scenarios

In order to assess suitability, a series of scenarios corresponding to high, medium, and low density residential development were developed. Each scenario was developed to provide a range of housing types, household sizes, and development characteristics against which to analyze the suitability of each site.

3. Development Suitability

Each site was analyzed for each density scenario in terms of the nature and level of impacts for each of the principal environmental/public service factors. Included as critical indices were: volumes of additional traffic and impacts upon roadway service, availability of mass transit; ecological features including rare and endangered species habitats, wetlands and other such features; flood prone area locations and extent of such areas; police and fire protection services, soils and geologic considerations including limitations for development; and provision of water and sewer services. Each indice was analyzed from the standpoint of development impacts, constraints and opportunities.

4. Suitability Rating

The development impacts were evaluated in two ways. Environmental factors were comparatively rated and ranked on the basis of environmental impacts (damage) and the value of the environmental factors affected. Municipal services and transportation impacts were examined by either the cost or a surrogate for cost to provide the necessary improvements. Cost was considered the proper approach as the higher the cost of the service, whether provided by the municipality or a private landowner, the higher the resulting cost of housing. Measures to weight, score, and rank each site were developed to account for differences in land area, location, site features, and development characteristics.

B. Description of Development Program

In order to determine the suitability of a given site for development, scenarios describing potential development types and intensities of use must first be formulated and specified. For purposes of this analysis the development type has been limited solely to residential use. Varying intensities of residential land use development, corresponding to low, medium, and high densities, were proposed for evaluation.

1. Density

While residential developments can take many forms, they are most commonly represented by single-family dwelling units, illustrative of the lowest densities, townhouses, typically representing medium densities, and lowrise/high-rise apartments representative of the highest densities. In order to formulate development scenarios which best characterize Franklin Township and its environs, the Consultant reviewed development plans and ordinances specific to Franklin Township including its Comprehensive Master Plan and Zoning Ordinance,

conducted meetins with Township planners and planning consultants knowledgeable of development trends in the area of study, reviewed housing development proposals submitted recently to the Franklin Township Planning Board, as well as conducted a search of the housing development literature.

Based upon this review four development density scenarios were considered for analysis. Each was included so that together they would provide a sufficiently wide range of densities so as to later distinguish between housing types, household size, and development site characteristics. The four development densities analyzed included:

1.0 Dwelling unit per acre;

4.0 Dwelling units per acre;

8.0 Dwelling units per acre; and

14.0 Dwelling units per acre.

2. Housing Types

For purposes of this analysis the four development densities were translated into corresponding housing types. Relying upon a visual survey of recent residential developments within Franklin Township and discussions with local planning officials and development consultants, each of the four development densities were translated into three readily distinguishable housing types representative of current residential developments. The densities and corresponding housing types are listed below.

Density	Housing Type
1.0 Dwelling unit per acre	Single Family (detached)
4.0 Dwelling units per acre	Single Family (detached)
8.0 Dwelling units per acre	Townhouses (attached)
14.0 Dwelling units per acre	Garden Apartments (low rise)

3. Population

The most common method used to estimate the population in a given development is to apply an average household size multiplier to the number of dwelling units of various types which will be included within the development. Typically, application of such multipliers will depend upon the dwelling unit type and the number of bedrooms provided in each unit.

For purposes of this analysis an average number of bedrooms was developed for each housing type based upon a review of recent residential developments in the Franklin Township area and representative of current housing market conditions which exist within the area, and by a review of the literature dealing with the relationships between housing type, number of bedrooms, and household size. From this investigation came estimates of the average number of bedrooms by housing type.

Housing Type	Typical Number of Bedrooms	Average
Single-Family	3-4	3.5
Townhouses	1-4	2.5
Garden Apartments	1-2	1.5

Research conducted by the Center for Urban Policy Research also found that on the average, a one-bedroom garden apartment houses 1.90 persons. A two-bedroom garden apartment houses an average of 2.80 persons, while in highrise structures there are an average of 2.48 persons per two-bedroom unit.

Townhouse units are quite comparable to moderately priced, single-family homes in terms of household size. In three-bedroom townhouses, an average of 3.35 persons per unit were found by the Center's studies versus 3.31 in single-family homes; in four-bedroom townhouses the comparable figures are 3.74 versus 3.72.

Relatively few people are found in similar townhouses. In two-bedroom townhouses, the average household size (2.68) falls almost midway between figures for highrise (2.48) and garden apartment (2.80) units.

Based upon this research an estimate of total household size by housing type was developed. Again, a range of estimates were found with an average household size selected for use from these ranges.

Housing Type	Household Size
Single Family (1-4 units per acre)	3.5 persons per unit
Townhouse (8 units per acre)	2.5 persons per unit
Garden Apartments (14 units per acre)	2.0 persons per unit

Tables 1 to 4 serve to summarize those factors which comprise the development density scenarios as applied in this study as well as the number of dwelling units and population anticipated under each scenario for each of the eleven sites.

Table 1

Development Scenario No. 1

(1.0 dwelling unit per acre)

Site[1.]	Total Acres[1.]	Total Dwelling Units	Total Site Population
Brener	177.4	177	620
JZR Associates	155.76	156	546
Whitestone	82.9	83	291
Rakeco	100.1	100	350
Woodbrook	40.0	40	140
Flama	92.8	93	326
Jops	87.1	87	305
Van Cleef	373.63	374	1,309
Field	1,835.0	1,835	6,423
Mindel	196.4	196	686
Ras	11.85	12	42
Total	3,152.94	3,153	11,038

1. Source: Township of Franklin, September 1984.

Table 2

Development Scenario No. 2

(4.0 dwelling units per acre)

Site[1.]	Total Acres[1.]	Total Dwelling Units	Total Site Population
Brener	177.4	708	2,478
JZR Associates	155.76	624	2,184
Whitestone	82.9	332	1,162
Rakeco	100.1	400	1,400
Woodbrook	40.0	160	560
Flama	92.8	371	1,298
Jops	87.1	348	1,218
Van Cleef	373.63	1,496	5,236
Field	1,835.0	7,340	25,690
Mindel	196.40	786	2,751
Ras	11.85	48	168
Total	3,152.94	12,613	44,145

1. Source: Township of Franklin, September 1984.

Table 3

Development Scenarios No. 3

(8.0 dwelling units per acre)

Site[1.]	Total Acres[1.]	Total Dwelling Units	Total Site Population
Brener	177.4	1,419	3,548
JZR Associates	155.76	1,246	3,115
Whitestone	82.9	663	1,658
Rakeco	100.1	800	2,000
Woodbrook	40.0	320	800
Flama	92.8	742	1,855
Jops	87.1	697	1,743
Van Cleef	373.63	2,989	7,473
Field	1,835.0	14,680	36,700
Mindel	196.4	1,571	3,928
Ras	11.85	95	238
Total	3,152.94	25,222	63,058

1. Source: Township of Franklin, September 1984.

Table 4

Development Scenario No. 4

(14.0 dwelling units per acre)

Site[1].	Total Acres[1].	Total Dwelling Units	Total Site Population
Brener	177.4	2,848	4,968
JZR Associates	155.76	2,181	4,362
Whitestone	82.9	1,161	2,322
Rakeco	100.1	1,400	2,800
Woodbrook	40.0	560	1,120
Flama	92.8	1,299	2,598
Jops	87.1	1,219	2,438
Van Cleef	373.63	5,231	10,462
Field	1,835.0	25,690	51,380
Mindel	196.4	2,750	5,500
Ras	11.85	166	332
Total	3,152.94	44,141	88,282

1. Source: Township of Franklin, September 1984.

SECTION THREE: SUITABILITY ANALYSIS

SECTION THREE: SUITABILITY ANALYSIS

A. Overview

Franklin Township, New Jersey, occupies a unique position within the New York-Philadelphia corridor. Located within southeastern Somerset County, Franklin Township has access to nearby major highway and rail transit services that together provide the means to commute to the employment, cultural, and commercial centers of northern New Jersey and New York to the north and Princeton, Trenton, and Philadelphia to the south.

1. Franklin Township

Franklin Township is bounded to the north by the Raritan River and the towns of Piscataway and South Bound Brook; to the west by the Millstone River and the towns of Bridgewater, Hillsborough, Manville, Millstone, Montgomery and Rocky Hill; to the south by Princeton; and to the east by South Brunswick, North Brunswick and New Brunswick. The Township is comprised of 46.4 square miles (29,696 acres) of historic residential settlements, fertile farmland and newly emerging commercial and industrial developments (Figure 2).

According to the Franklin Township Comprehensive Master Plan, the Township's earliest development took the form of old villages where the major portion of the population lived until the post World War II suburban development. The villages are a part of the historical heritage of the area -- East Millstone, Middlebush, Griggstown, Franklin Park, Kingston, Zarephath, Weston, Blackwell Mills, and Little Rocky Hill -- and within which still exist numerous examples of homes built in the 18th and 19th centuries. Also part of the Township's historical heritage is the Delaware and Raritan Canal, running parallel to the Raritan and Millstone Rivers along Franklin's western and northern borders. The Canal was built in the early 1800's as a means of transporting farm products and coal from Pennsylvania to eastern markets and is currently on the New Jersey Register of Historic Sites.

It was not until the 1950's that the Township's traditional rural character began to measurably change. The Somerset area, adjacent to New Brunswick, received substantial growth due to its proximity to major transportation facilities and New Brunswick itself. In the 1960's the first large subdivisions west of Franklin Boulevard were developed as sewers were extended. During this period the decline of agriculture also started as small subdivisions and lot sales of farm lands became increasingly frequent.

Recently, Franklin Township has been one of the more rapidly growing communities in the Morris-Somerset-Middlesex County region increasing its population by 58 percent from 1960 to 1980. Over the past decade Franklin Township has grown to be an important employment center. From 1972 to 1982, the Township added 8,052 private sector jobs, increasing its employment base by 223.6 percent. The 11,653 private jobs in the Township as of 1982 make it the second largest employer in Somerset County. During this same period, Franklin Township was responsible for 31.2 percent of the total employment growth in Somerset County. Much of this employment growth came in the form of office development along Easton Avenue and within the I-287 corridor; activity that is likely to continue as evidenced by current commercial developments in the area and recent development proposals.

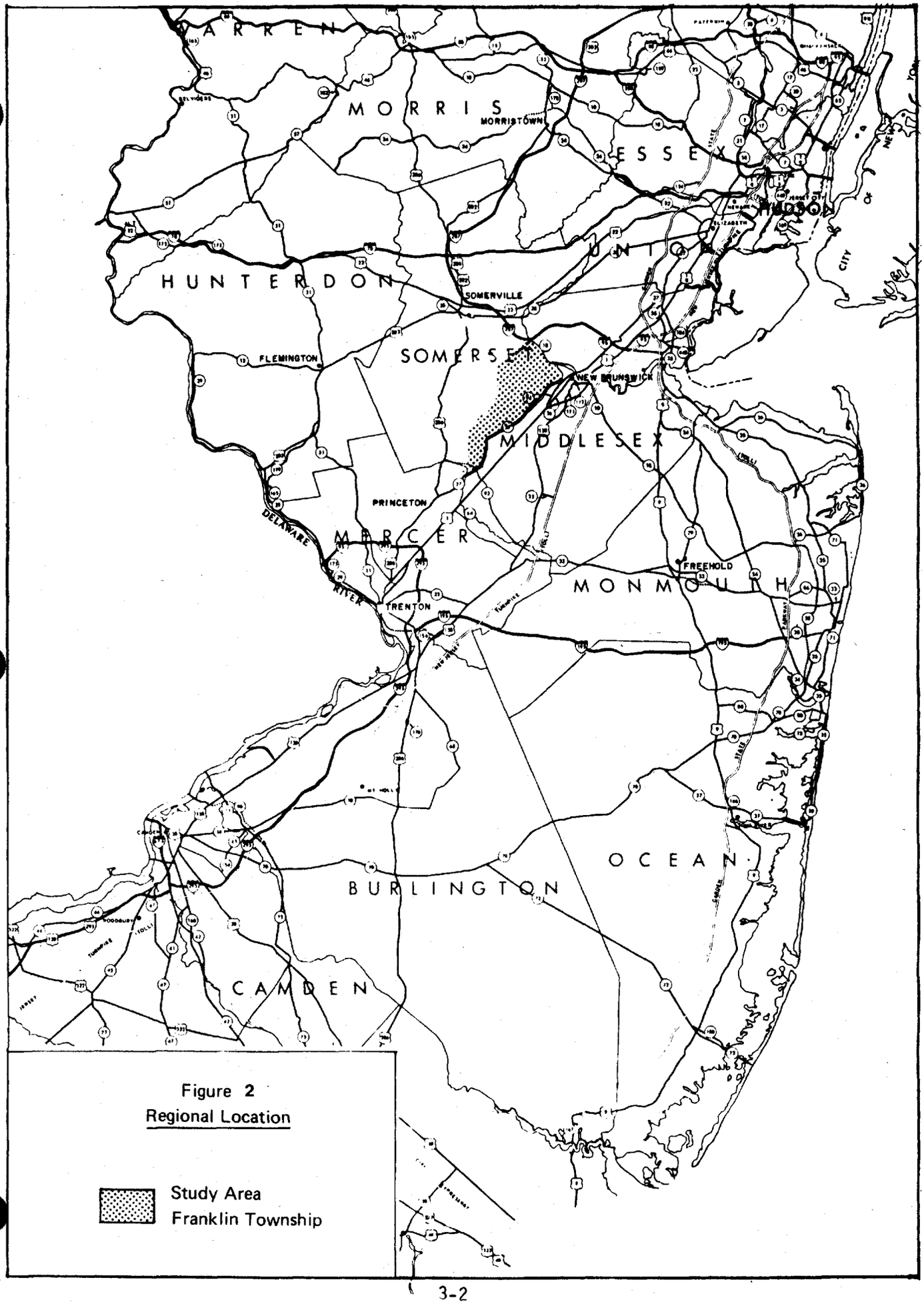


Figure 2
Regional Location

Study Area
Franklin Township

Residential development in the Township has also been occurring steady over this period. During the 1970's, the Township housing stock increased by 1,884 units, or 22.0 percent, to a total of 10,460 units in 1980. According to the Township's recently prepared Comprehensive Master Plan, population growth is expected to continue with estimates of from 47,000 to 65,000 persons projected to reside in Franklin by the year 2000.

2. Study Sites

Eleven sites, scattered throughout the Township, were evaluated individually and collectively as to their development suitability. Three of the sites (Mindel, Ras and Jops), ranging in size from 11.85 to 196.4 acres, are found within the northern portion of the Township in close proximity to the Town Center/Municipal Complex. Five sites (Flama, Woodbrook, Rakeco, Whitestone and JZR Associates), ranging in size from 40 to 155.76 acres, are located within the N.J. Route 27 corridor along Franklin's eastern border with North Brunswick. The two largest sites (Van Cleef and Field) are confined to the west-central portion of the Township. The Delaware and Raritan Canal forms a portion of their western borders. The eleventh site (Brener) totals 177.4 acres and is found the furthest south along the Township's border with South Brunswick (Figure 3).

This section describes briefly each site in terms of its location within the Township along with general site characteristics including land area, existing land uses, and adjacent land uses. Specific site characteristics relative to environmental and public service factors are addressed in Section Three B-H.

a. Mindel

The Mindel site is comprised of three separate parcels totalling 196.4 acres. Each of the parcels, which vary in size from 5 to 105 acres, front along DeMott Lane within the northern portion of the Township. The parcels are for the most part vacant with portions devoted to agricultural uses.

Residential development is the predominant land use in the area bordering the parcels along with such other uses as the Town Center/Municipal Building, existing and former agricultural developments, and vacant lands. For purposes of this analysis the parcels are considered as one site.

b. Ras

The Ras site is comprised of a single 11.85 acre parcel also located within the northern portion of the Township. The site, currently vacant, is bordered to the east by DeMott Lane, the Town Center/Municipal Complex to the south and west and the Mindel property (described above) to the north. Land uses in the area around the site include residential development, public uses in the form of the Municipal Complex, along with nearby vacant/undeveloped lands and agricultural uses.

c. Jops

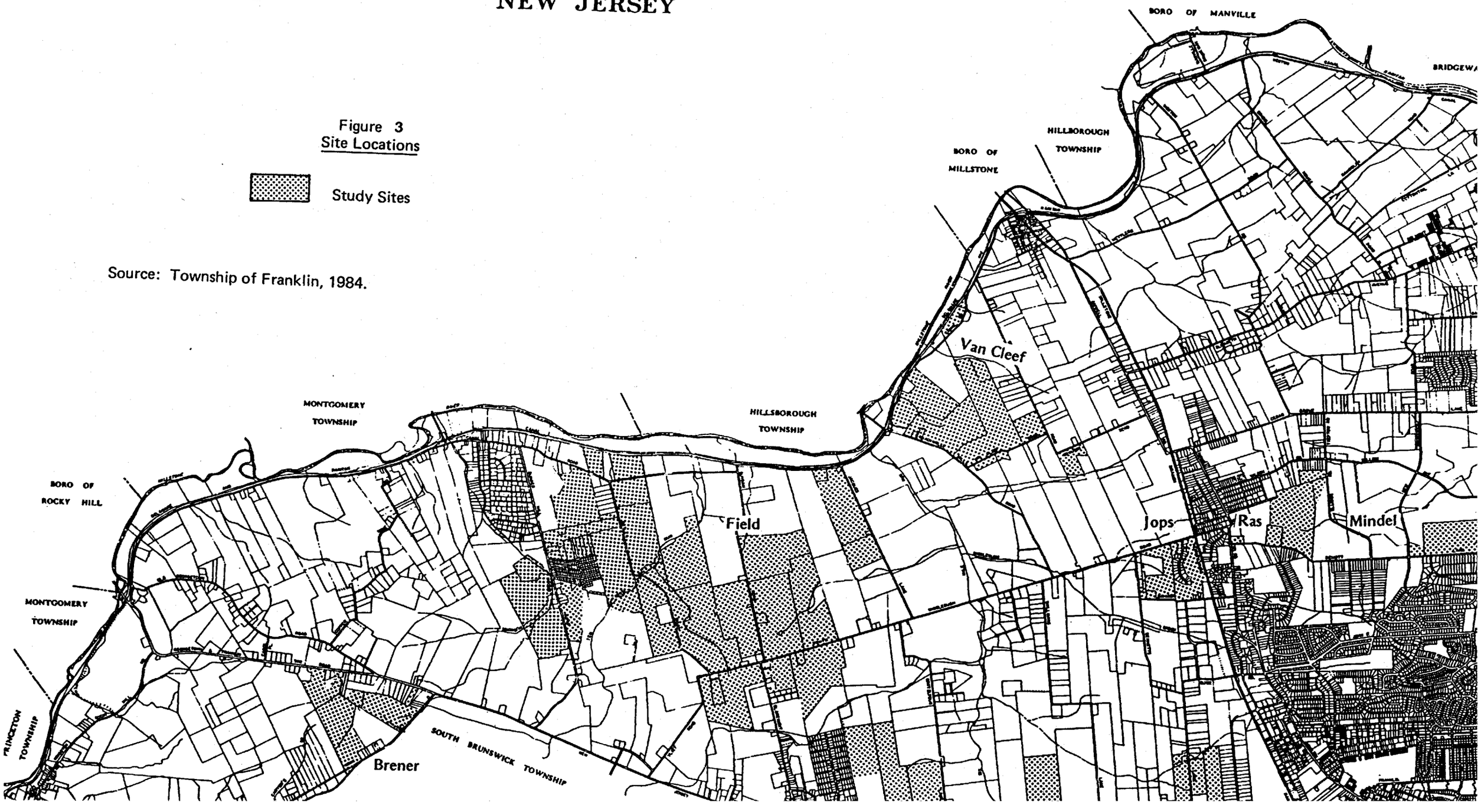
Also within Franklin's northern area is the Jops site. The site, covering approximately 87.1 acres, is irregular in shape and bordered to the east by Dahmer Road, to the south by Bennets Lane, Middlebush Road to the west and

TOWNSHIP OF FRANKLIN
SOMERSET COUNTY
NEW JERSEY

Figure 3
Site Locations

Study Sites

Source: Township of Franklin, 1984.



single family residences to the north. The largest portion of the site is in active agricultural use with the remainder undeveloped. Land uses in the vicinity of the site include, for the most part, agricultural use. Single-family residential developments also are found in the vicinity of the site centered upon the Middlebush area. Power utility property is also located adjacent to the site to the south.

d. Flama

The Flama site is located along Franklin's eastern border just south of the Somerset area. The site is comprised of 92.8 acres bordered by Bennets Lane to the south, N.J. Route 27 to the east and agricultural and vacant lands to the north and west. The site is currently vacant. Surrounding land uses include agricultural uses with a small scattering of single-family residences fronting along Bennets Lane nearest the intersection with N.J. Route 27. Light manufacturing uses along with commercial development are also found adjacent to the site's northern border.

e. Woodbrook

The Woodbrook site is located adjacent to the Flama site along Franklin's eastern border. The Woodbrook site totals 40.0 acres in size and is similarly bordered by Bennets Lane to the north and single-family residential uses along its eastern border (approximately 1,000 feet from N.J. Route 27). While the site appears for the most part vacant and undeveloped a portion continues to be used for agricultural purposes. Adjacent land uses include for the most part vacant/undeveloped lands, agricultural uses, and single-family residences confined to Bennets Lane.

f. Rakeco

The Rakeco site covers approximately 100.1 acres also within the eastern portion of the Township. The site is comprised of a single continuous parcel retangular in shape with N.J. Route 27 forming part of its eastern border. The site, currently in agricultural use, is bordered by other agricultural uses to its north, south and west. Small scale highway commercial development also borders the site as do residential uses along N.J. Route 27 in neighboring North Brunswick.

g. Whitestone

The Whitestone site is represented by an 82.9 acre retangular shaped parcel bordered by N.J. Route 27 to the east and Cortelyous Lane to the north. The site is currently actively farmed with its lands devoted to soybean and corn production. Farm buildings are found within the site. Adjacent land uses include for the most part agricultural development along with a scattering of single-family residences and undeveloped/va-cant lands.

h. JZR Associates

The JZR Associates site is comprised of 155.76 acres located along Franklin's eastern border with North Brunswick and adjacent to the Whitestone site (described above). The site is bordered by N.J. Route 27 to the east, agri-

cultural uses in the form of the Whitestone property to the north, agricultural and undeveloped lands to the west and residential developments in the Franklin Park area to the south. The JZR property is currently in agricultural use with adjacent land uses predominantly agricultural or residential. Commercial uses located along N.J. Route 27 are found in the Franklin Park area further south.

i. Van Cleef

The Van Cleef property is comprised of three separate parcels totalling 373.63 acres located along Franklin's western border. The site is bordered by Blackwells Mills Road to the south, Van Cleef Road to the east, Griggstown-Canal Road and the Delaware and Raritan Canal to the west, and Grouser Road to the north. The site is currently in active agricultural use as is the region surrounding the site. There is little or no development in the area except for other agriculture and farm-related uses. For purposes of this analysis the parcels are considered as one site.

j. Field

The Field site is by far the largest of the eleven sites studied extending over approximately 1,835 acres within the west-central portion of the Township. The site is bordered principally by Jacques Road to the north, the Delaware and Raritan Canal to the west, Bunker Hill Road to the south (although a portion of the site extends south of this road) and on the east by a line some 3,500 feet east of South Middlebush Road. The site, for the most part, is actively farmed with isolated woodlands and other undeveloped parcels part of the overall site. The area surrounding the site is also in agricultural production with a scattering of residential developments found at the fringes of the development site in the Franklin Park and Griggstown areas.

k. Brener

The Brener site is comprised of eight continguous lots totalling 1774.4 acres. The lots together form a wishbone configuration stretching from Georgetown-Franklin Turnpike (County Route 518) to N.J. Route 27. With exception of one single family lot, the site is undeveloped. There are several large wooded areas within the site with much of the remaining land in scattered trees and brush. Land uses adjacent to the site include undeveloped lands, a commercial nursery, along with a scattering of single-family houses. Commercial uses near the site are confined prinicipally to a shopping center located at the intersection of County Route 518 and N.J. Route 27 and further south along N.J. Route 27 in the Kingston area.

B. Transportation

1. Existing Conditions

Access to markets and employment centers is a hallmark of the transportation system serving the Somerset County area and one of the principal reasons behind the development now taking place in this central New Jersey region. The major transportation corridors within and adjacent to Franklin Township, including Interstate Routes 287 and 95, U.S. Routes 206, 130 and 1, and N.J. Routes 27 and 18, link the Township with other communities throughout the New York-Philadelphia region. In addition, planned highway improvements including proposed N.J. Route 92 across southern Franklin Township, improvements to U.S. Route 206, in addition to the Somerset Expressway, will increase access to the Township.

In general, the highway system serving Franklin Township consists of:

- Major highways having the highest volume capacities and travel speeds and are interconnected to the regional and interstate highway network.
- Arterial routes that extend the length or width of the Township and designed for intermunicipal or through community trips.
- Collector streets (including rural collectors) designed to carry traffic between major roads, generally collecting traffic from adjoining neighborhoods or other concentrations of development.
- Local roads and streets providing access to individual properties.

Interstate Route 287 is a multi-lane controlled access route passing across the northern portion of Franklin Township serving travel oriented toward northern Somerset County, Middlesex County and Morris County as well as connecting with other major highways serving northern New Jersey and New York. Access to Route I-287 from Franklin Township is provided by two interchanges located at Route 527, Easton Avenue; and Route 623, Weston Canal Road. Current traffic volumes along Route I-287 in the area of the Franklin Township interchanges is estimated at 70,000 annual average daily traffic (AADT).

Interstate Route 95 (New Jersey Turnpike) is the major route connecting the Philadelphia and New York City regions. This highway passes to the east of the Township in Middlesex County and is accessible from Interchange 9 at N.J. Route 18, east of New Brunswick.

Route U.S. 1 is a four-lane highway running parallel to the east of Franklin Township, and connecting the Trenton area with northeastern New Jersey. Routes providing access to Route U.S. 1 from Franklin Township include:

- Route N.J. 18
- Route 680, How Lane, Route N.J. 26, Livingston Avenue or Route N.J. 91, Jersey Avenue
- Route 608, Cozzens Lane
- Route 682, Finnegans Lane
- Route 610, Henderson Road
- Beekman Road
- Sand Hill Road

- New Road
- Raymond Road
- Route 522, Heathcote Brook Road

Each of these roads lead to a traffic signal-controlled intersection along Route U.S. 1, with the exception of Route N.J. 18 which has a grade separated interchange with Route U.S. 1. Route U.S. 1 is six lanes along the four-mile long section bypassing New Brunswick with all crossing roads being grade-separated. South of New Brunswick, Route U.S. 1 is four lanes with all left-turns and U-turns made at signalized intersections spaced at intervals averaging 0.5 miles.

Traffic volumes along Route U.S. 1 currently range from a high of 66,700 AADT (total for both directions) in the area near the Route N.J. 18 interchange to a low of 28,700 AADT in the area between the New Road and Raymond Road intersections. Further to the south traffic volumes increase as Route U.S. 1 approaches Princeton. During the four year period from 1979 to 1983, traffic volumes along Route U.S. 1 between New Brunswick and Princeton have increased at an average rate of 4.5 percent per year.

Further to the east of Route U.S. 1 is Route U.S. 130, a four lane north-south highway route paralleling Route U.S. 1 and the New Jersey Turnpike and connecting the Hightstown and New Brunswick areas. Traffic volumes along Route U.S. 130 range from 14,300 AADT near Hightstown to 23,000 AADT near its junction with Route U.S. 1 in North Brunswick.

The principal highway serving Franklin Township is N.J. Route 27. This highway is a two-lane road running along the Township's eastern boundary for a distance of 12.2 miles. The posted speed limit along N.J. Route 27 is 50 miles per hour. While Route 27 extends from northern Middlesex County to its terminus in Princeton, its primary function is in providing access to the residential developments located adjacent to the route. In fact, six of the eleven sites under study are located within the N.J. Route 27 corridor with five of the sites directly fronting upon the roadway. These include the Flama, Rakeco, Whitestone, JZR Associates and Brener sites. The Woodbrook site is located approximately 1,000 feet west of the roadway.

Thirteen roadways which intersect with N.J. Route 27 are controlled by traffic signals including:

- Somerset Street
- Douglas Avenue
- Juliet Avenue
- Route 617, Franklin Boulevard - Oliver
- Veronica Avenue - Route 680, How Lane
- Bennets Lane - Huron Road
- Route 608, Cozzens Lane
- Route 610, Henderson Road
- Stage Road - Sand Hill Road
- Route 632, Bunkerhill Road - New Road
- Route 518, Georgetown-Franklin Turnpike
- Route 603, Laurel Avenue - Heathcote Brook Road

Current traffic volume along N.J. Route 27 is 17,000 AADT north of Veronica Lane. South of Veronica Avenue traffic volumes progressively decrease from 14,000 AADT to 10,000 AADT in the area of the Route 518 (Georgetown-Franklin Turnpike) intersection. South of Route 518, traffic volume is 8,000 AADT, progressively increasing again as N.J. Route 27 approaches and enters Princeton.

Other principal roadways within or near Franklin Township includes:

- Route 514, Amwell Road
- Route 527, Easton Avenue
- Route 518, Georgetown-Franklin Turnpike
- Route 533, River Road
- Route U.S. 206

Route 514, Amwell Road is a two-lane east-west road crossing Somerset County. It connects Route U.S. 206 at Hillsborough with New Brunswick and the Somerset area of Franklin Township, a distance of about 10 miles. Beginning at Dahmer Road and continuing into Somerset, Route 514 has four travel lanes and is known as Hamilton Street. The primary function of Route 514 is to serve east-west travel between the many north-south collector streets that provide access to agricultural and residential developments in the northern part of Franklin Township.

Collector roads west of the John F. Kennedy Boulevard intersecting with Route 514, Amwell Road include:

- Mettlers Road
- Route 621, Elizabeth Avenue
- Grouser Road
- Route 619, Cedar Grove Road
- Wilson Road
- Route 615, Middlebush Road
- DeMott Lane
- Dahmer Road

East of John F. Kennedy Boulevard, there are many local streets having access to Route 514, Hamilton Avenue. Major collector streets intersecting with Route 514, Hamilton Road and controlled by traffic signals are:

- Veronica Avenue
- Route 617, Franklin Boulevard
- Matilda Avenue
- Highland Avenue - Meister Street

Current traffic volumes along Route 514 is approximately 7,770 AADT west of Route 619, Cedar Grove Lane, and approximately 10,000 AADT east of Route 617, Franklin Boulevard.

Route 527, Easton Avenue is an urban route running along the southern side of the Raritan River and the Delaware and Raritan Canal. It extends from Route N.J. 27, Albany Street in New Brunswick westward for a distance of about 5 miles providing access to the Route I-287 interchange. The posted speed limit is 45 miles per hour decreasing to 40 miles per hour as you approach New Brunswick.

Collector streets running north-south in the northern part of Franklin Township that intersect with Route 527, Easton Avenue include:

- Route 617, Franklin Boulevard
- John F. Kennedy Boulevard
- DeMott Lane
- Route 619, Cedar Grove Road

West of Route I-287, Route 527, Easton Avenue continues for about 1.6 miles as Main Street, South Bound Brook. Eight signalized intersections are located at an average interval of 0.5 miles along Route 527, Easton Avenue at:

- Route 617, Franklin Boulevard
- Foxwood Drive
- John F. Kennedy Boulevard
- Shopping center entrance
- DeMott Lane
- Willow Avenue
- Route 619, Cedar Grove Road
- Davidson Avenue

Current traffic volumes along Route 527, Easton Avenue is 21,000 AADT between Route 617, Franklin Boulevard and DeMott Lane. West of DeMott Lane traffic volumes progressively increase to a level of about 34,000 AADT at the Route I-287 interchange. West of the Route I-287 interchange, traffic volume averages 18,000 AADT to Davidson Avenue and about 10,000 AADT into South Bound Brook.

Route 518, Georgetown-Franklin Turnpike is an east-west, two-lane road crossing the southern portion of Somerset County. This roadway connects Route U.S. 206 at Rocky Hill in Montgomery Township with N.J. Route 27 in Franklin Township. Current traffic volumes along Route 518 between Route U.S. 206 and Route N.J. 27 is approximately 6,500-8,000 AADT. A portion of the Brener site fronts upon Route 518 in the vicinity of N.J. Route 27.

Franklin Township is bounded on the west and separated from the rest of Somerset County by the Delaware and Raritan Canal and the Millstone River. Along this western boundary between Interstate Route 287 and N.J. Route 27 there are only five roads crossing the Canal. These five two-lane crossings are at:

- Route 623, Manville Causeway
- Route 514, Amwell Road
- Blackwells Mill Road
- Route 632, Griggstown Causeway
- Route 518, Rocky Hill

Except for the Route 518, Rocky Hill crossing, each of the other four crossings connect with Route 533, River Road.

Route 533, River Road begins at Route U.S. 206 just north of Rocky Hill and runs northward along the west side of the Millstone River for about 12 miles through eastern Montgomery and Hillsborough Townships and through Millstone and Manville

Boroughs connecting with Routes N.J. 28, U.S. 22, and I-287 in Bridgewater Township. While Route 533, River Road is not located within Franklin Township, it does run in a north-south direction along the west bank of the Millstone River and the Delaware and Raritan Canal providing access to the western areas of Franklin Township. Current traffic usage along Route 533, River Road is about 4,700 AADT south of Millstone Borough and about 12,000 AADT north of Millstone Borough.

Route 623, Weston Canal Road, is a two-lane road connecting Main Street in South Bound Brook with Manville via the Manville Causeway and having an interchange with Route I-287 just south of South Bound Brook. Traffic volumes in the area near the Route I-287 interchange are high at some 15,000 AADT; but to the south toward Manville the road is lightly used, about 3,000 AADT.

Route 615, Middlebush Road, is the only north-south road extending through the center of the Township south of Route 514, Amwell Road. As such, it intersects with and collects traffic generated by areas surrounding the local east-west roads such as:

- Blackwells Mills Road
- Jacques Lane
- Suydam Road
- Butler Road
- Bennets Lane
- Skillmans Lane
- Cortelyous Lane
- Claremont Road, the continuation of Route 615 to N.J. Route 27
- Vliet Road, the extension of Middlebush Road to N.J. Route 27

All other roads in Franklin Township are collector-type roads connecting local areas of development with the main routes.

In the area of Franklin Township north of Route 514, Amwell Road, and west of Route 619, Cedar Grove Lane, the collector-type roads running north-south total 11.45 miles of roadway and include:

- Mettlers Road	2.1 miles
- Randolph Road	1.2 miles
- Cottontail Lane	1.7 miles
- Route 621, Elizabeth Avenue	5.0 miles
- Davidson Avenue	1.45 miles

East-west collector roads, totaling approximately 6.9 miles of roadway, include:

- Weston Road	3.3 miles
- School House Road	2.3 miles
- New Brunswick Road	1.3 miles

In the area north of Route 514, Amwell Road, and east of Route 619, Cedar Grove Lane, north-south collector roads totalling 12.65 miles of roadway include:

- Route 619, Cedar Grove Lane 3.1 miles
- Wilson Road - Willow Avenue 2.7 miles
- DeMott Lane 2.6 miles
- John F. Kennedy Boulevard 2.2 miles
- Route 617, Franklin Boulevard 2.05 miles

East-west collectors totaling 2.8 miles of roadway include:

- Treptow Road - Ellison Road 1.5 miles
- New Brunswick Road 1.3 miles

Collector roads within the area bounded by Route N.J. 27, Route 514 (Amwell Road) and Route 615 (Middlebush Road) total approximately 12 miles of roadway and include:

- Veronica Avenue 1.2 miles
- Bennets Lane 2.55 miles
- Skillmans Lane 2.4 miles
- Cortelyous Lane 1.8 miles
- Vliet Road 1.6 miles
- Route 615 - Claremont Road 1.3 miles
- Dahmer Road 0.6 miles
- Clyde Road 0.8 miles

Collector roads south of Route 514, Amwell Road, and west of Route 615, Middlebush Road total approximately 12 miles of roadway and include:

- Grouser Road 2.35 miles
- Van Cleef Road 0.75 miles
- Blackwells Mills Road 2.05 miles
- Jacques Lane 1.3 miles
- Suydam Road 1.72 miles
- Butler Road 1.9 miles
- Route 632, Bunker Hill Road 1.9 miles

The Van Cleef and Field sites are each served by these collector roadways. The Van Cleef site is bounded by Grouser Road, Van Cleef Road, Blackwells Mills Road and Canal Road. The Field site encompasses Suydam Road, Butler Road, Middlebush Road, and Bunker Hill Road while bordering on Jacques Lane and Canal Road.

Collector roads in Franklin Township south of Route 632, Bunker Hill Road total some 4.6 miles of roadway and include:

- Copper Mine Road 2.0 miles
- Old Georgetown Road 2.6 miles

Mass Transit

Commuter rail service supplements the area's transportation system with rail stations in nearby New Brunswick and Princeton Junction. Operated by N.J. Transit, rail service is provided on a frequent basis to Metuchen, Metropark,

Rahway, Newark and New York among other points north, and Trenton, North Philadelphia, and Philadelphia to the south. Currently in the planning stage is a proposal to develop a park-and-ride train station in the Monmouth Junction area of South Brunswick.

Bus service also exists within the area however it is confined exclusively within the N.J. Route 27 corridor. Bus service to points north and south of Franklin Township is provided by Suburban Bus Company.

Figure 4 shows the location of all roadways within Franklin Township in addition to all signal-controlled intersections, the location of mass transit services, river crossing points, and the proposed N.J. Route 92 corridor.

2. Development Impacts

Forecasting motor vehicle travel due to development is based upon previously observed and measured relationships of trip generation associated with various types and densities of land use activity. "Trip generation" refers to quantification of the number of daily or peak hour motor vehicle trips beginning and ending in an area with a given amount of land use activity.

Different types of land uses generate different volumes of trips. For example, 100 acres of agricultural land use will generate less travel than a similar sized residential area. Industrial or commercial land uses with their high concentrations of economic activities (employment and shopping destinations) will generate even higher volumes of travel per unit of area.

Over the past forty years many transportation planning surveys and studies have measured and analyzed the relationship of trip-making to land use types and densities. In 1976, the Institute of Transportation Engineers (ITE) compiled and analyzed all available data on trip generation. The results of their work (ITE Trip Generation Handbook) provides a basis for predicting changes in an area's trip generation due to changes in its land use type or concentration of activity.

The ITE Handbook, updated in 1982, provides average trip generation rates for a variety of land uses, including different densities of residential development. Table 5 identifies those trip generation rates used in estimating traffic volumes according to each development density and housing type. Tables 6 to 9 identify traffic volumes expected from each development site based upon land area, housing type, and development density.

TOWNSHIP OF FRANKLIN
SOMERSET COUNTY NEW JERSEY

Figure 4
Transportation Systems

- Signalized Intersections
- D&R Canal/Millstone River Crossings
- Mass Transit Corridor
- Proposed NJ Route 92 Corridor
- Study Sites

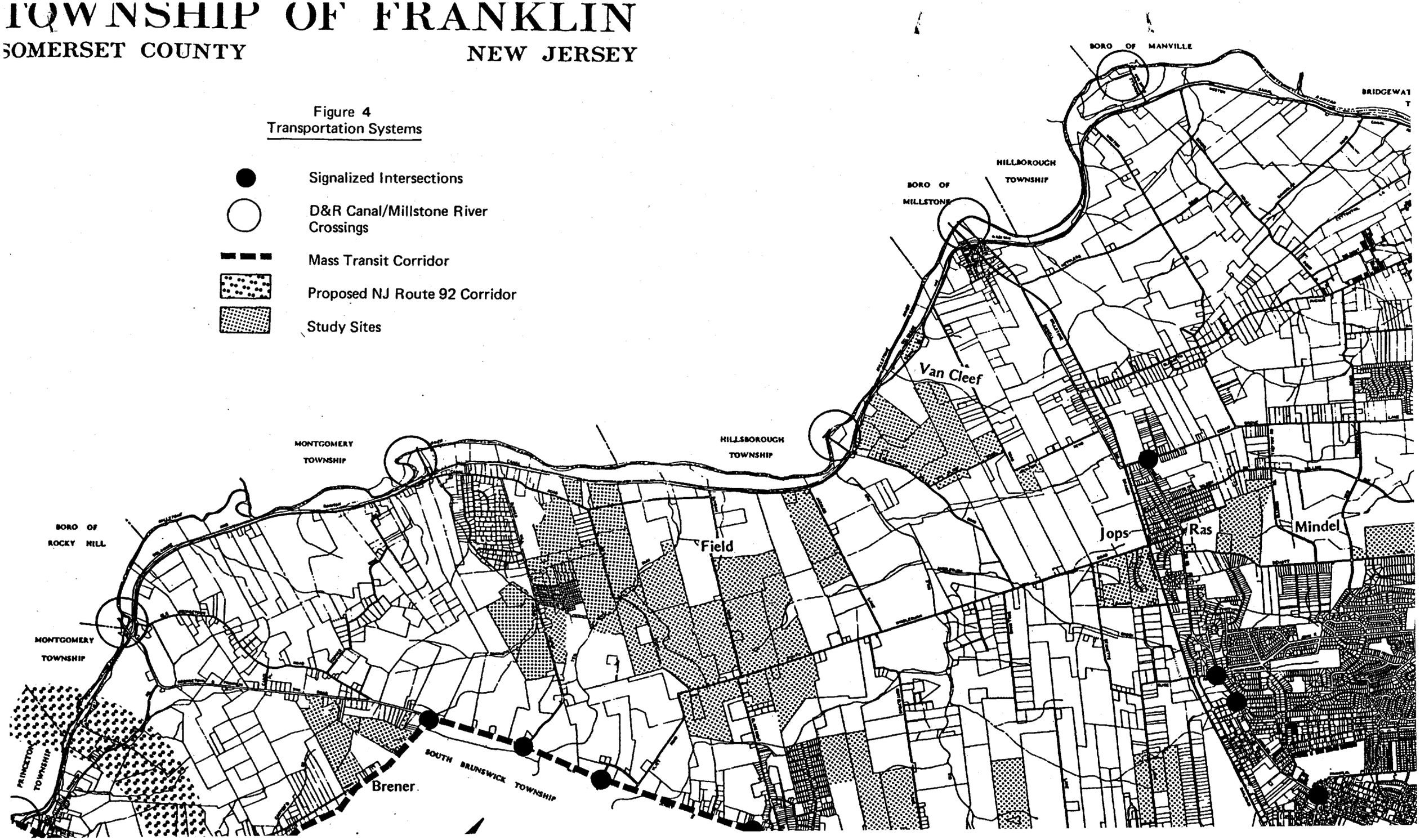


Table 5

Traffic Generation By Unit Type

(Motor Vehicle Trips per Unit)

Dwelling Unit Type	Density (Dwelling Units/Acre)	Daily Trips	PM Enter	PM Exit	PM Total
Single Family (Detached)	1.0	10.0	0.63	0.37	1.00
Single Family (Detached)	4.0	10.0	0.63	0.37	1.00
Townhouse (Residential Condominiums)	8.0	5.2	0.37	0.18	0.51
Garden Apartments (Low rise Apartments)	14.0	6.6	0.40	0.20	0.60

Source: Institute of Transportation Engineers, Trip Generation Handbook, 1982.

Table 6

Projected Traffic Generation

(1.0 dwelling unit per acre)

Site	Acres	Number of Units	Daily Trips	PM Enter	PM Exit	PM Total
Mindel	196.40	196	1,960	123	73	196
Ras	11.85	11	110	7	4	11
Jops	87.10	87	870	55	32	87
Flama	92.80	92	920	58	34	92
Woodbrook	40.00	40	400	25	15	40
Rakeco	100.10	100	1,000	63	37	100
Whitestone	82.90	82	820	52	30	82
JZR Associates	155.76	155	1,550	98	57	155
Van Cleef	373.63	373	3,730	235	138	373
Field	1,835.00	1,835	18,350	1,156	679	1,835
Brener	177.40	177	1,770	111	66	177

Table 7

Projected Traffic Generation

(4.0 dwelling units per acre)

Site	Acres	Number of Units	Daily Trips	PM Enter	PM Exit	PM Total
Mindel	196.40	784	7,840	494	290	784
Ras	11.85	44	440	28	16	44
Jops	87.10	348	3,480	219	129	348
Flama	92.80	368	3,680	232	136	368
Woodbrook	40.00	160	1,600	101	59	160
Rakeco	100.10	400	4,000	252	148	400
Whitestone	82.90	328	3,280	207	121	328
JZR Associates	155.76	620	6,200	391	229	620
Van Cleef	373.63	1,492	14,920	940	552	1,492
Field	1,835.00	7,340	73,400	4,624	2,716	7,340
Brener	177.40	707	7,707	445	261	707

Table 8

Projected Traffic Generation

(8.0 dwelling units per acre)

Site	Acres	Number of Units	Daily Trips	PM Enter	PM Exit	PM Total
Mindel	196.40	1,568	8,154	784	470	1,254
Ras	11.85	88	458	44	26	70
Jops	87.10	696	3,619	348	209	557
Flama	92.80	736	3,827	368	221	589
Woodbrook	40.00	320	1,664	160	96	256
Rakeco	100.10	800	4,160	400	240	640
Whitestone	82.90	656	3,411	328	197	525
JZR Associates	155.76	1,240	6,448	620	372	992
Van Cleef	373.63	2,984	15,517	1,492	895	2,387
Field	1,835.00	14,680	76,336	7,340	4,404	11,744
Brener	177.40	1,413	7,350	707	424	1,130

Table 9

Projected Traffic Generation

(14.0 dwelling units per acre)

Site	Acres	Number of Units	Daily Trips	PM Enter	PM Exit	PM Total
Mindel	196.40	2,744	18,110	1,098	549	1,646
Ras	11.85	154	1,016	62	31	92
Jops	87.10	1,218	8,039	487	244	731
Flama	92.80	1,288	8,501	515	258	773
Woodbrook	40.00	560	3,696	224	112	336
Rakeco	100.10	1,400	9,240	560	280	840
Whitestone	82.90	1,148	7,577	459	230	689
JZR Associates	155.76	2,170	14,322	868	434	1,302
Van Cleef	373.63	5,222	34,465	2,089	1,044	3,133
Field	1,835.00	25,690	169,554	10,276	5,138	15,414
Brener	177.40	2,473	16,325	990	494	1,484

After forecasting the daily and P.M. peak hour motor vehicle trips that would be generated by the development of each of the eleven sites under each of the four density scenarios, an evaluation was made of the impacts of each site development scenario on the operation of the Township road network. This network evaluation was carried out in the following manner:

- Roadways directly affected by a site's development were identified. Those directly affected include roads passing through or fronting on the site, which would be used to obtain access to the site. Collector roads were also identified for sites that were at a distance away from the more important arterial roads.

- The trips generated for each site were distributed to a number of potential destinations based upon transportation studies conducted for Somerset County in recent years.

- The percentage of trips using each road section was multiplied by the total P.M. peak hour trip generation for each development scenario, and added to the existing traffic volumes currently using the road section. This provided a forecast of future road volumes after site development.

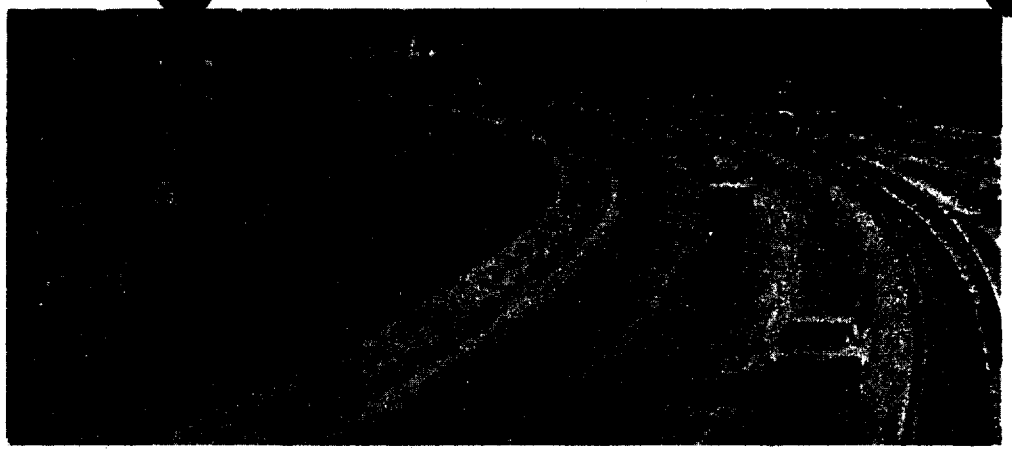
- After having forecasted traffic volume for the affected roads, an evaluation was made of the resulting roadway operating conditions under each site development scenario. The basis for traffic engineering measurements, comparisons, and evaluation of road traffic operating conditions is the relationship of a road's peak hour traffic usage (volume) to the road's capacity for carrying traffic (measured in vehicles per hour). This volume-to-capacity ratio (V/C) is the traffic volume divided by the road's capacity. The resulting V/C ratio provides an indication of the level of service being provided by the road. Generally, V/C ratio and level of service have the following relationship.

V/C Ratio	Level of Service
0.0	A
0.1	B
0.4	C
0.7	D
0.85	E
1.00	F

The significance of each level of service is described in Figure 5.

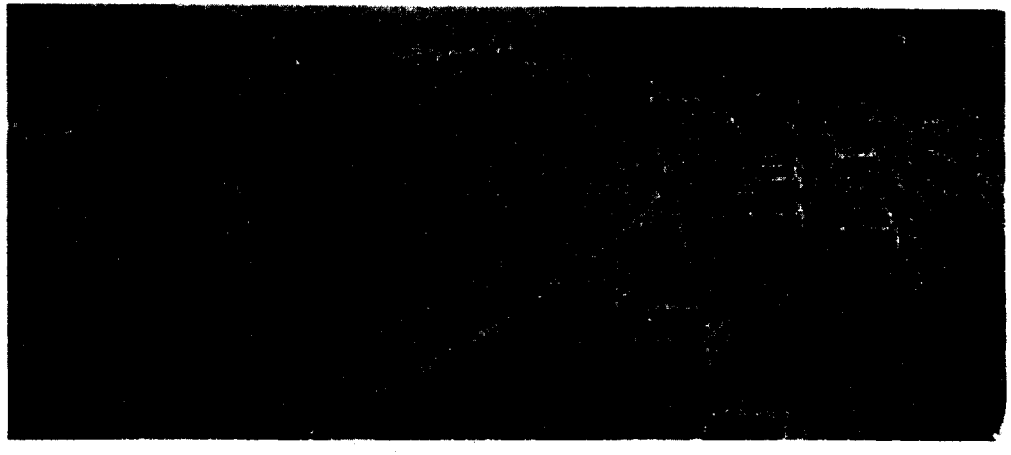
Figure 5 LEVELS OF SERVICE

Level of service A describes a condition of free flow, with low volumes and high speeds. Traffic density is low, with speeds controlled by driver desires, speed limits, and physical roadway conditions. There is little or no restriction in maneuverability due to the presence of other vehicles, and drivers can maintain their desired speeds with little or no delay.



Level of service B is in the zone of stable flow, with operating speeds beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speed and lane of operation. Reductions in speed are not unreasonable, with a low probability of traffic flow being restricted. The lower limit (lowest speed, highest volume) of this level of service has been associated with service volumes used in the design of rural highways.

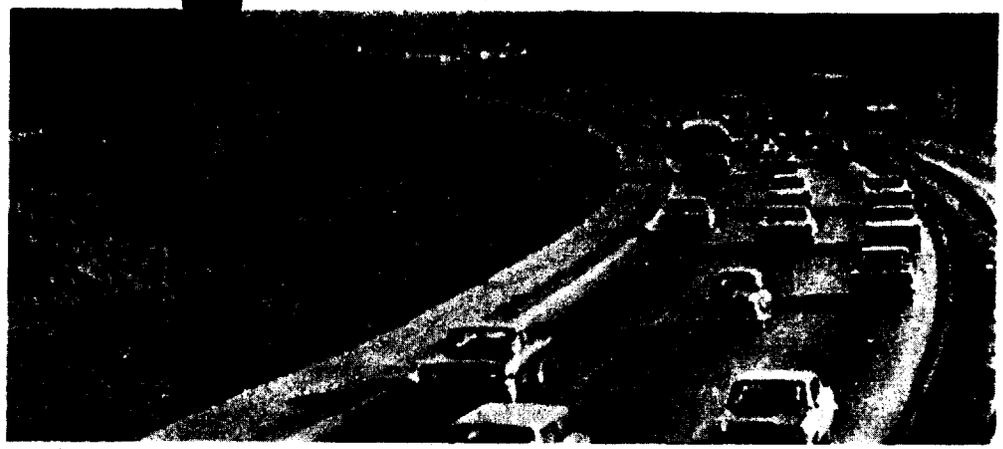
Level of service C is still in the zone of stable flow, but speeds and maneuverability are more closely controlled by the higher volumes. Most of the drivers are restricted in their freedom to select their own speed, change lanes, or pass. A relatively satisfactory operating speed is still obtained, with service volumes perhaps suitable for urban design practice.



Source: "Highway Capacity Manual", Highway Research Board, 1965.

ure 5 LEVELS OF SERVICE (Cont.)

Level of service D approaches unstable flow, with tolerable operating speeds being maintained though considerably affected by changes in operating conditions. Fluctuations in volume and temporary restrictions to flow may cause substantial drops in operating speeds. Drivers have little freedom to maneuver, and comfort and convenience are low, but conditions can be tolerated for short periods of time.



Level of service E cannot be described by speed alone, but represents operations at even lower operating speeds than in level D, with volumes at or near the capacity of the highway. At capacity, speeds are typically, but not always, in the neighborhood of 30 mph. Flow is unstable, and there may be stoppages of momentary duration.

Level of service F describes forced flow operation at low speeds, where volumes are below capacity. These conditions usually result from queues of vehicles backing up from a restriction downstream. The section under study will be serving as a storage area during parts or all of the peak hour. Speeds are reduced substantially and stoppages may occur for short or long periods of time because of the downstream congestion. In the extreme, both speed and volume can drop to zero.

Source: "Highway Capacity Manual", Highway Research Board, 1965.

Additional traffic can affect a roadway in two ways. First, the added traffic can result in an increase in congestion and a reduction in level of service. The additional congestion would mean that the other users of the road (today's existing users) would, by sharing the road with an increased number of user's, experience slower travel conditions, longer delays at intersections, etc. As a result, travel costs, motor vehicle operating costs, and time values for present users would be increased. However, while traffic conditions would deteriorate, the added traffic would not necessarily mean that the roadway must be upgraded to add more travel lanes.

The second affect would be to result in a roadway failure in terms of level of service. In this case the additional traffic would require additional roadway capacity so that the system could function. This would be a more significant impact that the first case because, if the affected roadway is not improved, the travel demand placed on the roadway would exceed the road capacity and result in stopping of traffic and lengthy delays, not just a progressive deterioration of travel conditions, slightly increased travel times and travel costs.

a. Mindel

The current traffic usage of DeMott Lane is not at a level where its roadway capacity is a concern. Even with development of the Mindel site to the densities of 1.0, 4.0 or 8.0 dwelling units per acre the level of service along DeMott Lane will not deteriorate below the "C" level of service. At 14.0 dwelling units per acre however, the traffic generated by the site's development will cause travel conditions along DeMott Lane to deteriorate to a "D" level of service.

b. Ras

As with the Mindel site, highway access to the Ras site will be via DeMott Lane. However, because the Ras land area is so small its traffic impacts would be minor.

The Ras site is in close proximity (0.25 mile) to the Route 514, Amwell Road intersection. Consequently, most travel to and from the Ras site will be via Route 514. If the site were developed at 1.0 dwelling unit per acre, DeMott Lane traffic approaching the Amwell Road intersection would be increased by some 3 percent. For the higher density scenarios, DeMott Lane traffic approaching Amwell Road would be increased by 14, 22 and 29 percent for 4.0, 8.0, and 14.0 units per acre.

c. Jops

The 87.1 acre Jops site is located within the area bounded by the Millstone Branch Railroad line on the north, Middlebush Road on the west, Bennets Lane on the south and Dahmer Road on the east. Access to the site would be via the three roads along the site boundaries.

Traffic generated by the Jops site will have an impact on Middlebush Road, Bennets Lane and Dahmer Road. Development of the site at 1.0 dwelling units per acre would increase traffic usage on adjacent roads by approximately 10 percent. These roads are currently uncongested and would not be significantly affected by this level of development. At 4.0 units per acre traffic volumes on the adjacent roads would be increased by some 50 percent, but they would still be operating at well below capacity. Development at 8.0 units per acre would increase traffic by some 80 percent on the adjacent roads, with a "C" level of traffic service still being experienced. At 14.0 units per acre with a 100 percent increase in traffic, the adjacent roads would provide a "C" level of traffic service.

Traffic generated by developing the Jops site would have more significance on Amwell Road than on the adjacent local roads. The two-lane roadway of Amwell Road is already carrying substantial traffic; approximately 10,000 vehicle per day. Operating condition during peak hours is approaching "D" level of service. Even the small percentage increase in traffic volumes using Amwell Road due to developing the Jops site at 1.0 unit per acre will degrade the level of traffic service on Amwell Road.

Development at 4.0 and 8.0 units per acre would reduce the level of traffic service to the "D" range. Development at 14.0 units per acre would create traffic demand on Amwell Road resulting in "E" level of service.

d. Flama

The 92.8 acre Flama site is located along the north side of Bennets Lane near Route N.J. 27. Traffic generated by development of this site would have access via Bennets Lane to Route N.J. 27 as well as use Bennets Lane and Clyde Road for access to Route 514, Amwell Road.

Bennets Lane, a local road, would be affected by development of the Flama site. Traffic usage of Bennets Lane would be increased by about 38 percent under a development density of 1.0 unit per acre but roadway capacity or level of traffic service would not be seriously affected. At a density of 4.0 units per acre traffic would be increased by approximately 150 percent, however roadway capacity on Bennets Lane would not be adversely affected. At 8.0 units per acre Bennets Lane traffic would increase by about 250 percent, with the traffic having a serious impact on the level of service, although a two-lane roadway would still be adequate. At 14.0 units per acre traffic usage of Bennets Lane would increase by 320 percent, resulting in a "D" level of service.

Traffic generated by the Flama site would also use N.J. Route 27, having access via Bennets Lane and its traffic-signal controlled intersection with Route N.J. 27, which in the vicinity of Bennets Lane, is operating at "E" level of service during peak hours of the day. Traffic generated at 1.0 unit per acre would increase the traffic volume using Route N.J. 27 by about 5 percent; with the level of service remaining within the "E" range. A density of 4.0 units per acre would generate so much Route N.J. 27 traffic that the resulting level of service would deteriorate to "F" level, failure. Development at 8.0 and 14.0 units per acre would result in Route N.J. 27 traffic north of Bennets Lane increasing by 30 and 40 percent respectively. In either case travel demand would exceed capacity for a two-lane roadway; so that Route N.J. 27 north of Bennets Lane would need to be widened to four-lanes.

e. Woodbrook

The 40 acre Woodbrook site is located along Bennets Lane opposite the Flama site. Traffic impacts of the Woodbrook site would be similar to the impacts of the Flama site, except that the traffic volumes generated would be less for the smaller Woodbrook site. As with the Flama site, Woodbrook generated traffic would have access via Bennets Lane to N.J. Route 27 and via Bennets Lane and Clyde Road to Route 514, Amwell Road.

At 1.0 dwelling unit per acre traffic volumes on Bennets Lane would be increased, but to a lesser extent than would be the case for comparable development of Flama. For none of the four scenarios would the traffic generated by Woodbrook cause the level of traffic service on Bennets Lane to be a problem.

Because N.J. Route 27 in the vicinity of Bennets Lane is currently operating at "E" level of service during peak hours of the day, the development of the Woodbrook site will have only a minimum impact on N.J. Route 27. The 2 percent increase in the traffic on N.J. Route 27, due to the development of the Woodbrook site at 1.0 unit per acre would result in the Route still operating within the "E" level of service. Development at 4.0 units per acre would, however, result in N.J. Route 27 travel demand causing a failure, "F" level of service.

Travel demands resulting from 8.0-14.0 units per acre would exceed the capacity of N.J. Route 27 as it currently exists.

f. Rakeco

The 100.1 acre Rakeco site is located along N.J. Route 27, north of Cortelyous Lane and about 2 miles south of the Somerset area. Access to this site would be from N.J. Route 27.

A development density of 1.0 dwelling units per acre would slightly increase traffic using N.J. Route 27 and only slightly degrade the level of traffic service. A development density of 4.0 units per acre would result in traffic on N.J. Route 27 approaching level of service "F", failure. A development density of 8.0-14.0 units per acre would increase N.J Route 27 traffic by about 24 and 33 percent respectively; and as a consequence the capacity of the existing roadway would be exceeded.

g. Whitestone

Motor vehicle traffic generated by development of the Whitestone site would have access to either Cortelyous Lane or N.J. Route 27.

With N.J. Route 27 currently operating at an E level of service, development of this site under a density scenario of 1.0 dwelling unit per acre would only have a slight impact on the level of traffic service. It would remain in the D-E range. Development at 4.0 units per acre would cause a 12 percent increase in traffic volumes on N.J. Route 27 and would result in the level of traffic service deteriorating to a condition approaching failure or level of service "F". With development at 8.0 or 14.0 units per acre, traffic volumes on N.J. Route 27 would be increased by 20 and 26 percent and the capacity of this roadway would be exceeded.

h. JZR Associates

The 155.76 acre JZR Associates site is located adjacent to N.J. Route 27, south of Cortelyous Lane about 3 miles south of Somerset. Motor vehicle traffic generated by development of this site would have access directly to N.J. Route 27.

Development of this site would cause an increase in traffic on N.J. Route 27. During daily peak hours, the N.J. Route 27 roadway is currently operating at a level of service in the D-E range. Development at 1.0 unit per acre would cause a 6 percent increase in N.J. Route 27 traffic and result in an "E" level of traffic service. Development at 4.0 units per acre would generate traffic to the extent that travel conditions on N.J. Route 27 would deteriorate to level of service "F". Development at densities of 8.0 and 14.0 units per acre would exceed N.J. Route 27 capacity and require upgrading to a four-lane highway.

i. Van Cleef

The Van Cleef site is the second largest of the eleven sites evaluated. In addition to being large in area, it is located in an undeveloped rural area and away from the higher type arterial roads. The Van Cleef site fronts along Grouser Road, Van Cleef Road, and Canal Road, all of which are rural land access roads designed for low traffic volumes and light loads. Access into the site would be by reconstructed two-lane roads which would carry the traffic from Route 514, Amwell Road into the site area. However, the local roads would have to be reconstructed as high type two-lane roads including: Grouser Road, Blackwells Mills Road, Van Cleef Road, Canal Road, and Middlebush Road.

The density of the development which influences total trip generation would also influence the level of traffic service experienced on the improved local two-lane roads. At a density of 1.0 unit per acre, the roads would provide a high level of traffic service (level B). At a density of 4.0 units per acre, C level of service would be possible. At 8.0 and 14.0 units per acre, congestion would be experienced although the upgraded two-lane local roads would still have sufficient capacity.

Route 514, Amwell Road would also be affected by development of the Van Cleef site. At 1.0 unit per acre, Route 514 would still have sufficient capacity to carry the generated traffic, although the level of traffic service and travel speed would be reduced from their present levels. At 4.0, 8.0, and 14.0 units per acre, Route 514 would need to be upgraded to four travel lanes.

j. Field

Many roads would be affected by the development of the Field site. Local roads that would be required to provide access to the various parts of the Field site but are currently narrow two-lane rural roads and not designed for high volume traffic usage nor heavy loads include the following:

- Jacques Lane
- Suydam Road
- Butler Road
- Bunker Hill Road
- Claremont Road

Parts of the Field site would also front on:

- Canal Road
- Middlebush Road
- Vliet Road

Although these three roads are currently of better design than the first that were mentioned, they would still not be adequate to serve the traffic generated by the Fields site. In addition, Blackwells Mills Road and Cortelyous Road would be affected by development of the site.

Although not adjacent to the site, Route N.J. 27 would be severely affected by development of the Field site even at the lowest density. Development at higher densities (4.0-8.0 units per acre) would necessitate the upgrading of Route N.J. 27 to a four-lane facility. Development at 14.0 units per acre, would generate so much motor vehicle traffic that a six-lane facility would be needed to replace Route N.J. 27.

Similarly, Amwell Road would be affected by development of the Field site. At 1.0 unit per acre, traffic operating conditions on Amwell Road would deteriorate. At 4.0, 8.0, or 14.0 units per acre, traffic demand on Amwell Road would greatly exceed capacity of its existing two-lane roadway requiring a four-lane facility.

Even beyond the boundaries of Franklin Township, the motor vehicle traffic generated by development of the Field site would have impacts on the surrounding road network. For example, the local roads in South Brunswick Township such as Finnegans Lane, Henderson Road, Sand Hill Road, and New Road which connect N.J. Route 27 to Route U.S. 1 would have increased traffic usage. The bridges crossing the Millstone River and Delaware and Raritan Canal as well as River Road would have increased traffic usage. None of these roads in the areas surrounding Franklin Township have the traffic carrying capacity needed to serve the traffic that would be generated by development of the Field site.

On a road by road basis, the impacts of the alternative densities for Field development are best seen by examining Appendix B, which shows the extremely large percent increases in traffic. The need for roadway improvements both within the site and along adjacent roads would be great. Whether such investment would be available in an appropriate time is unknown. There is currently little or no State initiative to widen N.J. Route 27, necessary if the Field project should be built at the highest densities, is extremely remote.

k. Brener

Motor vehicle traffic generated by the development of this site would have access to N.J. Route 27 at the east of the site and Georgetown-Franklin Turnpike at the west of the site. The impact of developing this site would be to cause an increase in the amount of traffic using N.J. Route 27 and to a lesser extent result in increased traffic using Georgetown-Franklin Turnpike.

Under development scenario 1 (1.0 unit per acre) N.J. Route 27 would increase by approximately 9 percent; an increase which would not result in a significant decrease in the level of traffic service or average travel speeds provided by N.J. Route 27.

Development at a density of 4.0 dwelling units per acre would result in a 37 percent increase in traffic using N.J. Route 27. North of the Georgetown-Franklin Turnpike intersection, where there currently is higher traffic volumes, the added traffic due to the development of the Brener site at this density would degrade the level of traffic service provided by N.J. Route 27 from a "C" level of service to a "D" level of service during daily peak hours. The deterioration of the level of service would mean a reduction in average highway travel speeds along N.J. Route 27.

Development at a density of 8.0 units per acres would produce a 59 percent increase in N.J. Route 27 traffic volumes. Peak hour level of traffic service would deteriorate to a capacity condition; a level of service approaching "F" failure. Average travel speed would be reduced to the extent that travel times for a 10 mile trip would be increased by some 30 percent.

Development at a density of 14.0 units per acre would generate such a volume of traffic that the demand for motor vehicle travel on N.J. Route 27, north of the Georgetown-Franklin Turnpike intersection would exceed the capacity of the existing roadway. Construction of low rise apartments on the Brener site would generate an amount of motor vehicle travel that when added to the current traffic using N.J. Route 27 would necessitate the widening of the roadway to a four-lane highway.

3. Development Suitability

To compare site suitability on the basis of transportation a rating system has been designed which takes into account the magnitude of impact as measured by the average increase in traffic volume projected for roadway links; the significance of impacts as measured by the changes in level of service; and the cost impacts as measured by the amount of road improvement required. The rating system was applied to each site under each development scenario.

The scoring system has a total possible score of 100 points, of which 20 are assigned to the traffic volume index, 35 to the level of service index and 45 to the road improvement index (which is a proxy for the relative estimate of improvement cost). For each index, points were awarded according to the scales shown in Table 10.

Tables 11 to 14 present the ratings and rankings of each site for each development scenario.

4. Comparative Suitability

The Ras, Jops, and Mindel sites emerge as the most suitable for development because of least traffic impact as measured by expected increases in traffic volume, change in service level on adjacent roadways, and the need to widen roads.

The Field, Whitestone, and Van Cleef sites are the least suitable for development with consistently low rankings for each development scenario. The development of these sites will require substantial road-widening and cause moderate to extreme degradation in service levels.

Table 10

Transportation Service Rating Criteria

Resulting Level of Service		Traffic Volume		Road Improvement	
Service Level Change Existing to Scenario	Score	Average Volume Increase on Roadways (%)	Score	Improvement	Score
No change	35	0- 30	20	No widening required	45
C	31	31- 60	17	1 widening required	30
D	23	61- 90	14	2 widenings required	15
E	13	91-120	11	More than 2 widenings required	0
F	0	121-180	8		
		151-180	5		
		181-210	2		
		210 +	0		

Table 11

Development Suitability - Transportation

(1.0 dwelling unit per acre)

Site	Average Volume Increase on Roadways (%)	Resulting Service Level	Road Improvement (Segments)	Volume Score	Service Level Score	Road Improvements Score	Total Score	Suitability Ranking
Brener	6.3	no change	0	20	35	45	100	1
JZR Associates	6.0	no change	0	20	35	45	100	1
Whitestone	9.3	no change	0	20	35	45	100	1
Rakeco	3.5	no change	0	20	35	45	100	1
Woodbrook	6.6	no change	0	20	35	45	100	1
Flama	15.0	E	0	20	13	45	78	3
Jops	7.3	no change	0	20	35	45	100	1
Van Cleef	32.1	no change	0	17	35	45	97	2
Field	146.7	D	2	8	23	15	46	3
Mindel	26.3	no change	0	20	35	45	100	1
Ras	2.0	no change	0	20	35	45	100	1

Table 12

Development Suitability - Transportation

(4.0 dwelling units per acre)

Site	Average Volume Increase on Roadways (%)	Resulting Service Level	Road Improvement (Segments)	Volume Score	Service Level Score	Road Improvements Score	Total Score	Suitability Ranking
Brener	28.3	D	0	20	23	45	88	2
JZR Associates	23.5	F	2	20	0	15	35	8
Whitestone	37.0	F	2	17	0	15	32	9
Rakeco	15.0	F	1	20	0	30	50	5
Woodbrook	26.0	E	2	20	13	15	48	6
Flama	59.6	E	1	17	13	30	60	4
Jops	30.0	no change	0	20	35	45	100	1
Van Cleef	126.2	D	2	8	23	15	46	7
Field	589.0	E	3+	0	13	0	13	10
Mindel	105.4	C	0	11	31	45	87	3
Ras	7.5	no change	0	20	35	45	100	1

Table 13

Development Suitability - Transportation

(8.0 dwelling units per acre)

Site	Average Volume Increase on Roadways (%)	Resulting Service Level	Road Improvement (Segments)	Volume Score	Service Level Score	Road Improvements Score	Total Score	Suitability Ranking
Brener	45.3	E	1	17	13	30	60	4
JZR Associates	37.5	F	2	17	0	15	32	9
Whitestone	59.3	F	3	17	0	0	17	10
Rakeco	24.0	F	2	20	0	15	35	8
Woodbrook	41.6	E	2	17	13	15	45	6
Flama	95.6	E	1	11	13	30	54	5
Jops	48.3	no change	0	17	35	45	97	2
Van Cleef	205.0	D	2	2	23	15	40	7
Field	943.3	F	3+	0	0	0	0	11
Mindel	168.6	C	0	5	31	45	81	3
Ras	12.0	no change	0	20	35	45	100	1

Table 14

Development Suitability - Transportation

(14.0 dwelling unit per acre)

Site	Average Volume Increase on Roadways (%)	Resulting Service Level	Road Improvement (Segments)	Volume Score	Service Level Score	Road Improvements Score	Total Score	Suitability Ranking
Brener	59.6	E	1	17	13	30	60	4
JZR Associates	47.0	F	2	17	0	15	32	6
Whitestone	77.6	F	3	14	0	0	14	9
Rakeco	31.5	F	2	17	0	15	32	6
Woodbrook	59.0	E	2	17	13	15	45	5
Flama	126.0	F	2	8	0	15	23	8
Jops	63.0	D	0	14	23	45	82	2
Van Cleef	270.0	E	3	0	13	0	13	10
Field	1,240.0	F	3+	0	0	0	0	11
Mindel	221.0	D	0	0	23	45	68	3
Ras	15.5	no change	0	20	35	45	100	1

C. Municipal Services

The provision of municipal services is an important consideration to determining suitability of a particular site for development. The availability of such services could minimize the costs associated with such development; the lack of services could increase initial development costs or those costs associated with serving a site on an on-going basis. For purposes of this study the analysis of municipal services has focused upon the provision of public utilities in the form of potable water supply and sewage collection and public safety including police and fire protection.

Public Water Supply

1. Existing Conditions

More than 75 percent of the population of Franklin Township is served by public water utilities. The majority of treated water is supplied by the Elizabethtown Water Company and distributed by the Franklin Township Water Utility. The peak daily consumption recorded, during a period of prolonged drought in June, 1980, was about 5 million gallons per day (mgd) and the average daily flow for the year 1980 was 3.36 million gallons, or about 100 gallons per capita. These figures include residential, industrial and commercial useage. It should be noted, that since 1980 the average daily flow has been at or below 2.7 mgd.

The present Elizabethtown system is actually two separate systems. The first system serves the Somerset area. This is the area southeast of John F. Kennedy Boulevard, northeast of the former Millstone Branch of the Pennsylvania Railroad, northwest of New Brunswick and southwest of the Raritan River and the Delaware and Raritan Canal. The supply for this area is through a single 20 inch main, generally in Amwell Road, which is connected to the Elizabethtown system at Mettler's Road. This connection is referred to as the Amwell Road connection.

The distribution system in the Somerset area is divided into two areas. The area northwest of Girard Avenue consists of 6 inch and 8 inch pipe reinforced with 10 inch and 12 inch lines. Except for cul-de-sacs, there are very few dead ends of pipe in this area. The area southeast of Girard Avenue consists primarily of 6 inch lines with some 8 inch lines. This area, however, has over 40 dead ends of pipe. These dead ends do not allow for two-way flow which reduces both the fire flow capacity of the system and circulation through the system.

The second system is the extreme northeasterly portion of the Township; the area generally north of School House Road, New Brunswick Road and Cedar Grove Lane. Except for one residential subdivision, this area is generally industrial. This area is supplied by two connections with Elizabethtown at School House Road and at Weston Canal Road. Mains in this area, except for the subdivision, are 12 inches through 24 inches in diameter.

North Brunswick Township also supplies treated water under contract to Franklin Township. North Brunswick currently has diversion rights to 8.0 mgd from the Delaware and Raritan Canal. The North Brunswick Utility treats water it diverts at its 10 mgd facility located in Franklin Township along Suydam Road adjacent to the Canal. A 24 inch transmission line runs across Franklin Township along Suydam and Claremont Roads to North Brunswick Township. Currently, Franklin Township's contract with the North Brunswick Township Water Utility allows for

the purchase of up to 1.0 mgd. Franklin Township currently uses about 0.5 mgd with much of this amount used by homes in the Franklin Park area. North Brunswick Township, however, has expressed interest in selling additional water supplies to Franklin Township.

South Brunswick also supplies water to several private homes along N.J. Route 27 in southern Franklin Township. However, the growing demand for water within South Brunswick Township has resulted in little or no interest in selling additional water to Franklin Township. Principal components of the public water systems serving Franklin Township are shown in Figure 6.

Those homes and businesses not supplied by Elizabethtown, North Brunswick or South Brunswick are served by groundwater supplies. The underlying geology in Franklin Township consists of two major formations, the Brunswick Shale which covers approximately 80 percent of the Township and the Triassic Diabase which covers the remainder of the Township. Safe sustained yields for the two formations range from 200,000 to 350,000 gallons per day per square mile for the Brunswick Shale area, and 85,000 to 120,000 gallons per day per square mile for the Triassic Diabase area, based upon existing well records and published estimates.

Water Use Rates

A study conducted for Franklin Township in 1968 showed that average annual water use ranged fron 100-110 gallons per person per day. Recently, the Comprehensive Master Plan (1982) utilized a water use rate of 100 gallons per person per day for planning purposes. It should be noted that differences in water use exist when comparing residential development densities. The Journal of the American Water Works Association cites a significant decrease in per capita water use when development density increases above 4.0 units per acre. The State of New Jersey in planning new water supply projects, also recognize such differences in water use characteristics, relying upon an average of 100 gallons per person per day for single-family developments and 75 gallons per person per day for multi-family developments. For purposes of this analysis the same water use rates will be used; 100 gallons per person per day for single-family units (1.0 and 4.0 units per acre) and 75 gallons per person per day for multi-family units (8.0 and 14.0 units per acre). Table 15 presents projected water supply requirements for each site under each scenario.

2. Development Impacts

a. Mindel

Public water supply is available to two of the three parcels of the Mindel site from the 20 inch water main that runs along the eastern property lines of the two parcels along DeMott Lane. The northernmost parcel of the Mindel site could also be serviced by that line as it abutts the southernmost corner of that parcel. The three parcels together would require anywhere from 68,600 to 412,500 gallons of water per day depending upon the density of development. Sufficient capacity exists within the water distribution system to meet water supply requirements under each scenario at this site.

b. Ras

Water capacity is available to the RAS site from the 20 inch water main that runs along the site's eastern property line along DeMott Lane. This site would

Table 15

Projected Water Supply Requirements

(Gallons Per Day)

Site	Development Scenario			
	1.0 Du/Acre[1]	4.0 Du/Acre[1]	8.0 Du/Acre[2]	14.0 Du/Acre[2]
Brener	62,000	247,800	266,100	372,600
JZR Associates	54,600	218,400	233,625	327,150
Whitestone	29,100	116,800	124,350	174,150
Rakeco	35,000	140,000	150,000	210,000
Woodbrook	14,000	56,000	60,000	84,000
Flama	32,600	130,200	139,125	194,850
Jops	30,500	121,800	130,725	182,850
Van Cleef	130,900	523,600	560,475	784,650
Field	642,300	2,569,000	2,752,500	3,853,500
Mindel	68,600	274,400	294,600	412,500
Ras	4,200	16,800	17,850	24,900

[1]Assumes 100 gallons per capita per day.

[2]Assumes 75 gallons per capita per day.

TOWNSHIP OF FRANKLIN
SOMERSET COUNTY NEW JERSEY

Figure 6
Water Supply Lines

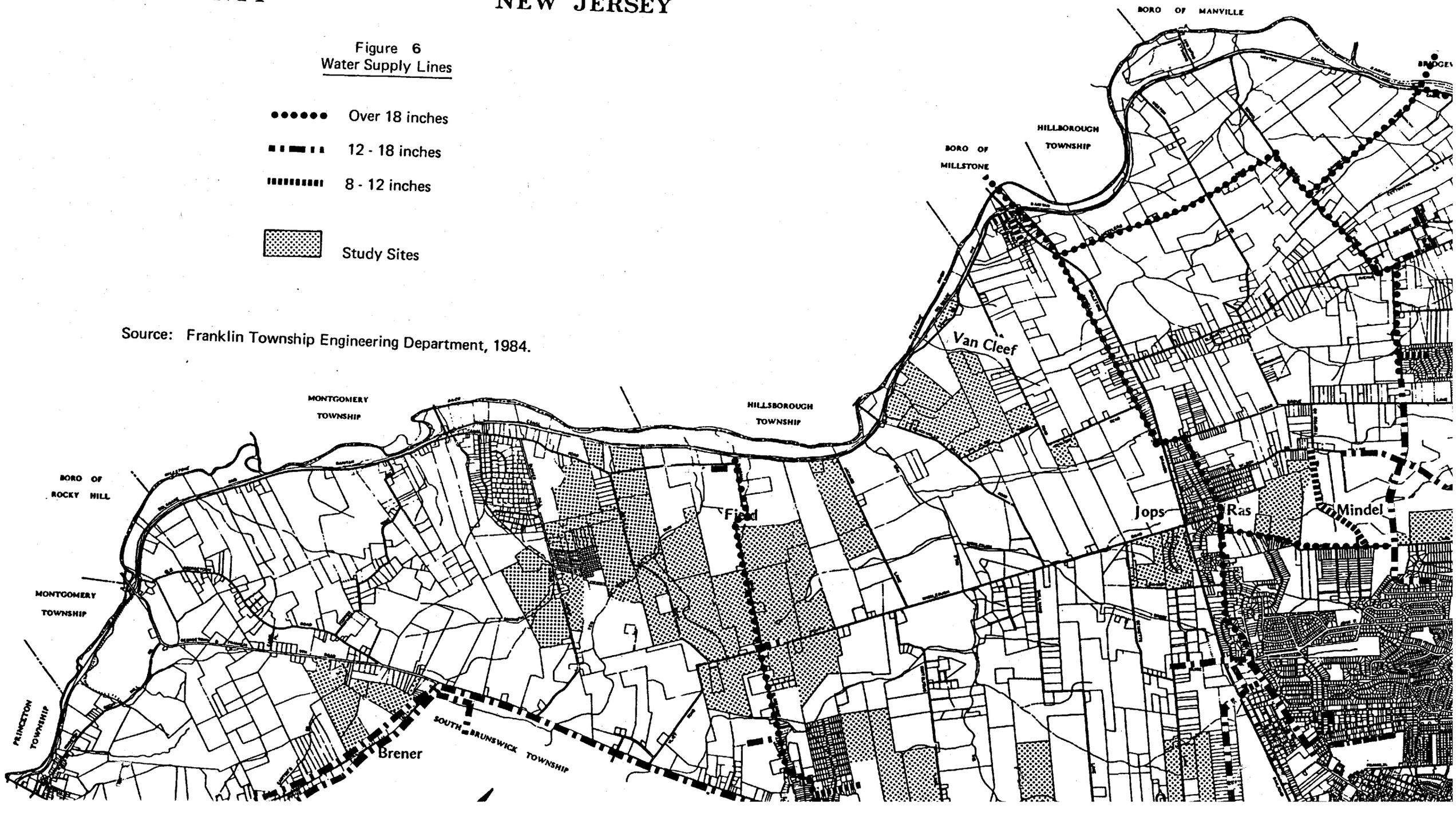
●●●●●● Over 18 inches

▪ ▪ ▬ ▪ ▪ 12 - 18 inches

▮▮▮▮▮▮▮▮▮▮ 8 - 12 inches

▒▒▒ Study Sites

Source: Franklin Township Engineering Department, 1984.



require from 4,200 to 24,900 gallons per day depending upon the density of development. Sufficient capacity exists to meet future water requirements under each scenario.

c. Jops

A 20 inch water main is found approximately 1,000 feet to the north of the Jops site. Capacity is available in that line for use at the Jops site. Approximately 30,500 to 182,850 gallons per day of capacity would be required depending upon the density of development.

d. Flama

A 12 inch water line runs along the eastern property line of the Flama site. Capacity is available in that line to provide the 32,600 to 194,850 gallons per day required as a result of the site's development at any of the densities analyzed.

e. Woodbrook

The Woodbrook site is expected to require between 14,000 to 84,000 gallons per day depending upon the density of development. A 12 inch water line exists approximately 800 feet east of the property line of the Woodbrook site along N.J. Route 27. Capacity is available in that line to service the Woodbrook site at any of the four densities.

f. Rakeco

At the present time public water service has not been extended to the area of the Rakeco site. There is, however, a 12 inch water line located approximately 2,400 feet north of the site along N.J. Route 27. Capacity is available in this line to meet the demands of each density. The line currently terminates in a dead end. North Brunswick also has a 20 inch line that runs along N.J. Route 27 terminating some 3,000 feet south of the Rakeco site. North Brunswick Township also has an 8 inch water line found at the intersection of Skillmans Lane and N.J. Route 27. The Rakeco site is expected to require between 35,000 and 210,000 gallons of water per day depending on the density of development.

g. Whitestone

The Whitestone site is located within approximately 1,800 feet of the North Brunswick Township 24 inch transmission line. North Brunswick's 20 inch water line along N.J. Route 27 also runs along the northeastern property line of the Whitestone site. Water supplies from these two lines are available to the Whitestone site from North Brunswick Township. About 174,150 gallons of water use per day is anticipated at the site at the highest density scenario and 29,100 gallons per day is anticipated under the lowest density scenario. Capacity is available to meet all expected water requirements.

h. JZR Associates

The JZR Associates site is located northeast of and within a hundred feet of North Brunswick Township's 24 inch transmission line which brings water from the Delaware and Raritan Canal to North Brunswick Township. An official of the

North Brunswick Water Department has expressed the Township's interest in providing Franklin Township with additional water supplies. North Brunswick also has a 20 inch water line along Route 27 along the northeastern property line of JZR Associates. Between and 327,150 gallons per day are expected to be required at the site depending the development density. Capacity in this line is capable of meeting anticipated requirements of the site.

i. Van Cleef

A 20 inch water main along Amwell Road is approximately 2,500 feet north of the northermost parcel of the Van Cleef site. Water capacity would be available to this site at each development as long as a water line was extended south to the site. Approximately 4,650 gpd would be required at this site if it were developed.

j. Field

North Brunswick Township's 24 inch transmission main runs through the center of the Field site. One 12 inch plug exists on the line within the Field site itself and two additional 12 inch plugs exist within approximately 800 feet of the site. Capacity is available in the line to service the Field site. However, arrangements would have to be made with North Brunswick Township for the purchase of additional capacity. The 642,300 to 3,853,500 gpd that would be required would cause the purchase agreement with North Brunswick Township to be exceeded.

k. Brener

South Brunswick Township has 12 inch water lines along the eastern border of the Brener site. The Franklin Township side of N.J. Route 27 provides water to a number of Township homes. However, no additional capacity is available to Township from that line. The line on The South Brunswick side of Route services South Brunswick residents only and capacity in that line is not available to Franklin Township. The Brener site is expected to require between 62,000 and 372,600 gallons per day of water depending upon the density of development; a range which could be met by the lines in the area.

3. Site Suitability

The provision of water supply service is a major factor influencing development suitability. As such the location and available capacity of public water supply and distribution systems will be a principal index against which each site will be evaluated in terms of service.

Those sites located immediately adjacent to a public water supply main will be rated most suitable for this factor (assuming sufficient excess capacity to serve the appropriate density of development). Sites in close proximity to public water mains (within 1,000 feet with sufficient capacity to serve future demands) are rated moderately suitable for this factor again assuming sufficient capacity to serve future demands. Sites located within 1,000-3,000 feet of a water main with sufficient capacity to serve future demands are rated least suitable.

4. Comparative Suitability

Seven of the eleven sites front upon Franklin Township, North Brunswick Township, or South Brunswick Township water mains. It has been confirmed that each water main adjacent to these seven sites has sufficient excess capacity to meet projected water demands up to 14.0 units per acre at each site. Two sites, Jops and Woodbrook, are within approximately 1,000 feet of public water mains with the remaining two, Van Cleef and Rakeco approximately 2,500 feet from a public water main.

Based solely upon the location and available supply within nearby water mains and not considering institutional and financial impediments to such supply, the Van Cleef and Rakeco sites are rated least suitable, the Jops and Woodbrook moderately suitable, and the remaining seven (Mindel, Ras, Flama, Whitestone, JZR Associates, Field and Brener) most suitable. This rating applies to each site under each development scenario with respect to provision of public water supply. In this analysis rating and ranking are equivalent. Table 16 presents the results of this analysis with respect to the overall ranking of sites.

Table 16

Development Suitability - Public Water Supply

Site	Immediate Access to Public Water Main	Within 1,000 Feet of Public Water Main	1,000-3,000 Feet to Public Water Main	Suitability Ranking
Mindel	1	-	-	1
Ras	1	-	-	1
Jops	-	2	-	2
Flama	1	-	-	1
Woodbrook	-	2	-	2
Rakeco	-	-	3	3
Whitestone	1	-	-	1
JZR Associates	1	-	-	1
Van Cleef	-	-	3	3
Field	1	-	-	1
Brener	1	-	-	1

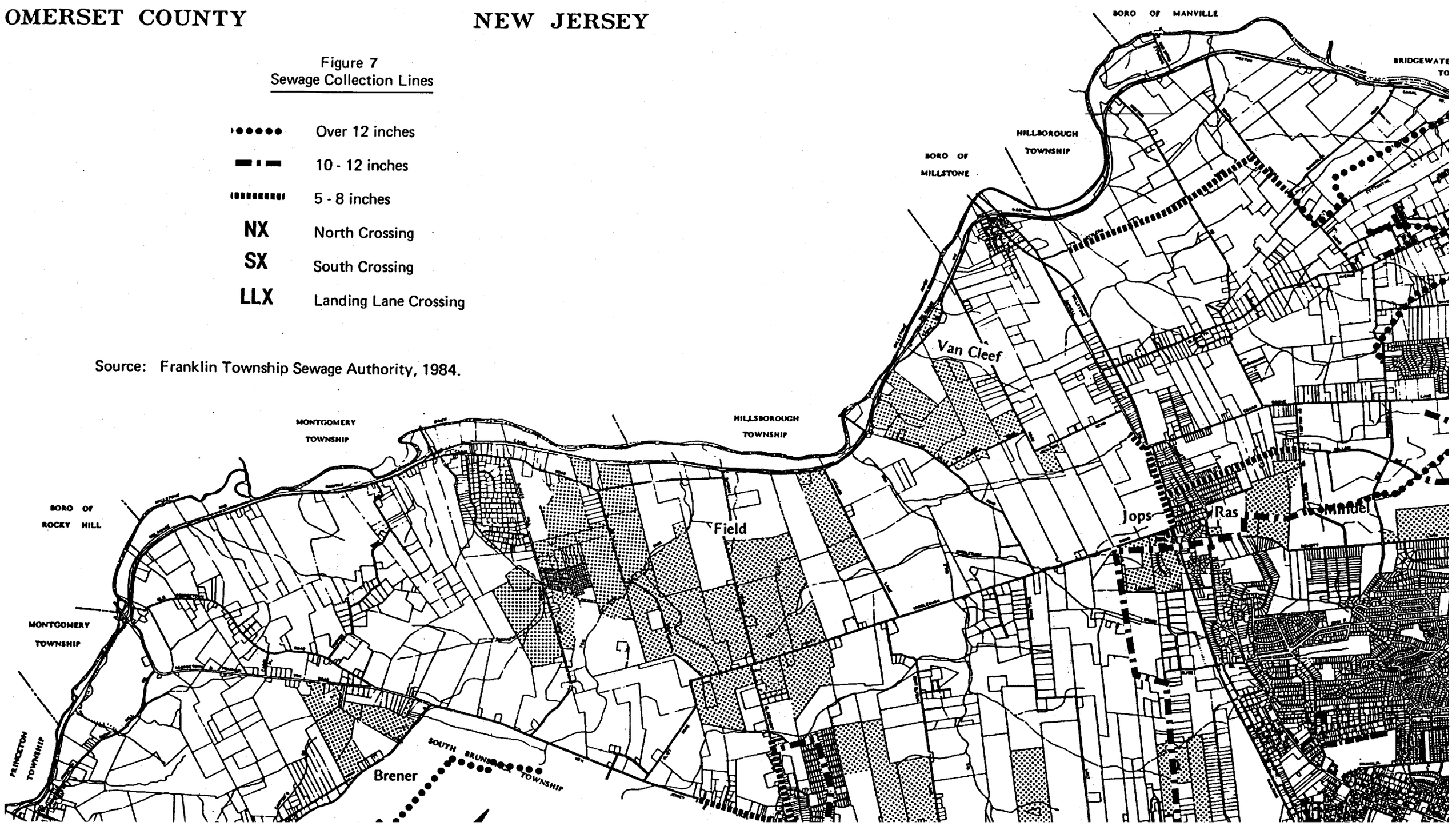
Rating: 1 - Highly Suitable
2 - Moderately Suitable
3 - Least Suitable

TOWNSHIP OF FRANKLIN
SOMERSET COUNTY NEW JERSEY

Figure 7
Sewage Collection Lines

●●●●●	Over 12 inches
▬ ▮ ▬	10 - 12 inches
▮▮▮▮▮▮▮▮▮▮	5 - 8 inches
NX	North Crossing
SX	South Crossing
LLX	Landing Lane Crossing

Source: Franklin Township Sewage Authority, 1984.



and pool-filling would reduce the amount of water used that is returned to the sewer system by at least the 10 percent figure noted above. For the purposes of this study, the conservative figure of 10 percent will be used. Therefore, sewer generation amounts to approximately 67.5 gallons per person per day for 14.0 and 8.0 units/acre densities, and 90 gallons per person per day for the 1.0 and 4.0 units/acre density. Table 17 presents projected wastewater estimates for each site under each scenario.

2. Development Impacts

a. Mindel

The Mindel site consists of three parcels. The southern two parcels of the Mindel site totalling 110 acres, are currently bordered or crossed by a 12 inch sewer line maintained by the Franklin Township Sewerage Authority. A 21 inch interceptor is located 800 feet west of the northernmost parcel. However, sewage capacity is not available to any of the three parcels as the remaining capacity in that line is dedicated solely to development currently under construction in the area. Sewer lines further to the east of the site are connected to a MCUA trunk line that is also operating at full capacity. Approximately 61,740 to 371,250 gallons per day of sewage are anticipated depending upon development density.

b. Ras

The Ras site shares a property line with the larger of the three Mindel parcels. Thus the Ras site is in the same position regarding availability of sewer capacity as described for the Mindel site. From 3,780 to 22,410 gallons per day of sewage is anticipated depending upon development density.

c. Jops

A 12 inch sewer crosses the Jops site. Excess capacity is not available to Jops as the capacity in the line is dedicated to a new residential development located further downstream. No other sewer lines presently exist in the immediate vicinity of the site. Depending on the development density, between 27,450 and 164,565 gallons per day will be generated.

d. Flama

A 10 inch force main is located along Bennets Lane adjacent to the southwestern border of the Flama site. Excess capacity is not available in that line and no other sewer lines exist in the immediate vicinity of the site. About 29,340 to 175,365 gallons per day of sewage are expected to be produced depending upon the development density.

e. Woodbrook

The same 10 inch force main located along Bennets Lane also borders the northeastern property line of the Woodbrook site. As with the Flama site excess sewer capacity is not available. No other sewer lines exist in the immediate vicinity of the site. Domestic sewage in the amount of 12,600 to 75,600 gallons per day is anticipated from the site depending upon development density.

Table 17

Projected Wastewater Generation

(Gallons Per Day)

Site	Development Scenario			
	1.0 Du/Acre[1]	4.0 Du/Acre[1]	8.0 Du/Acre[2]	14.0 Du/Acre[2]
Brener	55,800	223,200	239,490	335,340
JZR Associates	49,140	196,560	210,263	294,435
Whitestone	26,190	105,120	111,915	156,735
Rakeco	31,500	126,000	135,000	189,000
Woodbrook	12,600	50,400	54,000	75,600
Flama	29,340	117,180	125,213	175,365
Jops	27,450	109,620	117,653	164,565
Van Cleef	117,810	471,240	504,428	706,185
Field	578,070	2,312,100	2,477,250	3,468,150
Mindel	61,740	246,960	265,140	371,250
Ras	3,780	15,120	16,085	22,410

[1]Assumes 90 gallons per capita per day.

[2]Assumes 67.5 gallons per capita per day.

f. Rakeco

The 10 inch force main described above runs along the southeastern property line of the site along N.J. Route 27. Excess capacity in that line is not available. No other sewer lines exist in the immediate vicinity of the site. Depending on the density of development, between 31,500 and 189,000 gallons per day of domestic sewage is anticipated.

g. Whitestone

A 12 inch sewer line runs along the southeastern border of the site along N.J. Route 27. Excess capacity in that line is not available. No other sewer lines exist in the immediate vicinity of the site. Depending on the density of development, between 26,190 and 156,735 gallons per day is expected to be produced.

h. JZR Associates

Depending upon the density of development, the JZR Associates site would produce approximately 49,140 to 294,435 gpd of sewage. A 12 inch sewer line installed by the Franklin Township Sewerage Authority runs along the southeastern border of the site on N.J. Route 27. Excess capacity in that line is not available. A 10 inch force main that services Franklin Park is located 600 hundred feet away from the southwestern property line of the site. However, capacity in that portion of the line is also not available. No other sewer lines exist in the immediate vicinity of the site.

i. Van Cleef

The Van Cleef site would produce from 117,810 to 706,185 gallons per day of sewage depending upon the density of development. Sewer lines have not been extended to service this area of the Township and there are no plans to install sewer lines in this area of the Township in the foreseeable future.

j. Field

No part of the Field site is close enough to a sewer line of any significance to allow the practical consideration of using existing lines for sewage collection or transmission. Secondly, the capacity is not available for the Field parcels which would require from 578,070 to 3,468,150 gallons per day of capacity depending on the density of development. The most extreme eastern property lines of the Field site comes close to a Franklin Township 10 inch sewer. However, the use of this line cannot be considered due to capacity limits.

k. Brener

The Brener site, located in the southern part of the township, would produce from 55,800 to 335,340 gallons per day of sewage depending upon the density of development. Township sewer lines have not been extended to service this area of the Township, and no capacity is available from adjacent South Brunswick. The Franklin Township Sewage Authority described the potential for sewering the Brener site as beyond any planning to date. Both the Stony Brook Regional Sewerage Authority and the Middlesex County Utilities Authority are not anticipating providing sewers in that area of the Township.

3. Site Suitability

Sewer line accessibility and availability of excess capacity were the two principal factors evaluated with respect to sewerage service. Although nine of the eleven sites front upon existing sewer lines, these lines are currently operating at full capacity with no excess capacity available. The Franklin Township Sewerage Authority has no plans to install additional sewer lines in proximity to the study sites in the immediate future.

In order to distinguish the sites in terms of development suitability, the criteria of availability of capacity in Middlesex County Utilities Authority river crossing, distance to the main interceptors to the crossings or the crossings themselves if no interceptors exists, together with consistency with the Franklin Township Sewerage Authority Master Plan were used. In the case of sites not served by the Middlesex County Utilities Authority (Brener) accessibility to nearby truck lines with excess capacity was the principal criteria. Table 18 presents the results of this analysis.

4. Comparative Suitability

On the basis of the criteria used, the Brener site is ranked most suitable given the location of the site with respect to existing sewer lines in nearby South Brunswick. The Mindel and Ras sites are each within 13,200 feet of the existing sewerage infrastructure in northern Franklin. Those least suitable with respect to this factor are the Field and JZR Associates sites.

Table 18

Development Suitability - Sewerage Service

Site	Approximate Distance to Sewerage Infrastructure (feet)	Suitability Ranking
Mindel	12,000	2
Ras	13,200	3
Jops	16,800	5
Flama	18,000	6
Woodbrook	20,400	7
Rakeco	24,600	8
Whitestone	28,200	9
JZR Associates	29,400	10
Van Cleef	15,600	4
Field	39,600	11
Brener	2,000	1

Fire Protection

1. Existing Conditions

Franklin Township is served by a network of 10 volunteer fire companies organized in four fire districts, each of which is responsible to a separate Board of Commissioners. Revenues for each district is raised through special assessment districts. Each fire company is based at a fire station located on or near a major street. Fire stations are located throughout the Township, reflecting the pattern and density of land use development, response time, and fire calls (Figure 8). Each station is equiped with 3-4 fire fighting vehicles including pumpers, tankers, brush fire fighting equipment and support vehicles. Stations typically include 3-4 vehicle bays and storage space for equipment. Manpower for the companies is provided by trained area residents on a voluntary basis. Township-wide, approximately 14,588 manhours were devoted to responding to alarms, or an average of 9.3 manhours per alarm event.

As indicated in Table 19, Franklin Township generates nearly some 1,600 to 1,800 fire calls per year. The geographic distribution of these calls is a reflection of building diversity, brush fire hazard, and vehicular traffic. About 5.8 percent of calls are attributable to residential fires, 1.9 percent to commercial and industrial fires and 0.7 percent to institutional fires. Fully 42.4 percent of the alarms are attributable to trash, dumpster, vehicle, brush and miscellanous fires. About 17.5 percent of the alarms are false. The balance are unclassified. Each fire company serves as a "back-up" for adjacent companies in the event of a simultaneous fire call or a multiple alarm fire.

Table 19

Fire Calls by Type of Call

Type	1982	1983	Average 1982-1983	Percentage of Average Total
Residential	74	123	98	5.8
Commercial/Industrial	27	38	33	1.9
Institutional	14	10	12	0.7
Dumpster, Brush, Vehicle Misc. and Other	602	835	719	42.4
False Alarm	268	320	294	17.5
Unclassified	591	475	533	31.7
Total	1,576	1,801	1,689	100.0

Source: Township of Franklin, 1984

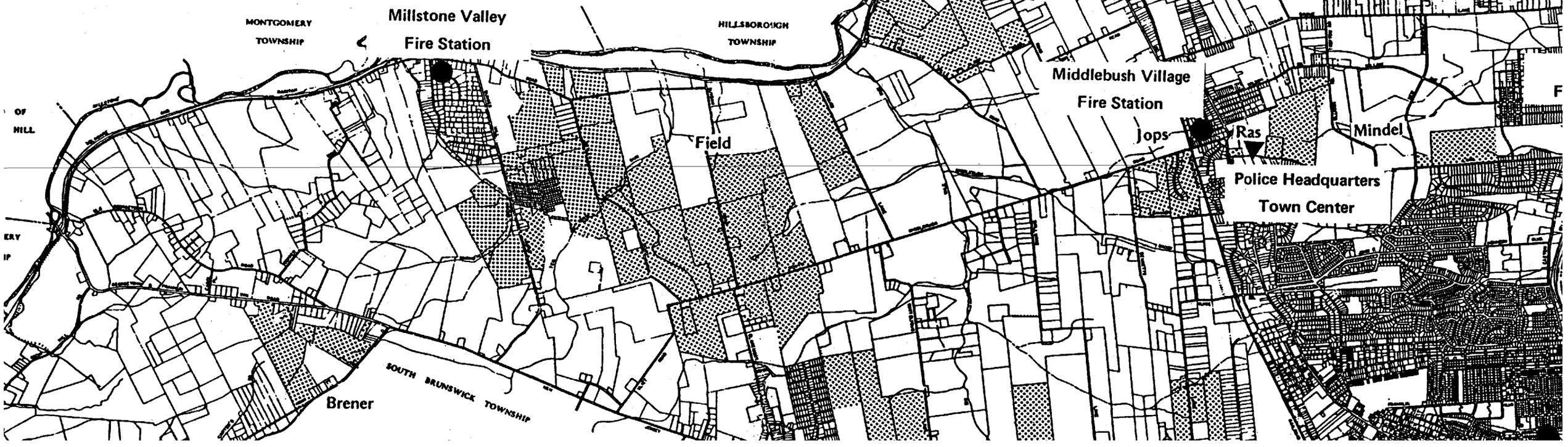
WNSHIP OF FRANKLIN
RSET COUNTY NEW JERSEY

Figure 8
Police & Fire Stations

▲ Police Station

● Fire Station

▒ Study Sites



Fire District 1 covers an area generally in the northwest portion of the Township. The District includes approximately 2,623 structures, 2,461 of which are single-family homes, 127 of which are commercial or industrial, and 35 are apartments or institutional. The largest concentration of industrial property in the Township is in District 1 near Route I-287. Fire District 1 responds to over 900 alarms per year. Of these, approximately 30 were for residential fires and 20 were commercial or industrial fires. Data on the characteristics of District 1-4 structures and the pattern of fire calls is presented in Table 20.

District 1 includes 4 fire companies: Millstone Valley serving the East Millstone community; Elizabeth Avenue serving the Route I-287 area; Somerset, serving the northern portion of the district; and Middlebush, serving the central district. The Mindel, Ras, Jops, Van Cleef, and a small portion of Field sites are located within Fire District 1.

As indicated by Table 21 below, the total budget for Fire District 1 rose from $220,652 to $270,893 between 1981 and 1983. During the same period, revenues rose from $241,739 to $330,434. Major expenditure categories in order of dollar amount were operation and maintenance, equipment purchase, and administration.

Table 21

Annual Budget - Fire District 1

Category	1981	1982	1983
Operation/Maintenance	$102,048	$ 93,436	$ 97,154
Administration	80,016	43,745	47,363
Equipment	38,588	127,818	126,364
Total Expenditures	$220,652	$265,019	$270,893
Revenues	$241,739	$297,768	$330,434

Source: Township of Franklin, Finance Office, October 1984.

Fire District 2 comprises the area from Jacques Lane/Bennets Lane south to the intersection of Georgetown-Franklin Turnpike and Kingston-Rocky Hill Road. The district is low density residential with two older residential clusters of higher density and concentration of commercial property on N.J. Route 27. About 1,013 structures exist of which 963 are single-family and 39 are commercial or industrial. Fire District 2 responds to about 120 alarms per year. Of these, approximately 10 were for residential fires and 3 were for commercial and industrial fires. District 2 includes 3 fire companies; Franklin Park, serving the vicinity of the intersection of Claremont Road and N.J. Route 27; Griggstown, serving the Griggstown community; and Little Rocky Hill, serving the community south of the intersection of Georgetown-Franklin Turnpike and N.J. Route 27.

Table 20

Fire Calls and Type of Alarm by District

District	Total Responses 1982	Total Responses 1983	Manhours 1982	Manhours 1983	Single/2-Family Alarms 1982	Single/2-Family Alarms 1983	Apartment Alarms 1982	Apartment Alarms 1983	Total Residential Alarms 1982	Total Residential Alarms 1983	Commercial/ Industrial Alarms 1982	Commercial/ Industrial Alarms 1983	Total Structures 1984
District 1	955	912	8,174	8,638	30	23	3	2	33	25	17	25	2,623
District 2	126	118	1,549	1,151	7	12	3	5	10	17	3	6	1,013
District 3	431	693	3,608	3,269	20	78	8	2	28	80	5	5	2,155
District 4	64	78	1,257	710	3	1	0	0	3	1	2	2	101
Total	1,576	1,801	14,588	13,768	60	114	14	9	74	123	27	38	5,892

Source: Township of Franklin, Tax Assessor, October 1984.
Township of Franklin, Fire Inspector, October 1984.

Six of the 11 subject sites are included in District 2. These include Woodbrook, Rakeco, Whitestone, JZR Associates, Field, and Brener.

As indicated by Table 22 below, the total budget for Fire District 1 has ranged from a low of $106,810 in 1982 to a high of $114,194 in 1983. Between 1981 and 1983 revenues rose from $111,305 to $132,457. Expenditure items in order of importance were operation and maintenance, equipment purchase, and administration.

Table 22

Annual Budget - Fire District 2

Category	1981	1982	1983
Operation/Maintenance	$ 71,450	$ 80,260	$ 78,461
Administration	4,150	4,550	4,557
Equipment	35,705	22,000	31,176
Total Expenditures	$111,305	$106,810	$114,194
Revenues	$111,305	$106,810	$132,457

Source: Township of Franklin, Finance Office, October 1984.

Fire District 3 covers the older, high density portion of the Township east of John F. Kennedy Boulevard and north of Bennets Lane. The district includes approximately 2,104 structures, 1,977 of which are single-family and 163 of which are commercial or industrial. District 3 contains a significant proportion of commercial structures. Fire District 3 responds to approximately 450-700 alarms per year. Of these, approximately 28-80 were for residential alarms and 5 were for commercial or industrial fires. District 3 contains two fire companies: East Franklin, located at the intersection of Highland and Pine Grove; and Community, located on Hamilton Street just south of Douglas Street. The Flama site is located within District 3.

As indicated by Table 23, the total budget for Fire District 3 has fluctuated in recent years ranging from a high of $226,239 in 1983 to a low of $125,616 in the previous year, 1982. Revenue has followed a similar pattern. Capital expenditures were particularly high for this district in recent years.

District 4 does not serve any of the subject sites on a primary or on a "back-up" basis and therefore has not been considered as part of the analysis.

Table 23

Annual Budget - Fire District 3

Category	1981	1982[1]	1983[1]
Operation/Maintenance	$121,712	$ 73,760	$105,063
Administration	7,846	4,580	7,008
Equipment	79,307	47,276	114,168
Total Expenditures	$208,865	$125,616	$226,239
Revenues	$215,367	$165,545	$151,840

Source: Township of Franklin, Finance Office, October 1984.
1. Includes carry over from prior years.

2. Development Impacts

Franklin Township fire companies have primary and secondary service areas. The primary service area consists of most geographically proximate area in which the company has responsibility for "first arrival" at a fire scene and primary responsibility for providing service. The secondary service area consists of portions of adjacent primary service areas in which the company has responsibility for providing back-up services on "second arrival" if called upon. Each site is described below in terms of distance and estimated response time from its primary and secondary fire company.

a. Mindel

The Mindel parcels are in the Somerset and Middlebush primary service areas and the Middlebush and Somerset secondary service areas. Averaged distance/response time is 1.25 miles/2.8 minutes and 2.15 miles/4.3 minutes from the primary and secondary stations respectively.

b. Ras

The Ras site is in the Middlebush primary service area and the Somerset secondary service area. Distance/response time is 0.75 miles/1.9 minutes and 2.5 miles/3.2 minutes from the primary and secondary stations respectively.

c. Jops

The Jops site is in the Middlebush primary service area and the Millstone Valley secondary service area. Distance/response time is 0.75 miles /1.9 minutes and 3.0 miles/5.8 minutes from the primary and secondary stations respectively.

d. Flama

The Flama site is in the East Franklin primary service area and the Community secondary service area. Distance/response time is 2.25 miles/4.5 minutes and 3.25 miles/8.2 minutes from the primary and secondary stations respectively.

e. Woodbrook

The Woodbrook site is in the Franklin Park primary service area and the Middlebush secondary service area. Distance/response time is 3.5 miles/6.6 minutes and 3.0 miles/5.8 minutes from the primary and secondary stations respectively.

f. Rakeco

The Rakeco site is in the Franklin Park primary service area and the Middlebush secondary service area. Distance/response time is 2.25 miles/4.5 minutes and 5.0 miles/9.2 minutes from the primary and secondary stations respectively.

g. Whitestone

The Whitestone site is in the Franklin Park primary service area and the Griggstown secondary service area. Distance/response time is 1.35 miles/2.9 minutes and 5.6 miles/10.2 minutes from the primary and secondary stations respectively.

h. JZR Associates

The JZR Associates site is in the Franklin Park primary service area and the Griggstown secondary service area. Distance/response time is 1.25 miles/2.8 minutes and 5.3 miles/10.0 minutes from the primary and secondary stations respectively.

i. Van Cleef

The Van Cleef site is in the Millstone Valley primary service area and the Middlebush secondary service area. Distance/response time is 1.75 miles/3.6 minutes and 2.5 miles/4.9 minutes from the primary and secondary stations respectively.

j. Field

The Field site is in the Franklin Park and Griggstown primary service areas and the Griggstown and Franklin Park secondary service areas. Average distance/response time is 1.5 miles/3.2 minutes and 3.0 miles/5.8 minutes from the primary and secondary stations respectively.

k. Brener

The Brener site is in the Little Rocky Hill primary service area and the Griggstown secondary service area. Distance/response time is 1.4 miles/3.0 minutes and 3.0 miles/5.8 minutes from the primary and secondary stations respectively.

3. Site Suitability

The development suitability for each of the eleven study sites varies according to location and access to fire protection services. The indices developed to measure the effect of site location on access to fire services include: proximity to existing fire hydrants or water lines appropriate for hydrant tap installation; response time to the site from the fire company with "first response" responsibility; and response time to the site from the "back-up" fire company. For purposes of this analysis, those sites with the best access to fire protection services are considered to be the most suitable for development.

Response time was calculated by measuring the over the road mileage between the primary and secondary fire companies and the sites and then applying the formula $T = 0.65 + 1.7D$ where T = minutes and D = miles. This formula is used by the Insurance Services Office (ISO) of New Jersey, a private agency which rates the fire suppression services of municipal fire departments. Insurance companies widely utilize the technical evaluation of the ISO in setting fire insurance rates. The ISO also evaluates the location of fire hydrants in evaluating fire protection services.

A system was developed to reflect the relative importance of primary response time, secondary response time and the location of fire hydrants. The primary response index was assigned a maximum score of 10; secondary response time a maximum score of 7; and the location of hydrants a maximum score of 3. The total possible score achievable by a given site is 20. Hydrant distance and response time values were converted to scores in the following manner.

Primary Response Time

Minutes	Score
0-2	10
2.1-3	8
3.1-4	6
4.1-5	4
5.1-6	2
6+	0

Secondary Response Time

Minutes	Score
0-5	7.0
5.1-7	5.6
7.1-9	4.2
9.1-11	2.8
11+	1.4

Hydrant Location

Access/Proximity	Score
Adjacent to Site	3
Water Line Only	2
Distance of 1000'+ to Water Line	1

The method described above was applied to each of the eleven sites considering the location of fire companies and water distribution and transmission lines in the Township. The scores generated and the rank assigned to each site is presented in Table 24.

4. Comparative Suitability

The two sites most suitable for development due to superior access to existing fire services are the Ras and Mindel sites with composite scores of 20 and 18 respectively. The high scores for these sites are attributable to excellent access to primary and secondary fire companies and fire hydrants adjacent to the sites.

Sites ranked third and fourth were Brener and Jops; both with a score of 16. The Jops site had particularly good access to the primary fire company but no fire hydrants adjacent to the site. The Brener site has good fire company access and fire hydrants adjacent to the site.

Sites scoring lowest included Flama, Woodbrook, and Rakeco. The combination of fair to poor access to primary or secondary fire companies and a lack of adjacent fire hydrants was responsible for the low scores.

Table 24

Access to Fire Protection Services and Development Suitability

Site	Response Time to Primary Company	Response Time to Secondary Company	Distance to Hydrant	Distance to Waterline	Primary Response Score	Secondary Response Score	Fire Hydrant Score	Composite Score	Overall Rank For Fire Protection Services
Brener	3.0	5.8	100	NA	8	5.6	3	16.6	3
JZR	2.8	10.0	100	NA	8	2.8	3	13.8	5
Whitestone	2.9	10.2	100	NA	8	2.8	3	13.8	5
Rakeco	4.5	9.2	NA	3,100	4	2.8	1	7.8	8
Woodbrook	6.6	5.8	NA	1,200	0	5.6	1	6.6	9
Flama	4.5	6.2	100	NA	4	5.6	3	12.6	7
Jops	1.9	5.8	NA	1,800	10	5.6	1	16.6	3
Van Cleef	3.6	4.9	NA	3,600	6	7.0	1	14.0	4
Field	3.2	5.8	100	NA	6	5.6	2	13.6	6
Mindel	2.8	4.3	100	NA	8	7.0	3	18.0	2
Ras	1.9	3.2	100	NA	10	7.0	3	20.0	1

NA: Not Available

Police Protection

1. Existing Conditions

Police protection in Franklin Township is provided by a professional department consisting of 65 sworn officers and 11 civilian employees. An additional 5 patrol officers are scheduled for hiring later this month. The Department, headquartered at the Franklin Township Municipal Building, contains approximately 6,900 square feet of floor area. The headquarters is currently operating under limited space conditions, as evidenced by the relocation of the Juvenille Division to the general administration section of the municipal building. The Department maintains a fleet of 27 vehicles, 15 of which are marked and 12 unmarked. Three to six patrol cars are deployed per shift and the balance are held in reserve for back-up or repair and maintenance.

Franklin Township, over the last three years, has spent 16-18 percent of its total budget on police services. Between 1981 and 1984, annual police expenditures rose from $1.6 million to $2.2 million, an increase of $.6 million or 40 percent. This represents an average annual increase of approximately 13 percent. Table 25 below provides data on police expenditures for the years 1981 to 1984.

Table 25

Police Expenditures by Year

Year	Expenditure	Increase over Prior Year	Percentage Change
1981	$1,575,055	-	
1982	1,891,766	$ 316,711	20.1
1983	1,928,574	36,808	1.9
1984	2,173,451	244,877	12.7

Source: Franklin Township, Finance Office, October 1984.

The Department has responded to 81,200 police calls since 1981, an average of 20,300 per year, or 56 calls per day. Approximately 6.8 percent of these calls were related to serious crimes reported in the New Jersey Uniform Crime Report. To estimate the average cost of servicing a police call, police expenditures for the years 1981 to 1984 were divided by the number of police calls received in those years. This method provides a means of equating "service output" and the cost of providing that service. Table 26 indicates that the average cost of responding to a police call was $93.20. It should be recognized that this is an average measure only, and significant variation exists in the manpower and follow-up effort devoted to service calls, traffic accidents, and crime calls of various types.

Table 26

Cost per Police Call 1981-1984

Year	Total Budget	Total Calls	Average Cost Per Call
1981	$1,576,000	18,200	$ 86.50
1982	1,891,000	18,700	101.00
1983	1,928,000	23,900	80.70
1984	2,173,000	20,400	107.00
Total	$7,568,000	81,200	$ 93.20

The Police Department deploys patrols in patterns of 3, 4, 5, or 6 patrol cars depending on such factors as crime and call pattern, season, and personnel availability. The size and location of patrol area (patrol district) depends upon the number of cars deployed. The greater the number of cars, the smaller the patrol districts and the more intensive the patrol coverage. Patrol districts in the southern portion of the Township are widely spread out, reflecting the low density of the area. Northern districts are more compact to provide more intensive coverage to that higher density area. Each district is assigned 1 car manned by a patrolman. Vehicles from adjacent districts provide mutual back-up services. During 1983, the Department allocated 5.4 percent of its shifts to the 3 car deployment; 26.9 percent to the 4 car; 39.4 percent to the 5 car and 28.1 percent to the 6 car deployment.

Franklin Township has a somewhat higher overall crime rate but a lower number of police officers per 1,000 population than neighboring communities in Mercer, Somerset and Middlesex Counties. Franklin had 2.0 officers per 1,000 population in 1982, compared to 2.22 for the region. At the same time, Franklin had a crime rate of 42.8 per 1,000 population, compared to 37.63 for the region. Franklin's crime and law enforcement profile is more comparable to an urban city-like setting than the rural communities to the west and south.

2. Development Impacts

The development suitability of the 11 subject sites is dependent upon a comparison of: access to police services as measured by response time from headquarters and from patrol districts; the level of service as measured by population of various densities; and the cost of serving particular locations. Because most police services in Franklin Township are delivered from patroling cars dispatched from a central location, police "presence" tends to be distributed evenly throughout the Township. The wide distribution of service under existing conditions would make the task of attributing police costs to particular locations impossible. Further, even if the data were available, in all likelihood the costs of servicing one location as opposed to another in a jurisdiction of 40 square miles would be negligable. Therefore, the analysis will focus upon access to service and population density.

To estimate the level of service required by various development scenarios, the following methodology was followed. First, per capita police calls were analyzed from each of 5 police patrol districts and 13 apartment complexes of widely ranging density. This analysis identified an appropriate police call multiplier to be used in conjunction with population projections for each site and density scenario. Step 2 involved multiplying project population by the police call multiplier to estimate the number of police calls expected from a site for a development scenario. Finally, costs were estimated by multiplying the expected number of police calls by the average cost per call of $93.20.

Examination of Township data for the 5 patrol districts presented in Table 27 shows very little variation in per capita police calls despite a variation in unit density of 3.64 du/acre to 0.24 du/acre. However, consideration of Table 28 reveals a strikingly different pattern. If high density developments alone are considered, a pattern of generally lower per capita calls is revealed for developments of densities ranging from 5-28.2 du/acre than for the Township as a whole. Within this category per capita calls increase slightly as density increases, but at no point do the call rates reflect that which was observed for the Township as a whole.

This difference in high-low density police call rates can be attributed to the greater vulnerability of the single family dwelling to a wide range of crimes and problems than a self contained and protected apartment unit. Apartments exist in a well defined and potentially controllable environment. A police car patroling an apartment complex extends protection to a larger number of units and persons than a car patroling a low density subdivision. Consequently, the lower per capita call rate for apartments may be attributable to preventative effects of a greater "patrol presence" or visability. The socioeconomic characteristics of apartment dwellers also reduce the call rate, especially if complex occupants are elderly or households with low crime propensities.

Table 29 below presents police call per capita estimates for each of 4 development scenarios developed from Tables 27 and 28. The per capita call rate of 0.48 used for the 1.0 du/acre was derived from the Township-wide mean. The 4.0, 8.0, and 14.0 du/acre call rates were derived from Table 28.

Table 29

Police Calls by Development Scenario

Development Scenario	Average Calls Per Capita
1.0 unit per acre	0.48
4.0 units per acre	0.08
8.0 units per acre	0.08
14.0 units per acre	0.17

Tables 30-33 illustrate the application of the capita call multipliers defined above and the cost per call estimates to the population projections for each site and density scenario. This will yield an estimate of the total cost of providing police service to each of the subject sites.

Table 27

Per Capita Police Calls by Patrol District

Patrol District	1983 Police Calls	1980 Population	1980 Dwelling Units	Estimated Acreage	Unit Density	Population Density/ac.	Police Calls Per Capita
1	1,558	3,195	1,211	332	3.64	9.6	0.49
2	2,757	5,524	1,924	757	2.5	7.3	0.50
3	698	1,384	438	1,439	0.3	1.0	0.50
4	367	727	416	2,983	0.15	0.25	0.50
5	627	1,728	614	3,372	0.24	0.55	0.36
Total	6,007	12,558	4,630	8,883	0.50	1.4	0.48

Source: Franklin Township Police Department and Louis Berger & Associates, Inc., October 1984.

Table 28

Per Capita Police Calls by Apartment Complex

Complex	1983 Police Calls	1980 Population	1980 Dwelling Units	Estimated Acreage	Unit Density	Population Density/ac.	Police Calls Per Capita
Douglas Gardens	69	376	188	11.6	16.2	32.4	.18
Franklin Hamilton Gardens	9	160	80	5.1	15.7	31.4	.15
Edgemere at Somerset	308	796	398	25.2	15.8	31.6	.39
Harrison Towers	39	639	320	11.4	28.2	28.2	.06
Franklin Greens	126	1,296	649	48.0	13.5	27.0	.10
Easton North	37	424	212	17.3	12.2	24.5	.09
Parkside	13	200	100	9.2	10.9	22.2	.07
Queens Square	3	660	330	33.0	10.0	20.0	.01
Carriage Run	23	320	160	20.0	8.0	16.0	.07
Hempsted Gardens	58	556	300	42.0	7.1	14.3	.10
Somerset Mews	41	640	320	63.5	5.0	10.0	.06
Townhouse at Quailbrook	3	56	28	7.5	3.8	7.5	.05
Kingsbury Acres	10	176	88	42.0	2.0	4.2	.06
Total	739	6,290	3,173	335.8	9.4	18.8	.17

Source: Franklin Township Police Department and Louis Berger & Associates, Inc., October 1984.

Table 30

Projected Police Costs-Development Scenario No. 1

(1.0 dwelling unit per acre)

Site	Total Population	Police Calls	Total Cost
Brener	620	298	$27,800
JZR Associates	546	262	24,400
Whitestone	291	139	12,900
Rakeco	350	108	15,600
Woodbrook	140	67	6,200
Flama	326	156	14,500
Jops	305	146	13,600
Van Cleef	1,309	628	58,500
Field	6,423	3,083	287,300
Mindel	686	329	30,600
Ras	42	20	1,900

Table 31

Projected Police Costs-Development Scenario No. 2

(4.0 dwelling units per acre)

Site	Total Population	Police Calls	Total Cost
Brener	2,478	199	$18,500
JZR Associates	2,184	175	16,300
Whitestone	468	93	8,600
Rakeco	1,400	112	10,500
Woodbrook	560	45	4,200
Flama	1,302	104	9,700
Jops	1,218	97	9,000
Van Cleef	5,236	418	38,900
Field	25,690	2,055	191,500
Mindel	2,744	219	20,400
Ras	168	13	1,200

Table 32

Projected Police Costs-Development Scenario No. 3

(8.0 dwelling units per acre)

Site	Total Population	Police Calls	Total Cost
Brener	3,548	283	$26,400
JZR Associates	3,115	249	23,200
Whitestone	1,658	132	12,300
Rakeco	2,000	160	14,900
Woodbrook	800	64	5,900
Flama	1,855	148	13,800
Jops	1,743	139	12,900
Van Cleef	7,473	594	55,360
Field	36,700	2,936	273,600
Mindel	3,928	314	29,300
Ras	238	19	1,800

Table 33

Projected Police Costs-Development Scenario No. 4

(14.0 dwelling units per acre)

Site	Total Population	Police Calls	Total Cost
Brener	4,968	844	$78,700
JZR Associates	4,362	741	69,060
Whitestone	2,322	394	36,700
Rakeco	2,800	476	44,400
Woodbrook	1,120	190	17,700
Flama	2,598	441	41,100
Jops	2,438	414	38,600
Van Cleef	10,462	1,778	165,700
Field	51,380	8,734	814,100
Mindel	5,500	935	87,142
Ras	332	56	3,200

Density if a significant factor in the anticipation of public costs in the provision of police protection. Based on Franklin Township data, the higher the density the lower the per capita police call rate and the total cost of providing service. On a per person basis, the 1.0 dwelling unit per acre scenario is most costly at approximately $44 per person. The 4.0 and 8.0 dwelling units per acre scenario is expected to cost about $7.30 per person. The 14.0 dwelling units per acre scenario is expected to cost about $15.00 per person. This array of costs is consistent with the high per capita call ratios observed for the 1.0 dwelling unit per acre scenario.

As discussed previously, low density neighborhoods containing single family dwellings may be more vulnerable to crime or the fear of crime. This would explain the high call rate. High density apartments may be less vulnerable, self contained complexes where police presence may be more easily established for a greater number of units. This would explain the lower per capita call rate for apartments.

Since 9 of the 11 subject site are clustered within a 3.5 mile radius of Police Headquarters, transportation and other location-related costs associated with the provision of police protection are not expected to be measurably different or significant. Therefore, the impact of location on police services will be discussed in terms of response time for answering calls from police headquarters and from the centroids of patrol districts in the 5 car patrol car mode. The location of each site in relation to Police Headquarters and the centroids of the applicable patrol district is discussed below.

The Brener site is located 7.0 miles (12.5 minutes response time) from Police Headquarters and 2 miles (4.0 minutes response time) from the Patrol District 5 centroid. The site has frontage on N.J. Route 27 and Georgetown-Franklin Turnpike.

The JZR Associates site is located 6.25 miles (11.3 minutes response time) from Police Headquarters and 2 miles (4.0 response time) from Patrol District 5 centroid. The site has N.J. Route 27 frontage.

The Whitestone site is located 4.25 miles (7.9 response minutes) from police headquarters and 4.25 miles (7.9 minutes response time) from Patrol District 5 centroid. The site has frontage on N.J. Route 27.

The Rakeco site is located 4.35 miles (8.0 minutes response time) from police headquarters and 4.15 miles (7.9 minutes response time) from Patrol District 4 centroid. The site has frontage on N.J. Route 27.

The Woodbrook site is located 2.75 miles (5.3 minutes response time) from police headquarters and 5.0 miles (9.1 minutes response time) from Patrol District 4 centroid. The site has frontage on Bennets Lane and N.J. Route 27.

The Flama site is located 2.65 miles (5.2 minutes response time) from police headquarters and 5.0 miles (9.1 response time) from Patrol District 4 centroid. The site has frontage on Bennets Lane and N.J. Route 27.

The Jops site is located 0.55 miles (1.6 minutes response time) from police headquarters and 4.25 miles (7.9 minutes response time) from Patrol District 4 centroid. The site is located east of South Middlebush Road.

The Van Cleef site is located 2.5 miles (4.9 minutes response time) from Police Headquarters and 0.20 miles (1 minute response time) from Patrol District 4 centroid. The site has fronage on Blackwells Mills Road and Van Cleef Road.

The Field site is located 4.25 miles (7.9 minutes response time) from Police Headquarters and 0 miles (0 minutes response time) from the Patrol District 5 centroid. The site has frontage on Bunker Hill, Butler, Suydam, and South Middlebush Road.

The Ras site is located .25 miles (1.1 minutes response time) from Police Headquarters and 4.25 (7.9 minutes response time) from Patrol District 3 centroid. The site has DeMott Lane frontage.

The Mindel site is located 5.2 (1.2 minutes response time) from Police Headquarters and 3.75-4.0 miles (7.3 minutes response time) from Patrol District 3 centroid. The site has DeMott Lane frontage.

3. Site Suitability

Previous discussion has identified site location and development density as variables significantly influencing the suitability of site for development. To analyze the impact of density police calls per capita, average cost per call, and site population were analyzed to arrive at an estimate of the cost per person of providing police services to the various sites.

This analysis showed that low density sites were generally more costly for police protection services because of a higher rate of police calls generated by single-family homes. To analyse the impact of location, two indices were utilized: response time from police headquarters and response time from the appropriate center of development of patrol districts. Response time ranged from 1 minute to over 10 minutes.

A system of weighting indices was developed to evaluate the impact of the location variable. Of a total site score of 15 points, 10 points were assigned to response time from Police Headquarters and 5 points to response from Patrol District centroid. Response time ranges and assigned scores are presented in Tables 34 and 35. The scores of individual sites and composite rankings are presented in Table 36.

4. Comparative Suitability

The Van Cleef and Field sites were ranked first and second with composite scores of 14.0 and 12.0 respectively. The sites have fair to good access to Police Headquarters but excellent access to patrol district centroids. A three way tie is observed for the third ranked site between Ras, Mindel, and Jops with a composite score of 9.0. These sites have excellent access to Police Headquarters but only fair to good access to the patrol district centroid. Woodbrook and Flama were ranked last because of remoteness from the patrol district centroid and fair to good access to Police Headquarters.

Table 34

Response Time From Patrol District Centroid

Response Time (Minutes)	Score
1-2	10
2.1-3	9
3.1-4	8
4.1-5	7
5.1-6	6
6.1-7	5
7.1-8	4
8.1-9	3
9.1-10	2
10.1-11	1
11+	0

Table 35

Response Time From Police Headquarters

Response Time (Minutes)	Score
1-3	5
3.1-5	4
5.1-7	3
7.1-9	2
9.1-11	1
11+	0

Table 36

Site Ranking For Access to Police Services

Site	Response Time From Headquarters	Score	Response Time From District Centroid	Score	Composite Score	Suitability Ranking
Mindel	1.2	5	7.3	4	9	3
Ras	1.1	5	7.9	4	9	3
Jops	1.6	5	7.9	4	9	3
Flama	5.2	3	9.1	2	5	6
Woodbrook	5.3	3	9.1	2	5	6
Rakeco	8.0	2	7.9	4	6	5
Whitestone	7.9	2	7.9	4	6	5
JZR Associates	11.3	0	4.0	8	8	4
Van Cleef	4.9	4	1.0	10	14	1
Field	7.9	2	0	10	12	2
Brener	12.5	0	4.0	8	8	4

D. Air Quality

1. Existing Conditions

The New Jersey State Implementation Plan is designed to ensure the attainment of National Ambient Air Quality Standards within the schedule outlined by Congress in the Clean Air Act Amendments. Prepared in its original form in 1978, the State Implementation Plan was subsequently amended and received approval and certification by the U.S. Environmental Protection Agency in April 1981. Table 37 shows the National Ambient Air Quality Standards. The State of New Jersey has accepted the national standards but has not yet modified the standards to conform with recent changes at the national level. Therefore, New Jersey's primary and secondary standards for ozone are .08 ppm rather than the national standard of .12 ppm. For sulfur dioxide, New Jersey still has a maximum 24-hour secondary standard of .10 ppm.

New Jersey's air pollution monitoring network is comprised of 32 continuous air monitoring stations for gaseous pollutants and over 100 high volume samplers for particulates. Continuous air monitoring stations in proximity to Franklin Township are located within New Brunswick measuring the pollutants ozone, sulfur dioxide, nitrogen dioxide, and nitric oxide, and Somerville measuring ozone, carbon monoxide, sulfur dioxide, smokeshade, and suspended particulate matter. Two high volume samplers located in South Brunswick and Somerville also measure suspended particulate matter. Air quality concentrations for pollutants measured at these stations are shown on Tables 38 to 41.

Based upon the data reported at each of the four monitoring stations, it would appear that present air quality within Franklin Township is generally quite good. As seen from Tables 38 to 40, ambient air quality in New Brunswick (which forms the eastern border with Franklin Township) and Somerville (which is approximately 2 miles to the northwest) meet National Ambient Air Quality Standards for all criteria pollutants other than ozone. It should be noted that the ozone standard is exceeded at all monitoring stations in New Jersey. This is indicative of the fact that ozone is a regional problem, with most of the northeast United States exceeding the standard.

Current air quality in Franklin Township is most likely better than that which is indicated by the data from the New Brunswick and Somerville monitoring stations. This is true for two reasons. As a result of improved emission controls on automobiles and additional point source controls, ambient concentrations for most pollutants show a definite downward trend over time evidenced by the number of times the 8-hour standard for carbon monoxide was exceeded in Somerville.

Year	Number of Times Standard Exceeded
1975	19
1976	20
1977	9
1978	3
1979	10
1980	1
1981	0
1982	0
1983	0

Also, Somerville and New Brunswick both represent areas that are more highly urbanized than Franklin Township and, in turn, are the locations of a higher concentration of air pollution sources. The only exceptions to this could be locally higher concentrations of particulate matter as a result of farming or construction activities and locally higher carbon monoxide concentrations at congested, high traffic volume intersections.

The absence of air pollution monitors within close proximity to each study site makes impossible a site by site analysis. However, given the location of monitors in nearby New Brunswick, South Brunswick, and Somerville, current monitoring data for each station, and trends in monitoring data since 1979 it would appear that air quality at each site is well within national standards.

2. Development Impacts

The following steps were taken in analyzing air quality impacts of each study site.

a. Location of Sensitive Receptors

Each site was examined to determine the presence of sensitive air quality receptors either adjacent to the site or along the existing roadways that would be travelled by the additional traffic generated by a development in order to access a major highway. Thus, if a site was located on N.J. Route 27 or had access to it without traffic passing by any residences it was judged Neutral. If traffic had to travel by several houses located more than 30 feet from the roadway it was rated to be Slightly Sensitive to microscale air quality. If traffic had to pass by several homes less than 30 feet from the roadway it was rated to be Moderately Sensitive. These factors were then adjusted for the density of the proposed development. For example, in areas where there were several houses less than 30 feet from the roadway it was rated Highly Sensitive to 8.0 and 14.0 units per acre development, Moderately Sensitive to 4.0 units per acre development and Slightly Sensitive to 1.0 unit per acre development.

b. Microclimate Differences

The terrain in Franklin Township is primarily flat or gently rolling. Thus, there were no differences of note between the sites with respect to topography. In addition, there are no major air pollution point sources in the area which would make one site or area more or less appropriate for residential development.

Table 37

National Ambient Air Quality Standards

Pollutant	Average Time	Primary Standard	Secondary Standard
Ozone	1 Hour[1]	235ug/m^3 (0.12 ppm)	Same as Primary Standard
Carbon Monoxide	8 Hour[1]	10mg/m^3 (9 ppm)	Same as Primary Standards
	1 Hour[1]	40mg/m^3 (35 ppm)	
Nitrogen Dioxide	Annual Average	100ug/m^3 (0.05 ppm)	Same as Primary Standard
	24 Hour	------	
Sulfur Dioxide	Annual Average	80ug/m^3 (0.03 ppm)	------
	24 Hour[1]	365ug/m^3 (0.14 ppm)	------
	3 Hour[1]	------	1300ug/m^3 (0.05 ppm)
Suspended Particulate Matter	Annual Geometric Mean	75ug/m^3	60ug/m^3
	24 Hour[1]	260ug/m^3	150ug/m^3
Hydrocarbons (Corrected for Methane)	3 Hour[1] (6-9 am)	160ug m^3 (0.24 ppm)	Same as Primary Standard
Lead	3 Month Average	1.5ug/m^3	Same as Primary Standard

[1]Maximum concentration not to be exceeded more than once per year.

[2]The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above .12 ppm is equal to or less than one.

Source: U.S. Environmental Protection Agency.

Table 38

Historical Summary of Air Quality

New Brunswick Station

Pollutant	1979	1980	1981	1982	1983
Sulfur Dioxide					
Maximum 1-hour (ppm)	.077	.081	.108	.126	.073
Maximum 3-hour (ppm)	.073	.073	.099	.094	.071
Maximum 24-hour (ppm)	.043	.053	.080	.053	.042
Annual Average (ppm)	---	---	---	.010	.010
Times Standard Exceeded	0	0	0	0	0
Ozone					
Maximum 1-hour (ppm)	.105	.188	.138	.168	.197
Times Standard Exceeded	10	210	79	176	285
Nitric Oxide					
Maximum 1-hour (ppm)	.417	.344	.441	.479	.393
Maximum 24-hour (ppm)	.221	.205	.297	.224	.217
Annual Average (ppm)	---	.026	---	.028	.031
Times Standard Exceeded	NA	NA	NA	NA	NA
Nitrogen Dioxide					
Maximum 1-hour (ppm)	.104	.131	.114	.120	.185
Maximum 24-hour (ppm)	.070	.049	.070	.086	.139
Annual Average (ppm)	---	---	---	.029	.027
Times Standard Exceeded	NA	NA	NA	NA	NA

Source: New Jersey Department of Environmental Protection, 1984.
NA: Not Applicable

Table 39

Historical Summary of Air Quality

Somerville Station

Pollutant	1979	1980	1981	1982	1983
Sulfur Dioxide					
Maximum 1-hour (ppm)	.093	.157	.097	.053	NA
Maximum 3-hour (ppm)	.075	.137	.076	.051	NA
Maximum 24-hour (ppm)	.058	.066	.058	.031	NA
Annual Average (ppm)	.009	.013	.011	.011	NA
Times Standard Exceeded	0	0	0	0	NA
Ozone					
Maximum 1-hour (ppm)	.163	.135	.132	.158	NA
Times Standard Exceeded	72	99	50	53	NA
Carbon Monoxide					
Maximum 1-hour (ppm)	21.0	13.3	20.1	14.1	12.6
Maximum 8-hour (ppm)	12.9	9.2	8.8	8.7	7.2
Times Standard Exceeded	10	1	0	0	0
Smokeshade (COHS)					
Maximum 1-hour	4.31	2.79	3.87	2.85	NA
Maximum 24-hour	2.23	1.46	1.79	1.38	NA

Source: New Jersey Department of Environmental Protection, 1984.
NA: Not Applicable

Table 40

Historical Summary of Air Quality

Somerville Station

Pollutant	1979	1980	1981	1982	1983
Total Suspended Particulates					
Maximum 24-hour (ug/m^3)	108	104	95	96	70
Annual Geometric Mean (ug/m^3)	40	41.8	41.1	37.2	34.5
Times Standard Exceeded	0	0	0	0	0

Table 41

Historical Summary of Air Quality

South Brunswick Station

Pollutant	1979	1980	1981	1982	1983
Total Suspended Particulates					
Maximum 24-hour (ug/m^3)	101	101	126	100	164
Annual Geometric Mean (ug/m^3)	43.1	43.2	45.2	36.5	36.3
Times Standard Exceeded	0	0	0	0	1

Source: New Jersey Department of Environmental Protection, 1984.

Thus, the only real difference from the microclimate standpoint was whether the site was a forest or a field. A forested buffer around a construction site will minimize wind erosion of the exposed soil by reducing wind velocities. It will also help to filter out the suspended particulates before they reach adjacent receptor locations. The density of development was also considered in the use of this factor. Thus, forested sites were judged Neutral for 1.0 and 4.0 units per acre development and Slightly Sensitive for 8.0 and 14.0 units per acre development. Sites that are currently open fields were judged Slightly Sensitive for 1.0 and 4.0 units per acre development and Moderately Sensitive for 8.0 and 14.0 units per acre development.

The more dense development typically involves more site grading, a greater percentage of area disturbed during development, and greater use of heavy construction equipment. Thus, the potential for wind erosion is greater.

c. Regional Emissions

As noted under existing conditions, the only air pollutant that exceeds the NAAQS is ozone, which is formed by photochemical reactions in the atmosphere. Studies have shown that automobile and truck emissions of hydrocarbons and nitrogen oxides are the major cause (upwards of 90 percent). As a result, the N.J. State Implementation Plan contains recommendations for reducing vehicle miles travelled (VMT) in order to reduce mobile source emissions.

It is acknowledged that it is not the responsibility of individual projects to solve this problem. However, regional site suitability analyses certainly must take this into account. Thus, access to mass transit facilities (bus and rail) become an air quality evaluation factor. Direct access to bus lines on N.J. Route 27 was the primary factor, with proximity to the New Brunswick and Princeton Junction train stations a secondary factor.

3. Site Suitability

Based upon the three critera described above, each site was evaluated as to its suitability for development under each scenario. The results of this analysis is presented in Tables 42 to 45.

4. Comparative Suitability

Each site's comparative suitability for development under each scenario is presented in Table 46.

Table 42

Development Suitability - Air Quality

(1.0 dwelling unit per acre)

Site	Location of Sensitive Receptors	Microclimate Differences	Regional Emissions	Total Score
Mindel	0	0	0	0
Ras	0	0	0	0
Jops	0	1	0	1
Flama	0	1	0	1
Woodbrook	0	1	0	1
Rakeco	0	1	0	1
Whitestone	0	1	0	1
JZR Associates	0	1	0	1
Van Cleef	1	1	0	2
Field	1	1	0	2
Brener	0	1	0	1

Sensitivity: 0 - Neutral
1 - Slight
2 - Moderate
3 - High

Table 43

Development Suitability - Air Quality

(4.0 dwelling units per acre)

Site	Location of Sensitive Receptors	Microclimate Differences	Regional Emissions	Total Score
Mindel	1	0	1	2
Ras	1	0	1	2
Jops	1	1	1	3
Flama	0	1	0	1
Woodbrook	0	1	0	1
Rakeco	0	1	0	1
Whitestone	0	1	0	1
JZR Associates	0	1	0	1
Van Cleef	2	1	1	4
Field	2	1	1	4
Brener	0	1	0	1

Sensitivity: 0 - Neutral
1 - Slight
2 - Moderate
3 - High

Table 44

Development Suitability - Air Quality

(8.0 dwelling units per acre)

Site	Location of Sensitive Receptors	Microclimate Differences	Regional Emissions	Total Score
Mindel	2	1	2	5
Ras	2	1	2	5
Jops	2	2	2	6
Flama	0	2	1	3
Woodbrook	0	2	1	3
Rakeco	0	2	1	3
Whitestone	0	2	1	3
JZR Associates	0	2	1	3
Van Cleef	3	2	2	7
Field	3	2	2	7
Brener	0	2	1	3

Sensitivity: 0 - Neutral
1 - Slight
2 - Moderate
3 - High

Table 45

Development Suitability - Air Quality

(14.0 dwelling units per acre)

Site	Location of Sensitive Receptors	Microclimate Differences	Regional Emissions	Total Score
Mindel	2	1	3	6
Ras	2	1	3	6
Jops	3	2	3	8
Flama	0	2	1	3
Woodbrook	0	2	1	3
Rakeco	0	2	1	3
Whitestone	0	2	1	3
JZR Associates	0	2	1	3
Van Cleef	3	2	3	8
Field	3	2	3	8
Brener	0	2	2	4

Sensitivity: 0 - Neutral
1 - Slight
2 - Moderate
3 - High

Table 46

Air Quality Evaluation - Summary

Site	Density (units per acre) 1.0 Score	1.0 Rank	4.0 Score	4.0 Rank	8.0 Score	8.0 Rank	14.0 Score	14.0 Rank
Mindel	0	1	2	2	5	2	6	3
Ras	0	1	2	2	5	2	6	3
Jops	1	2	3	3	6	3	8	4
Flama	1	2	1	1	3	1	3	1
Woodbrook	1	2	1	1	3	1	3	1
Rakeco	1	2	1	1	3	1	3	1
Whitestone	1	2	1	1	3	1	3	1
JZR Associates	1	2	1	1	3	1	3	1
Van Cleef	2	3	4	4	7	4	8	4
Field	2	3	4	4	7	4	8	4
Brener	1	2	1	1	3	1	4	2

E. Water Quality

1. Existing Conditions

The objective of the water quality analysis is to determine the impacts associated with four densities of residential development as a means of determining suitablity for such development within 11 specific locations. In doing so, it was necessary to analyze the changes in stormwater runoff quality for each site within its particular drainage basin and assess the level of significance associated with such changes. Changes in water quality resulting from the various development densities under study were evaluated and the significance of such changes assessed.

Changes in stormwater pollutant loadings associated with land use changes can be estimated by using several different methods. The method that will be employed in this analysis can be described as the "Areal Loading Method." This method uses pollutant loading rates for various land uses based on data reported in the literature. These rates describe the amounts of pollutants which are transported from a watershed via stormwater runoff, and are reported as mass/unit area/unit time (i.e., pounds/area/year). The loading rates pertain to long term average conditions, rather than to individual storm events or particular seasons of the year.

The areal loading method is best suited to planning level analysis and evaluation of water quality impact from land use changes and is appropriate method for comparing the pollution potential of one type of land use to another.

One of the most complete compilations of stormwater pollutant areal loading rates is the N.J.DEP Stormwater Quantity/Quality Management Manual, (1981). This source lists loading rates for undeveloped and developed land use categories as a function of density and generalized soil type. Estimates are provided for five pollutants: biochemical oxygen demand (BOD_5), total phosphorus (TP), total nitrogen (TN), lead (PB) and zinc (ZN). Loading rates for other pollutants are not as well-established and therefore were not included in the N.J. DEP Manual or as part of this analysis.

Loading rates for undeveloped land vary as a function of land use activity, with lowest for forests and highest for crops. For residental land uses, loading rates generally increase as density increases. The loading rates used in this report for varying land uses are shown in Table 47 along with generalized estimates of land use at each study site (Table 48).

2. Pollutant Characteristiscs

a. Biochemical Oxygen Demand

Oxygen is found combined in water, many mineral elements, and biological compounds and is an essential element for all forms of plant and animal life. Dissolved oxygen (DO) is important since a high enough level must be maintained in an aquatic system for many orgainisms to survive and for aerobic (in the presence of oxygen) decompcsition of waste materials. Low DO levels can lead to undesirable anaerobic conditions. The amount of oxygen in the water is consumed in the process of oxidizing waste materials.

Table 47

Uncontrolled Nonpoint Pollution Loading Rates

(Pounds/acre/year)

Land Use	Pollutant BOD	TP	TN	ZN	Pb
Undeveloped					
Crops (conventional tillage)	45	4.2	18.6	0.22	0.04
Pasture	32	0.5	6.2	0.02	0.03
Forest	7	0.1	2.5	0.01	0.02
Residential					
1.0 du/acre	23	0.8	6.6	0.20	0.18
4.0 du/acre	28	1.1	8.8	0.34	0.42
8.0 du/acre	41	1.6	12.4	0.53	0.93
14.0 du/acre	43	1.8	13.9	0.62	1.08

Source: N.J. Department of Environmental Protection, 1981.

Table 48

Generalized Land Use

Site	Total Acres	Conventional Tillage		Pasture		Forest	
		Percent	Acres	Percent	Acres	Percent	Acres
Mindel	196.4	2.5	4.9	10	19.6	87.5	171.9
Ras	11.85	-	-	-	-	100	11.9
Jops	87.1	35	30.5	15	13.1	50	43.6
Flama	92.8	-	-	60	55.7	40	37.1
Woodbrook	40.0	25	10.0	50	20.0	25	10.0
Rakeco	100.1	95	95.1	-	-	5	5.0
Whitestone	82.9	95	78.8	-	-	5	4.1
JZR Associates	155.76	90	140.2	-	-	10	15.6
Van Cleef	373.6	90	336.2	-	-	10	37.4
Field	1,835.0	70	1,284.5	10	183.5	20	367.0
Brener	177.4	-	-	10	17.7	90	159.7

Source: 1980 Aerial photographs and 1984 field surveys.

The major demand for oxygen in an aquatic system results from the decay of organic matter that is released into the system and may be measured by the biochemical oxygen demand (BOD). The BOD is a measure of the amount of oxygen needed to oxidize organic material by biochemical means. This biochemical oxidation yields CO_2 water inorganic chemicals, and new biological cells. The oxidation of the organics can create an oxygen deficit in the water, thereby severely affecting fish life. In addition, the assimilation of the organics can provide an energy source for high bacterial populations which can render a watercourse unfit for human contact or consumption.

b. Total Phosphorus

Phosphorus is one of the major nutrients carried by stormwater. Principal sources include sediments, leaves, fertilizers, and atmospheric fallout and washout. High levels of TP can lead to eutrophication (increased aquatic growth) in reservoirs and streams and higher treatment costs to downstream water purveyors.

c. Total Nitrogen

Nitrogen is another major nutrient carried by stormwater. Like phosphorus, it is an essential nutrient for plant and animal growth and passes through cycles of decomposition and photosynthesis. Major sources of nitrogen include organic wastes, fertilizers, and atmospheric fallout and washout. High nitrogen levels can lead to eutrophication and consequent excessive growth of aquatic plants.

d. Zinc

Zinc is found in some natural waters, most particularly where it is mined. High levels of zinc can make drinking water taste very bitter.

e. Lead

Like many pollutants, heavy metals are associated with human activities and types of land use. Roadway runoff represents a major source of heavy metals. Many metals undergo biological magnification in the food chain and can become toxic to man, wildlife, and many aquatic organisms at higher concentrations. Metals can also inhibit bacterial activities that are necessary in the decomposition of organic wastes.

Lead is a highly toxic metal that accumulates in the tissues of man and other animals. It is not essential to human or animal nutrition. The major toxic effects of lead are anemia, paralysis of the body, and impaired neurological functions. Even brief exposures to lead in water can seriously affect health since lead is a cumulative poison.

Lead and zinc are closely associated water quality pollutants, meaning that high concentrations of one are associated with high concentrations of the other. Both pollutants are often indicative of other heavy metals, such as beryllium and cadmium. Like lead, cadmium is a nonessential, nonbeneficial element recognized to be of high toxic potential. In short, heavy metals clearly warrent special attention as the pollutants with the greatest potential for harm to human health.

f. Nonpoint Source Loadings

Based upon the loading rates and land uses at each site, existing nonpoint source loadings can be estimated. In addition, using the same procedure the loadings can be applied to the four development scenarios.

The areal loading method rates represent land use activities without stormwater pollution control measures. It is recognized that implementation of certain stormwater management practices can reduce pollutant loads. However, the exact reduction in the loads as a function of these management practices is not known at present. In addition, the management practices could vary from site to site. Therefore, given the range in removal efficiencies associated with each type of management practice, controlled loadings are not included in this analysis.

In order to facilitate comparison among the various land use categories, the estimated residential loads were divided by existing loads to form a ratio for each parcel, as follows:

$$\frac{\text{Residential load (1 Du/ac)}}{\text{Existing Load}} = \text{Ratio}$$

The ratios fall into 3 groups:

Less than 1.0 - Residential land use would generate less pollutants than existing land use.

1.0 - No change in water quality if the existing land use is developed for residential purposes.

Greater than 1.0 - Residential land use would generate more pollutants than existing land use.

These ratios can then be used to the rate the parcels in terms of estimated water quality impact. For example, those parcels with ratios greater than 1.0 would be rated more negatively than those parcels with ratios less than 1.0.

3. Site Suitability

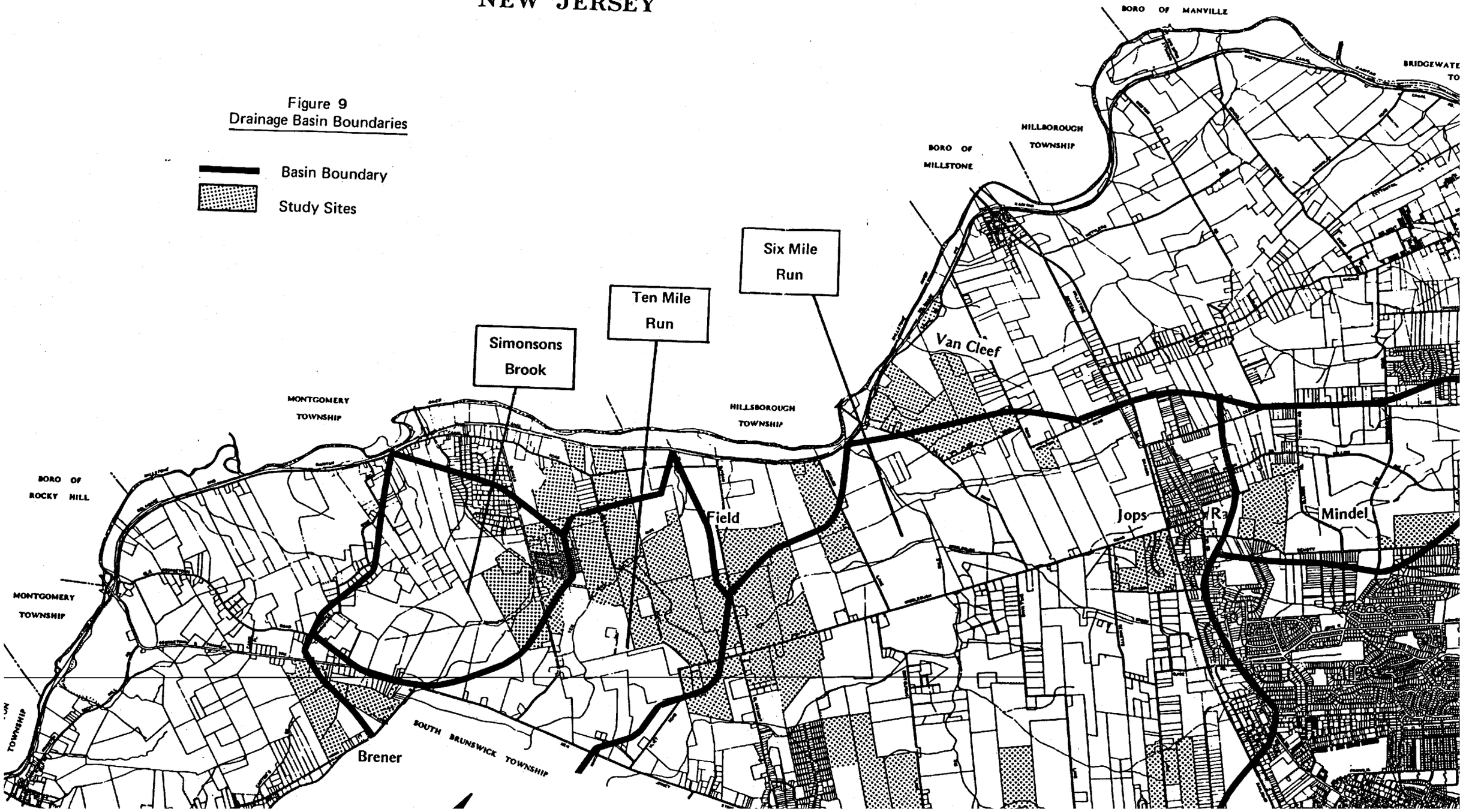
In order to rank the parcels in terms of development suitability based on water quality, it was necessary to determine the nature of the receiving watercourse for each site. First, each site was located on topographic maps to identify those portions of each site that drained into a major watercourse (Figure 9). Next, each site was disaggregated into pertinent water quality-related watersheds.

The first level of disaggregation grouped the Mindel and Ras site together, as they both drain into the Raritan River below any public potable water purveyor intake. This means that any loadings from these tracts would not affect public water supplies. Conversely, the other 9 sites drain into the Millstone River which is classified by the State as FW-2 waters, i.e., fresh surface waters approved as sources of public supply.

TOWNSHIP OF FRANKLIN
SOMERSET COUNTY
NEW JERSEY

Figure 9
Drainage Basin Boundaries

Basin Boundary
Study Sites



A second level of disaggregation grouped those parcels that drain into Six Mile Run into a special category. The rationale for this is based on the planned construction of Six Mile Run Reservoir by the State of New Jersey. This reservoir would substantially augment the yield of the Delaware and Raritan Canal; a major water supply source for central New Jersey. In particular, the Elizabethtown Water Co., Middlesex Water Co., North Brunswick, and New Brunswick all divert water from the Canal in the area.

The following sites (or portions thereof) drain into Six Mile Run:

-Jops
-Flama
-Woodbrook
-Whitestone
-JZR Associates
-Van Cleef (35%)
-Field (27%)

Since pollutant loadings from these sites would directly affect a future water supply source, it is appropriate to evaluate these sites together.

Since lead and zinc are particularly important pollutants, it is appropriate to give them additional weight in the analysis. Accordingly, the ratings reflect the following weights:

BOD	-	16.67
TP	-	16.67
TN	-	16.67
ZN	-	25.0
Pb	-	25.0
		100.0

4. Comparative Suitability

The site rankings are shown in Table 49 with sites ranked 1 most suitable (least impact) and 11 least suitable (greatest impact). Since each site was analyzed for identical development scenario the rankings reflect the ratio of proposed residential to existing land use. Thus, those sites (such as Mindel, Ras and Brener) which are more heavily forested show up as less suitable for development (column 1). This situation is a consequence of the overall low pollutant loadings from forest areas. Conversely, those sites (Rakeco, Whitestone, JZR Associates, Van Cleef, and Field) with large portions of the tract in agricultural use (conventional tillage) are ranked most suitable for development. Again, this reflects the the relatively high pollutant loading rates for BOD, TP, and TN for crops with conventional tillage.

It should be noted that the rankings do not reflect the total amount of the estimated pollutant loadings. If they did, then the largest site (Field) would generate the greatest volume of pollutants and would rank least suitable. However, size was not taken into cosideration in the rankings; rather, weight was given to location within the respective watersheds.

Table 49

Development Suitability - Water Quality

Site	Rank
Mindel	5
Ras	7
Jops	8 (a)
Flama	10 (a)
Woodbrook	9 (a)
Rakeco	2 (a)
Whitestone	1 (a)
JZR Associates	4 (a)
Van Cleef	3 (b)
Field	4 (c)
Brener	6

Note: 1. All rankings based on uncontrolled residential/existing loading ratios at 4.0 du/acre.

2. Average of 5 pollutants with Six Mile Run weights.

a) All ratings multiplied by 2.0

b) All ratings multiplied by 1.35

c) All ratings multiplied by 1.27

F. Ecology

1. Existing Conditions

Franklin Township is in an area that was once uninterrupted oak-chestnut, red maple-hickory forest characteristic of the moist New Jersey uplands. The present species and conditions of vegetation, however, reflect the human activity in the area. Agricultural use of the land in the Township started in the early 1700's and continues today on many sites. Agricultural practices have left many areas of open land, old fields and later suscessional stages of vegetation. This diverse vegetation, along with a ready supply of water, provide habitat for many wildlife species. Common animals in the area include: white-tail deer, squirrel, rabbit, groundhog, field mice, opposum, chipmunks, racoon, red fox and various species of birds, reptiles and amphibians.

Based upon field surveys conducted during the period from September 24, 1984 to October 15, 1984, descriptions of existing vegetation and wildlife habitats are provided for each of the eleven study sites. Supplementing the field surveys were aerial photographs and other reports and maps describing the location of known wildlife habitats, wetland areas, bird nesting areas, vegetation, and habitats of rare, threatened and endangered species of plants and animals.

a. Mindel

The Mindel site is comprised of three separate parcels located along DeMott Lane. The parcel located closest to Easton Avenue is approximately 86.4 acres of disturbed open woodland. This parcel has numerous open areas of old field associations in different stages of succession from grass to grass/red cedar/cherry. Other species present in this old field include: aster, Queen Anne Lace, goldenrod, ragweed and Japanese honeysuckle. The mature woods in this parcel has a canopy dominated by red and white oaks and less abundant canopy species including: pin oaks, shagbark and pigment hickories, white ash and red cedar. The understory species include sassafras, winged euonymous, staghorn sumac, American elm, red cherry and is dominated by flowering dogwood. The ground cover in the wooded area is quite thick and include: poison ivy, violets, catbriar, rose, grape, mapleleaf viburnum, and Japanese honeysuckle. There are signs of recent logging in isolated areas in this woodland parcel.

The second parcel comprising the Mindel property, located west of Ellison Road, has areas of active horse grazing, old field, cedar woods and red maple/oak woods. The old field association present in the parcel includes red cedar (dominant species), sassafras, red cherry, rose, catbriar, aster, goldenrod, grass, raspberry, poison ivy, and Japanese honeysuckle. The small woodland area on the north portion of this parcel is dominated by red maple and white oak and include sassafras, pigment hickory, sweet cherry, red oak, mapleleaf viburnum, and flowering dogwood spicebush.

The third parcel of the Mindel property, located at the intersection of DeMott Lane and Amwell Road is actively farmed and is currently the site of a 5 acre corn field.

The wooded and old field areas of the property provide good vegetative diversity, density and cover for wildlife. However, there appears to be a scarcity

of water in this area which would limit the value of wildlife habitat. The development and general activity in the area together with the lack of adjacent undisturbed areas further reduce the wildlife habitat value of this property to only marginal valuable for wildlife.

b. Ras

The Ras site, adjacent to the Franklin Township Municipal Complex, is comprised principally of old field dominated by rose thickets with some isolated red cedars. The property also contains various grasses, asters, goldenrod and sumaes. Some portions of the property appear to have been mowed. The small property contains some nesting and prefer wildlife habitat, but its size and location near to housing, administrative buildings, and roads limit its wildlife habitat value to marginal.

c. Jops

The Jops site is composed of a wooded area and an agriculture area. Field surveys of the wooded area found an old field association including such species as red ceder (dominant), quaking aspen, sassafras, red and silver maple, white ash, flowering dogwood, red cherry, rose and catbriar thickets and Japanese honeysuckle. There are open areas dominated by grasses, goldenrod and sumacs. The small intermittent stream contained in this property is bordered by moist soil-vegetation such as red maple and weeping willow. The agriculture fields are planted in corn and soybean and have sparsely wooded stream corridors.

The old field wooded area of the site provides good wildlife habitat considering density and diversity of vegetation and some available water. The small size of this woodland and its location, surrounded by residential areas and agricultural activity, limit this area to moderate wildlife habitat value. The agricultural fields are also of moderate value for wildlife.

d. Flama

The Flama site consists of agricultural fields, hedgerows, wooded stream corridors, old field areas and a small area of planted spruce. The hedgerows include species such as black cherry, American elm, pin oak, staghorn sumac and rose thickets. The wooded areas along the stream corridors which cross the property are comprised of small diameter American elm (dominant species), pin oak, cedar, green ash, silky dogwood, red maple, northern arrowwood, rose, catbriar, touch-me-nots, Japanese honeysuckle, and poison ivy. The old field areas are adjacent to the stream corridors and include rose and catbriar thickets, asters, goldenrod, northern arrowwood, touch-me-nots and Japanese honeysuckle. The agricultural fields are planted in soybean or corn, or have been allowed to go fallow.

Field surveys of the Flama site found a variety of habitats suitable for wildlife, the most valuable being the wooded stream corridor and old field areas. These small woodlands have good diversity and density of vegetation and a supply of water. They are limited in value because of their small size and location near residential, agricultural and commercial activities and are classified as moderately valuable for wildlife. The hedgerows and agricultural field are also moderately valuable for wildlife habitat.

e. Woodbrook

The Woodbrook site is similar to the adjacent Flama property across Bennets Lane. The site is comprised of two wooded stream corridors, old field areas and agricultural fields. The wooded areas extend approximately 50 feet from the streams and consist of swamp oak, black cherry, weeping willow, ash, pin oak, cedar, red osier dogwood, touch-me-nots, Japanese honeysuckle, spicebush, red maple and rose thickets. Old field extends between the two stream crossings and includes red maple, willow, cedar, black cherry, grasses, asters, goldenrod and rose. The agricultural fields and planted in soybean.

The wooded stream corridors and old field in the Woodbrook property provide valuable wildlife habitat. The small size of undisturbed adjacent areas limit the value of this wildlife habitat to moderate value. Because of the availability of water the site is rated moderate for wildlife habitat value.

f. Rakeco

The Rakeco site is principally an agricultural field planted in corn and associated hedgerow, and an area of active horse grazing. The hedgerow is dominated by blackcherry, sumac, rose thicket and Japanese honeysuckle. The grazing area is crossed by a meandering stream and there is a wet area with standing water at the north border of the site below an adjacent pond. The grazing area is between the agricultural field to the east and west.

The wildlife habitat value of the Rakeco property is moderate at best. The lack of vegetation density and diversity, and the presence of human activity along N.J. Route 27 limits its value but the presence of water allows this site to be rated as moderate value for wildlife habitat.

g. Whitestone

The Whitestone property is comprised principally of agricultural fields and associated hedgerows located along its border. The agricultural areas are planted in corn and soybean, and the hedgerows are dominated by black cherry and rose thickets.

The agricultural fields and hedgerows of the site provide marginal wildlife habitat because of the lack of water within the site and its location adjacent to N.J. Route 27 and the commercial and residential developments along this heavily travelled route.

h. JZR Associates

The JZR Associates site is comprised of agricultural fields, hedgerows and small areas of old field associations. The hedgerows are dominated by black cherry, but also include green ash, cedar, red maple, American elm, apple, sumac, rose thickets and Japenese honeysuckle. The old field areas contain grasses, cedar, red maple, green ash and rose. The agricultural fields are planted in corn, soybean, or have been allowed to go fallow.

The valuable wildlife habitat within the JZR Associates site is limited to the hedgerows and old field areas. These areas are relatively isolated

from undisturbed lands and appear to lack a sufficient source of water for wildlife maintenance. As a whole, the property is of marginal value for wildlife habitat given the factors noted above in addition to its proximity to N.J. Route 27 and the residential and commercial developments in the surrounding area.

i. Van Cleef

The Van Cleef site is comprised of three separate parcels. The largest parcel, located on Blackwells Mills Road, is comprised of a woodland, a wooded stream corridor and agricultural fields. (The woodland was not extensively examined due to the ongoing hunting season). This woodland was a oak/hickory association with species including red, white and pin oaks, shagbush and pigment hickories and sassafras. The wooded stream corridor includes species such as red and silver maples, American elm, black cherry, weeping willow, apple, cedar, boxelder, touch-me-nots, Japanese honeysuckle, rose and poison ivy. The agricultural fields are planted in corn.

The small woodland parcel along the Delaware and Raritan Canal has open wetland areas. The soil is wet with tree species including American elm, boxelder and red osier, and ground cover including tear-thumb, touch-me-nots, arrow leaf, violets, rose and Japenese honeysuckle. The woodland along the Canal are dominated by green ash and also contained American elm, red maple, red and white oaks, silky dogwood, sycamore, spicebush and cedar. Touch-me-nots dominated the ground cover.

The third parcel located along Grouser Road is agricultural field planted in corn. The largest parcel of the Van Cleef property is valuable as wildlife habitat. The property has diverse habitats from corn field to oak forest with several streams surrounding the parcel to supply water. Although the woodland/wetland area along the Canal is small, it provides valuable wildlife habitat. The vegetation is diverse and dense, and water is readily available. Many deer tracks were found in this area. The corn field is of moderate value as wildlife habitat because of a nearby stream and isolation from residential and commercial areas. As a whole the property is valuable as wildlife habitat.

j. Field

The Field site contains numerous vegetative associations from wooded stream corridors to moist upland woods to old fields and hedgerows. However, agriculture fields dominate this area. The wooded stream corridors contain such species as box elder, river bird, spicebush, rose, touch-me-nots, and violets. The areas along the Delaware and Raritan Canal contains similar species and also include alder and willow. The moist upland woods are comprised of species such as white ash, white and pin oaks, red maple, quaking aspen, black cherry, cedars, flowering dogwood, tulip tree, and hickories. Within some of the woods are open areas of thickets with sumac and black walnut present.

The old field areas of this site are dominated by beardgrass and cedars and also include goldenrod, asters, roses, Japanese honeysuckle and poison ivy. The hedgerows are dominated by sassafras, cherry, cedar and rose thickets. The agricultural fields, which dominate the land use of this property are planted in soybean, corn or have been allowed to go fallow.

This site contains valuable areas for wildlife. The woods are usually centered around streams, and provide a source of water, as well as protective cover. Food sources are abundant in the agriculture fields, and hedgerows provide diverse vegetation for nesting and cover. The sparse human activity, in terms of commercial or residential development, adds measurably to the value of this property in terms of wildlife habitat.

k. Brener

The Brener site contains areas of woodlands, agricultural fields with hedgerows and old fields. The woodlands include areas characterized as lowland hardwoods dominated by white ash and red maple and include other species such as American elm, cedar, silky dogwood, black gum, sweet gum, gray birch, sassafras, northern arrowwood, flowering dogwood, catbriar, rose, poison ivy, raspberry and Japanese honeysuckle. Wooded areas include upland hardwoods which are dominated by American beech, red, white and pin oaks and also include sweet gum, red maple, tuliptree, mapleleaf vibrunum, serviceberry, blueberry, catbriar, and poison ivy.

The old field areas include such species as winged sumac, goldenrod, asters, grasses, catabriars, Japanese honeysuckle and rose thicket. The hedgerows include black cherry, cedars, and rose thickets.

The Brener site abutts an area of undeveloped woodland to the south. This area contains Carter's Brook, a source of water for wildlife. The vegetation in the Brener site is diverse, dense in areas, and provides some good cover for wildlife.

2. Development Impacts

Since several of the study sites contain undisturbed wetland and upland habitats the possibility was high that endangered or threatened species of reptiles, amphibians, birds or vascular plants would be found. In order to determine whether the study sites were the location of such species of reptiles and amphibians (herptiles), an intensive search was conducted encompassing time-constrained field sampling techniques, diurnal and noctural roadway cruising, random opportunistic sampling as well as a search of the literature. Results of this study are described below.

A thorough ground survey was carried out for each of the sites. During preliminary field work visual inspections were made of both wetland and upland habitats throughout the study area. Any areas that had indications of potential endangered or threatened species habitat were mapped and subsequently rechecked in order to thoroughly evaluate the area and search for specimens. Such areas were visited several (2-5) times during this study, or until it was determined specimens would not be found.

Several of the potential development sites, especially areas near Ten Mile Run, the Millstone River, and the Delaware and Raritan Canal, were highly suitable habitat for wildlife in general, and reptiles and amphibians in particular. The undisturbed woodlands, farmfields, and stream floodplains play an important role in the preservation of wildlife and nongame species in Franklin Township. Only

portions of the farmlands were suitable as habitat for reptiles and amphibians throughout most of the year (e.g., hedgerows, irrigation ditches, uncut property boundaries, stream corridors and farm ponds). The undisturbed sections proved to be the most productive areas for herptiles. These included floodplains, streams, rivers, and uncut forest land.

The floodplains of the various streams, brooks and rivers within each study site are subject to flooding during periods of heavy rainfall. Changes in water level may be a limiting factor for habitat utilization by some herptiles within the study areas. Some species such as the wood frog (Rana sylvatica) prefer temporary woodland ponds in which to deposit their eggs. Bog turtles, (Clemmys muhlenbergii, endangered) prefer clean, slow moving, muddy-bottomed streams and marshy meadows in which to live (Zappalorti; 1976). Wood turtles, Clemmys insculpta (threatened), are usually found in clean rivers, streams, and brooks where they spend the winter in hibernation, but become terrestrial in summer. Long-tailed salamanders, (Eurycea longicavda, threatened), prefer unpolluted streams, seepage areas and limestone springs. All are secretive and difficult species to find in their preferred wetland habitats and are adversely effected by long-term disturbances and/or pollution. While most small tributary streams and irrigation ditches that were surveyed were not considered potential habitat for endangered or threatened species, a few of the sites were considered as critical habitat for the wood turtle and other herptiles.

The intensive sampling regime did not reveal bog turtles or long-tailed salamanders within the various study areas. However, an adult male wood turtle (threatened) was captured on the edge of Ten Mile Run within the Field site. The specimen was photographed, permanently marked, and released where it was found. Suitable upland habitat for the wood turtle does exist in the floodplains of the Millstone River. It is possible they utilize the Delaware and Raritan Canal as well at certain times during the year (June-September), but probably hibernate in the moving water of the Millstone River and Ten Mile Run. Upland forest habitat and the edges of fields and active farmland could serve as foraging habitat for the wood turtle during the summer. The abandoned fields or edges of dirt roads may serve as good nesting areas for the turtle. This area compares favorably with confirmed wood turtle habitat in Sussex County (Farrell and Zappalorti, 1980). Other turtle eggs were observed on the edge of the Canal during this study. These included the snapping turtle (Chelydra serpentine), stinkpot or musk turtle (Sternotherus odoratus), painted turtle (Chryscemys picta), and red-bellied turtle (Chrysemys rubriventris).

During the literature search the locality records of the Endangered and Nongame Species Program (NJDEP) were checked to see if there were any records of the bog turtle, wood turtle and long-tailed salamanders for the study area. There were bog turtle, wood turtle, and long-tailed salamander records from northern Somerset County; (Zappalorti and Johnson, 1982), but only a wood turtle recorded from Franklin Township.

Based upon a literature search and field observations conducted between 1980 and 1984 the existence of endangered and threatened bird species was determined for each study site. Table 50 which follows lists each bird species designated by the State of New Jersey as endangered or threatened. Also included is a description as to each bird's status within Franklin Township. Table 51 identifies sites where these birds have been observed and are known to nest.

Table 50

Status of Endangered and Threatened Bird Species

Species	State Status	Status in Franklin Township
Great Blue Heron (Ardea herodias)	Threatened	Uncommon migrant and nonbreeding summer resident wherever there is water; rare in winter.
Osprey (Pandion haliaetus)	Endangered	Fairly common migrant, frequently seen flying overhead.
Northern Harrier (Circus cyaneus)	Endangered	Fairly common migrant and winter resident in open country.
Cooper's Hawk (Accipiter cooperii)	Endangered	Uncommon migrant, occasional in winter in forests, forest edges, and old fields. Sometimes seen in winter in the vicinity of bird feeders.
Red-Shouldered Hawk (Buteo lineatus)	Threatened	Uncommon migrant and winter resident in forests, forest edges and old fields; prefers somewhat wet areas.
Merlin (Falco columbarius)	Threatened	Uncommon migrant, rare in winter in open habitat.
Peregine Falcon (Falco peregrinus)	Endangered	Rare migrant in open habitats.
Upland Sandpiper (Bartramia longicauda)	Endangered	Rare breeder and migrant in fallow fields, pastures, and agricultural fields.
Short-Eared Owl (Asio flammeus)	Endangered	Rare migrant inhabiting large fallow fields and marshes.
Vesper Sparrow (Pooecetes gramineus)	Endangered	Uncommon but widespread breeder in agricultural land; uncommon migrant away from breeding sites, rare in winter.
Savannah Sparrow (Passerarlus sandwichensis)	Threatened	Fairly common migrant; uncommon to rare in winter.
Grasshopper Sparrow (Ammodramus savannarum)	Threatened	Uncommon breeder in fallow fields and cropland; rare migrant away from actual nesting sites.
Bobolink (Dolichonyx oryzivorus)	Threatened	Uncommon breeder in large fallow fields, common migrant throughout.

Source: Wander, W., 1982.

Table 51

Endangered and Threatened Bird Species Observed

at Select Locations in Franklin Township

Site	Great Blue Heron	Osprey	Northern1 Harrier	Cooper's Hawk	Red-Shouldered Hawk	Merlin	Peregine Falcon	Upland2 Sandpiper	Short-Eared Owl	Vesper Sparrow	Savannah Sparrow	Grasshopper Sparrow	Bobolink4
Mindel													
Ras													
Jops			X										
Flama	X	X	X	X	X	X	X				X	X	X
Woodbrook	X	X	X				X				X	X	X
Rakeco			X								X		X
Whitestone			X							X	X		X
JZR Assocates			X							X	X		X
Van Cleef	X	X	X		X	X				X	X		X
Field		X	X	X				X	X	X	X	X	X
Brener					X								

1. Most common on the Field and Van Cleef sites.

2. Field site is one of few N.J. locations where this species is known to have recently nested.

3. Field site currently supports one of the highest densities of breeding vesper sparrows in N.J.

4. Known to nest on Field site only.

Source: Wander, W. and Brady, S., Field Observation 1977-1984.

A search of the literature coupled with field surveys did not reveal the presence of rare, endangered or threatened species of vascular plants within any of the eleven study sites.

3. Site Suitability

Each site's ecological value was rated using three criteria: vegetation/wildlife habitat, rare and endangered species, and wetlands. Each criteria was given a value (0-10) with the total values averaged to yield a final ecological value between 1 and 10.

The vegetation/wildlife habitat rating was based on vegetative diversity and density, food nesting and cover characteristics of vegetation, availability of water, acreage of various habitat types within the site and human activity in the area. The results of the rating system are shown in Table 52. The Field and Van Cleef sites had the most value for wildlife and the Ras, Mindel, Whitestone, and JZR Associates sites were rated for the lowest.

The rare and endangered species rating was based on presence of preferred habitat and sighted species of birds and reptiles, and amphibians within that classification. As in vegetation/wildlife habitat, the Field and Van Cleef sites had the highest rating and Ras and Mindel the lowest (Table 53).

The wetlands rating was based on the acreage of hydric soils, one indicator of wetlands, and the presence of the wetland on the National Wetlands Inventory. The Field and Van Cleef sites again had high rating and Ras had the lowest rating (Table 54).

The final ecological rating combined all three factors and is shown in Table 55. The Field site was rated highest followed by Van Cleef, and the lowest rating was the Ras site. The ratings of the sites appear to be in the groupings: High - Field and Van Cleef; Moderate - Flama, Woodbrook, Rakeco, and Brener; and Low - Jops, Whitestone, JZR Associates, Mindel, and Ras.

4. Comparative Suitability

The suitability for development based upon ecological factors is inversely related to the ecological value of the site. Thus, sites with high ecological value should not be developed, or at most developed at the lowest density (1.0 unit per acre) and then only on those portions of a site with the lower ecological value. Those sites with moderate ecological value have within their borders areas of higher ecological value and those areas should also be buffered from development. Sites of moderate ecological importance could be developed at densities no greater than 4.0-8.0 units per acre. This development would still decrease the overall ecological value of the properties through destruction of wooded and old field areas, while areas that remain undisturbed by construction will experience the pressures of human activity. The properties with the lowest ecological value can be developed at the highest housing density (14.0 units per acre). The ecological value of these sites will not be significantly affected by higher density development. Table 56 summarizes these ratings.

As can be seen in Table 56 two sites are most suitable for low density development, four sites are most suitable for medium density development and five sites are most suitable for high density development. This reveals that the sites are indeed density sensitive for this factor.

Rankings, in terms of a site's suitability for development under each of the four density scenarios, was developed and applied. An important assumption in the development of the ecological rating matrix was that there are no distinct changes in development suitability in terms of ecology over the four densities. For example, the suitability of developing a site rated acceptable for low density development, (1.0-4.0 units per acre) can indeed be suitable for development at 5 to 6 units per acre depending upon local conditions. Therefore, the approach was taken that if a site was suitable for development at a specific density, the site would be ranked highest. Under the next highest density scenario, the site ranked moderate given that additional pressures (impact) upon local ecology that would occur at a higher density.

A site was determined to be clearly unacceptable for development at a density much greater than that determined clearly acceptable for the site. Consequently, development of a site at a density much higher than that recommended was ranked lowest in terms of ecological suitability as local conditions would not allow development at a density significantly higher.

Table 52

Vegetation/Wildlife Habitat Rating

Site	Land Utilization	Acreage	Vegetation	Water	Lack of Human Activity	Total
Mindel	Woodland	1	2	2	1	6
	Grazing	1	0	0	1	2
	Old field	1	3	1	1	6
	Agriculture	0	1	0	1	1
	Overall					15/48=.31
Ras	Old field	0	2	0	1	3
	Overall					3/12=.25
Jops	Woodland	1	2	1	1	5
	Old field	0	3	1	1	5
	Agriculture	1	1	3	1	5
	Overall					15/36=.42
Flama	Woodland	0	2	3	1	6
	Old field	0	3	2	1	6
	Agriculture	1	1	1	1	4
	Overall					16/36=.44
Woodbrook	Woodland	0	2	3	2	7
	Old field	0	3	2	2	7
	Agriculture	0	1	2	1	4
	Overall					18/36=.50
Rakeco	Agriculture	1	1	2	0	4
	Grazing	1	0	3	0	4
	Overall					8/24=.33
Whitestone	Agriculture	1	1	1	0	3
	Overall					3/12=.25
JZR Associates	Old field	0	3	0	0	3
	Agriculture	2	1	0	0	3
	Overall					6/24=.25
Van Cleef	Woodland	1	2	2	3	8
	Agriculture	3	1	1	3	8
	Overall					16/24=.67
Field	Woodland	2	2	3	3	10
	Old field	1	3	1	3	8
	Agriculture	3	1	2	3	9
	Overall					27/36=.75
Brener	Woodland	1	2	1	2	6
	Old field	0	3	2	2	7
	Agriculture	0	1	1	1	3
	Overall					16/36=.44

			Value
Vegetation -	Grazing	-	0
	Agricul.	-	1
	Woodland	-	2
	Old Field	-	3

		Value
Water -	None near	- 0
Intermittent stream or water near site		- 1
Abutt water on site		- 2
Open water		- 3

	Acres		Value
Acreage -	0-30	-	0
	30-100	-	1
	101-200	-	2
	200+	-	3

		Value
Lack of Human Activity -	Adjacent to major activity or surrounded by activity	- 0
	Near major activity	- 1
	Buffer between habitat and activity	- 2
	Isolated area	- 3

Table 53

Endangered and Threatened Species Rating

Site	Herptiles Habitat	Herptiles Presence	Birds Habitat	Birds Presence	Total
Mindel	0	0	0	0	0
Ras	0	0	0	0	0
Jops	0	0	1	3	4
Flama	0	0	1	3	4
Woodbrook	2	0	1	3	6
Rakeco	2	0	0.5	2	4.5
Whitestone	0	0	0.5	2	2.5
JZR Associates	0	0	0.5	2	2.5
Van Cleef	2	0	2	3	7
Field	2	3	2	3	10
Brener	1	0	1	1	3

Habitat Ratings	Value
None	0
Low	0.5
Moderate	1.0
High	2.0

Presence/Sighting Birds	Herptiles	Value
None	None	0
Single species flying	-	1
Several species flying	-	2
Nesting 1 or more species		3

Table 54

Wetlands Rating

Site	Hydric Soils	National Wetlands Inventory	Total
Mindel	2.5	0	2.50
Ras	0	0	0
Jops	1.25	0	1.25
Flama	2.50	2.5	5.00
Woodbrook	1.25	0	1.25
Rakeco	0	2.5	2.50
Whitestone	0	2.5	2.50
JZR Associates	0	0	0
Van Cleef	1.25	5.0	6.25
Field	3.75	5.0	8.75
Brener	2.5	0	2.50

Hydric Soils[1].

Acres	Value
0-5	0
5-30	1.25
31-100	2.50
101-200	3.75
200 +	5.00

National Wetlands Inventory

Presence	Value
0	0
Abutt	2.5
Present	5.0

1. Hydric soil ratings are based on total area of hydric soils rather than percentage of a site due to the fact that larger areas of such soils have a higher ecological value than smaller areas.

Table 55

Ecological Rating

Site	Vegetation/ Wildlife Habitat	Rare and Endangered Species	Wetlands	Final Ecological Value
Mindel	3.1	0	2.5	1.9
Ras	2.5	0	0	0.8
Jops	4.2	4.0	1.25	3.2
Flama	4.4	4.0	5.0	4.5
Woodbrook	5.0	6.0	1.25	4.1
Rakeco	3.3	4.5	2.5	3.4
Whitestone	2.5	2.5	2.5	2.5
JZR Associates	2.5	2.5	0	1.7
Van Cleef	6.7	7.0	6.25	6.7
Field	7.5	10.0	8.75	8.8
Brener	4.4	3.0	2.5	3.3

Table 56

Development Suitability - Ecology

Site	Ecological Rating	Maximum Recommended Development Density
Mindel	Low (1.9)	High Density (8-14 du/ac)
Ras	Low (0.8)	High Density (8-14 du/ac)
Jops	Low (3.2)	High Density (8-14 du/ac)
Flama	Moderate (4.5)	Medium Density (4-8 du/ac)
Woodbrook	Moderate (4.1)	Medium Density (4-8 du/ac)
Rakeco	Moderate (3.4)	Medium Density (4-8 du/ac)
Whitestone	Low (2.5)	High Density (8-14 du/ac)
JZR Associates	Low (1.7)	High Density (8-14 du/ac)
Van Cleef	High (6.7)	Low Density (1-4 du/ac)
Field	High (8.8)	Low Density (1-4 du/ac)
Brener	Moderate (3.3)	Medium Density (4-8 du/ac)

G. Geology and Soils

1. Existing Conditions

Franklin Township is located in a region characterized by a sequence of Triassic red beds (Brunswick shale) and igneous intrusives (Triassic diabase) similar to other sediment-filled structural basins found from Nova Scotia to North Carolina. The Brunswick shale is formed by the compaction of clay or mud producing rock which is structurally weak and easily shattered into thin flakes and plates. The Triassic diabase is an intrusive igneous rock, generally a fine crystalline basaltic rock composed of plagioclase felderspar and pyroxene; the diabase rock is not as friable as the shale. Plant and dinosaur fossils suggest that these widespread deposits occurred at the earth's surface. The red beds overlie crystalline rock of great age, while younger beds have been largely removed by subsequent marine movements. Only a relatively sparse and discontinuous cover of Quaternary gravels and their alluvial beds in stream bottoms obscure the red bed and intrusive materials.

The Brunswick shale and Triassic diabase intrusives form what is known as the Newark Group and lie on the northwestern-sloping crystalline rocks at dip angles ranging from 12° - 15°. Down faulting at the northwestern edge block has resulted not only in the stratigraphic thickening in this direction but repetition of strata as well. About 90 percent of the area of Franklin Township is underlayed by Brunswick shale and 10 percent by the Triassic diabase with the diabase found principally within the southern portion of the Township (Figure 10).

The bearing capacity for structures in the Brunswick shale formation varies with the depth of the rock from the ground surface. At a depth of from 3 feet to 8 feet from the surface the bearing capacity is between 2 and 8 tons per square foot, with greatest strength in the deeper zones. At depths greater than 8 feet the rock strength increases even with increasing depth because of the fractured nature of the material.

At diabase-shale contacts, the sedimentary rocks have in some cases been baked and are often more similar in weathering character to the igneous rock than bedding planes. Major joints are often wide and are generally far apart. The material is highly resistant to weathering and results in a weathered layer of varying thickness composed generally of large rounded boulders mixed with soil.

The complexity of the boulder-soil mixture, frequently 3 feet to 10 feet from the ground surface, limits bearing capacity in this layer to 2 tons per square feet. In the unweathered zone, the diabase has great strength and the bearing capacity at depths greater than 10 feet may be expected to be 20 tons per square foot. In this material, bearing capacity continues to increase with increasing depth.

All of the sites with the exception of the Field and Brener sites are located over the Brunswick shale formation. Approximately 10 percent of the Field site and some 15 percent of the Brener site is found on the Triassic diabase with the balance of these two sites being on the Brunswick shale.

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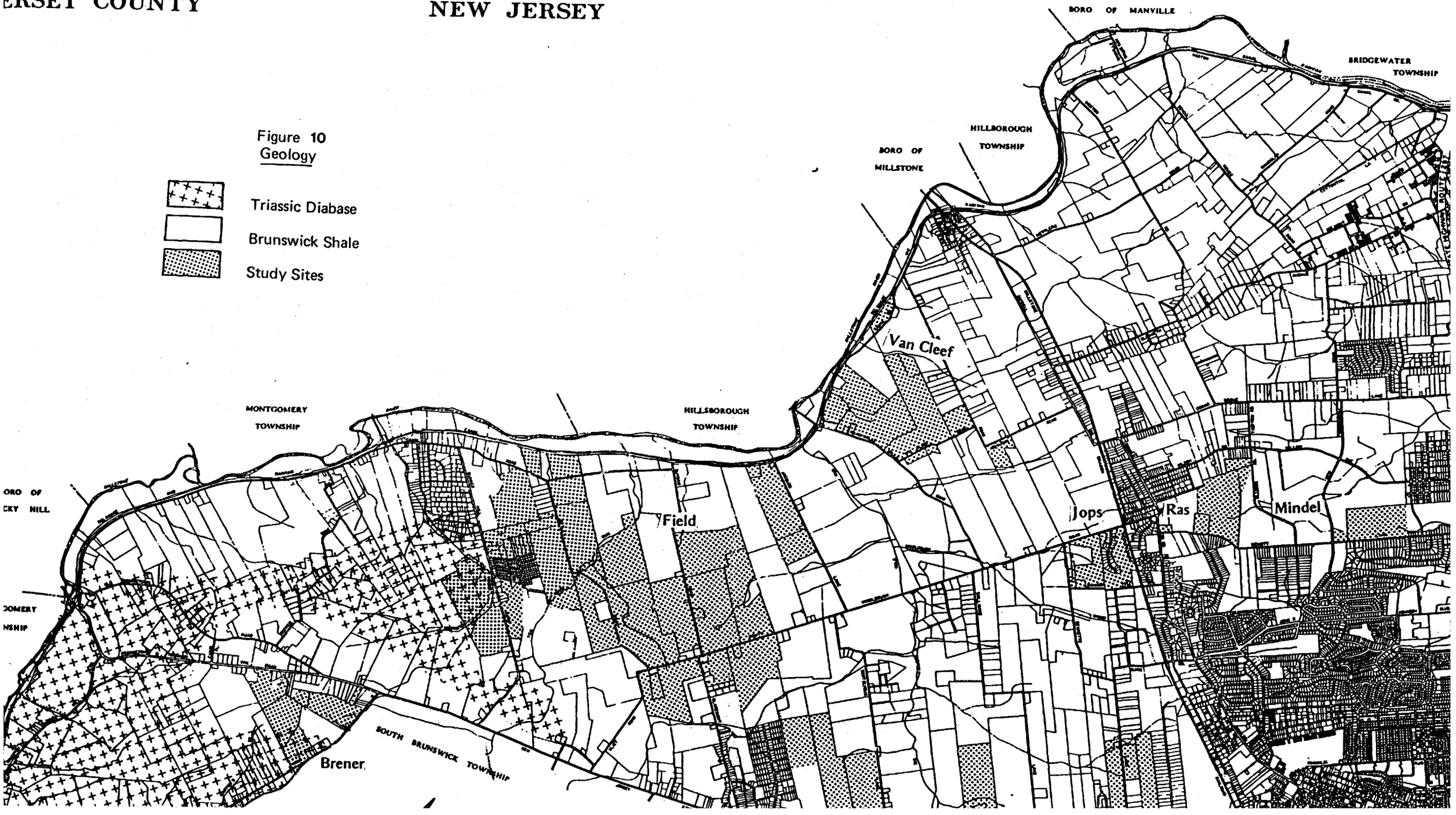
Figure 10
Geology

Triassic Diabase

Brunswick Shale

Study Sites



The U.S. Department of Agriculture, Soil Conservation Service, in preparing its soil survey for Somerset County, New Jersey, identified six principal soil associations within Franklin Township. The location of these six associations are identified in Figure 11. The following presents a description of the principal soils within each association based upon Soil Conservation Service soil studies for the Somerset County area.

Neshaminy-Mount Lucas-Amwell Association

Neshaminy soils are well drained or moderately well drained silt loams or very stony silt loams that are deep over bedrock. They are gently sloping to very steep. The very steep Neshaminy soils are very stony. Mount Lucas soils are deep, moderately well drained to somewhat poorly drained silt loams, gravelly silt loams, or very stony silt loams. They are gently sloping to strongly sloping. Amwell soils are deep, moderately well drained to somewhat poorly drained loams and gravelly silt loams. They are gently sloping to strongly sloping.

The soils in this association are used mainly for farming and woodland. The stony steep soils are used as woodland and are better suited to this use than to others. The nonstony, nearly level to strongly sloping soils are used for corn, soybeans, small grains, and hay and pasture plants. Artifical drainage is needed to remove excess water from the Mount Lucas and Amwell soils. Erosion is a potential hazard where the soils are strongly sloping or steep. Steep slops, stoniness, and a seasonal high water table are limitations for community development. This association is found generally within the southern-most portion of the Township.

Penn-Klinesville-Reaville Association

Penn soils are moderately deep, well-drained silt loams and shaly silt loams. They are nearly level to strongly sloping. Klinesville soils are shallow, well-drained shaly loams. They are gently sloping to very steep. Reaville soils are moderately deep, moderately well drained to somewhat poorly drained silt loams. They are nearly level or gently sloping.

The soils in this association are used mostly for general farming and dairying. The less sloping soils are used for corn, soybeans, small grains, hay, and pasture. Klinesville soils are droughty, shallow, and shaly and are not well suited to crops. Artificial drainage is generally needed to remove excess water from the Reaville soils. Erosion is a potential hazard where the soils are farmed intensively unless conservation measures are used. Depth to bedrock, steepness of slope, and a seasonal water table are limitations for community development. This association covers some 50 percent of the Township, principally within the central-most area.

Royce-Penn-Klinesville Association

Royce soils are deep, well-drained silt loams. They are gently sloping. Penn soils are moderately deep, well-drained silt loams or shaly silt loams. They are nearly level to strongly sloping. Klinesville soils are shallow, well-drained shaly loams. They are gently sloping to very steep.

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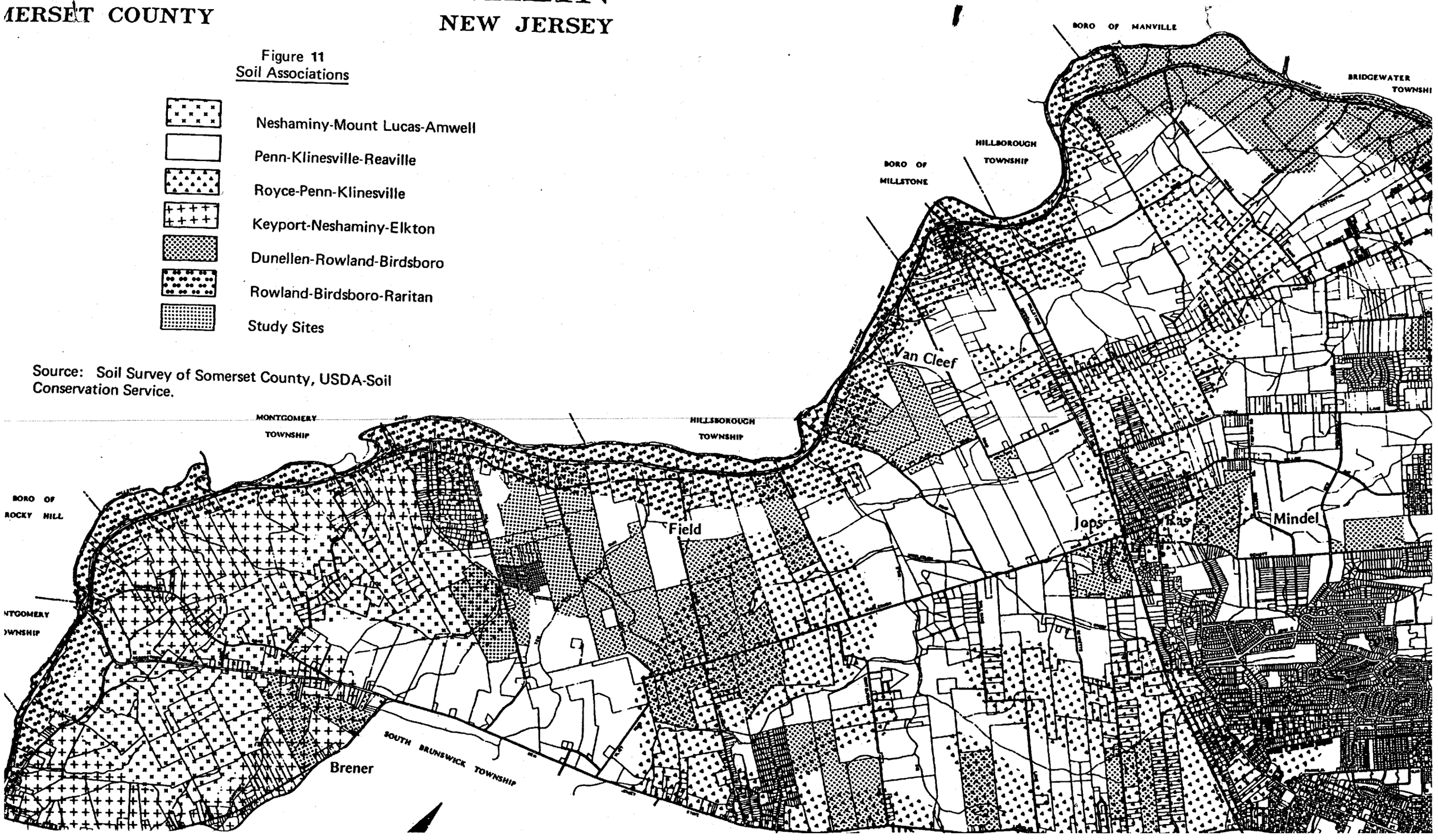
Figure 11
Soil Associations

- Neshaminy-Mount Lucas-Amwell
- Penn-Klinesville-Reaville
- Royce-Penn-Klinesville
- Keyport-Neshaminy-Elkton
- Dunellen-Rowland-Birdsboro
- Rowland-Birdsboro-Raritan
- Study Sites

Source: Soil Survey of Somerset County, USDA-Soil Conservation Service.



Most of the soils in this association are used for general farming and dairying. Royce and Penn soils are well suited to cultivated crops. The hazard of erosion is the main limitation to use of the Royce and Penn soils for farming. The Klinesville soils are generally wooded or are used for pasture. Steep slopes and depth to bedrock are limitations for community development. Like the Penn-Klinesville-Reaville association, this association is found within central Franklin Township.

Keyport-Neshaminy-Elkton Association

Keyport soils are deep, moderately well drained silt loams. They are nearly level to gently sloping. Neshaminy soils are deep, well-drained silt loams. They are nearly level and occupy slight depressions. A seasonal high water table is near the surface several months each year. Elkton soils are deep, poorly drained silt loams. They are nearly level and occupy slight depressions. A seasonal high water table is near the surface several months each year.

The soils in this association are used mainly for farming and as woodland. The nearly level and gently sloping soils are used for corn, soybeans, small grains, hay, and pasture. Artificial drainage is needed to remove excess water from the Keyport and Elkton soils. The very stony and more sloping Neshaminy soils are used mainly as woodland. A seasonal high water table and slow permeability are limitations for community development. This association is found principally within the southern-most areas of the Township.

Dunellen-Rowland-Birdsboro Association

Dunellen soils are deep, well-drained sandy loams. These soils formed in glacial outwash material and are on high terraces. They are nearly level to gently sloping. Rowland soils are deep, moderately well drained and somewhat poorly drained silt loams that formed in recent alluvium along the major streams. They are subject to flooding several times a year. Birdsboro soils are deep, well-drained silt loams that formed in old alluvium deposits on stream terraces. They are nearly level to strongly sloping and are subject to flooding in only the lowest areas.

Most of the soils in this association are used for farming and for urban uses. The main crops are corn, small grains, hay, and pasture. Vegetable crops are also well suited to most of the soils in this association. Where water is available for irrigation, vegetables, nursery crops, and other high-value crops can be grown on these soils. The Rowland soils, which are subject to annual flooding, are used mainly for pasture and sod farming. Frequent flooding is a limitation for community development. This association appears only in the northern portion of the Township along the Millstone and Raritan Rivers.

Rowland-Birdsboro-Raritan Association

The soils of this association are along the major streams. Soils that are subject to flooding are dominant in the association. These soils occupy the flood plains and terraces that are adjacent to the north and south branches of the Raritan River and adjacent to the Lamington, Millstone, Neshanic, and Green Brook Rivers. Rowland soils are moderately well drained to somewaht poorly drained soils on flood plains. They have a seasonal high water table and are subject to frequent flooding. These soils are deep silt loams that formed in

drained to somewhat poorly drained soils on flood plains. They have a seasonal high water table and are subject to frequent flooding. These soils are deep silt loams that formed in recent alluvium washed from uplands. Birdsboro and Raritan soils formed in old alluvium. Birdsboro soils are deep, well-drained silt loams. They are on the higher positions on the terraces, and only the lowest areas are subject to infrequent stream flooding. Raritan soils are deep, moderately well drained to somewhat poorly drained silt loams. They have a seasonal high water table and are slowly permeable. They are on stream terraces, and only the lowest areas are subject to flooding. Flooding as a result of stream overflow, however, is an infrequent occurrence.

Most of the soils in this association have been cleared of trees and are used mainly for general farming. The main crops are corn, small grains, soybeans, hay and pasture. Because flooding is a hazard, the Rowland soils are used mainly for pasture, but some areas are used for sod farming. Birdsboro soils are well suited to cultivated crops. Vegetables or nursery crops are well suited, particularly where water for irrigation is available. Frequent flooding and a perched seasonal high water table are limitations for community development. This association is found only along the Millstone River in western Franklin Township.

2. Development Impacts

With the exception of small percentages of two sites (10 percent of the Field site and 15 percent of the Brener site) all of the sites were underlayed entirely by the Brunswick shale. Weathered Brunswick shale at a depth of 3 to 8 feet from the surface has a bearing capacity of 2 to 8 tons per square foot. This formation could support a structure comparable to a multi-family residence with a maximum height of 3 stories. Weathered diabase can support the same type of structures. Consequently, there is little difference between the sites in terms of bearing capacity.

There are fewer construction limitations for sites within the Brunswick shale than on the Triassic diabase because its removal is easier. However, depth to the shale is usually shallow while depth to the diabase can be deep although rock outcrops may occur. Consequently, building in areas underlayed by either formation may not offer a decided advantage. With this in mind and the fact that the diabase makes up only a small portion of two sites, it would appear that there are no real construction limitation differences on any of the sites.

Seismic activity has not been a problem in the area. No damage claims have been reported in the region due to seismic activity. While the Hopewell fault is located near Franklin Township, the fault is inactive and has been inactive for a number of years. Consequently, the sites are not expected to be affected by seismic activity in the future.

Table 57 presents the predominant soil types present at each study site. All but three sites, Brener, JZR Associates, and Whitestone, have the Penn series as the soil in most abundance within the site. The most common soil at the Brener site is Keyport. Within the JZR Associates and Whitestone sites the most common soil type is Royce.

Table 57

Predominant Soil Types

Site	Amwell	Birdsboro	Dunellen	Elkton	Keyport	Clinesville	Landowne	Mount Lucas	Neshaminy	Penn	Raritan	Deaville	Rowland	Royce
Mindel										P		S		
Ras										P				
Jops										P		S		
Flama										P		S		
Woodbrook										P				
Rakeco						S				P				
Whitestone							S							P
JZR Associates							S							P
Van Cleef						S				P				
Field		P								P				
Brener					P					S				

Source: USDA, Soil Conservation Service.

P - Predominant soil present.

S - Secondary soil present.

Soils of secondary abundance at the sites include: Klinesville, Landowne, and Reaville.

3. Site Suitability

All eleven sites were reviewed against Soil Conservation Service (SCS) soil maps for Franklin Township with the predominant soils within each site identified. "Limitations of Soils for Community Development" appearing in the soil survey for Somerset County was reviewed to determine the most critical factors for the analysis. Of the factors, four were chosen as the most critical including: foundations for dwellings with basements; foundations for dwellings without basements; septic tank absorption fields; and local roads and streets. The three ordinal scale descriptors used by the SCS, slight, moderate, and severe were associated with the three nominal scale descriptors, 0, -1, -2, repectively. The nominal scale descriptor was determined for the predominant and secondary soils for each site for each of the factors. The total for the four factors was then added and compared.

4. Comparative Suitability

Using the primary soils found in the sites, all but one site, Field, had severe limitations in terms of septic tank absorption fields. Only slight or moderate limitations were encountered for all of the sites for all of the other factors except one, Brener, which had severe limitations in terms of local roads and streets.

When secondary soils were considered for each site, the development suitability of the site in terms of soils for the four factors selected stayed the same or lessened except for Brener where the soil suitability for local roads and streets increased. Table 58 presents the soil suitability matrix developed in this analysis.

Table 58

Development Suitability - Soils

Site	Foundations For Dwelling Units With Basements	Foundations For Dwelling Units Without Basements	Septic Tank Absorption Fields	Local Roads and Streets	Score (Average)	Suitability Ranking
Brener	-1	-1	-2	-2	-1.50	3
JZR Associates	0	-1	-1	-1	-0.75	1
Whitestone	0	-1	-1	-1	-0.75	1
Rakeco	-1	-1	-2	-1	-1.25	2
Woodbrook	-1	-1	-2	-1	-1.25	2
Flama	-1	-1	-2	-1	-1.25	2
Jops	-1	-1	-2	-1	-1.25	2
Van Cleef	-1	-1	-2	-1	-1.25	2
Field	0/-1	-1	0/-1	-1	-0.75	1
Mindel	-1	-1	-2	-1	-1.25	2
Ras	-1	-1	-2	-1	-1.25	2

Limitations for Development: 0 - None
-1 - Slight
-2 - Moderate
-3 - Severe

H. Hydrology

1. Existing Conditions

The Raritan River and Millstone River are the two primary waterways which drain Franklin Township. Generally, the Raritan River drains the 13 square mile area northeast of Amwell Road and the remaining 33 square miles of the Township is drained by the Millstone River.

The Raritan River drainage area is divided into 5 subareas of up to 3 square miles in size. The streams draining these areas include: Mile Run Brook, which drains the area southeast of Girard Avenue and forms the boundary between New Brunswick and Franklin Township; Seeley's Brook, which empties into the Raritan River just south of John F. Kennedy Boulevard and drains the area between Girard Avenue and DeMott Lane; Randolph Brook which enters the Raritan just east of Randolph Road and drains the area from Elizabeth Avenue to Randolph Road and southerly to School House Road; an unnamed stream which empties into the Raritan just south of the Township line at Easton Avenue and drains the area between Elizabeth Avenue and Cedar Grove Lane westerly to Weston Road; and DeRouse Brook which enters the Raritan River just west of Hamilton Boulevard and drains the northeast portion of the Township.

Within the Millstone River drainage basin, the tributary streams are even more numerous. Here, there are 5 streams with relatively large drainage areas and 17 smaller streams. The most important of these streams is Six Mile Run, which drains an area of 11 square miles in Franklin extending northerly to Amwell Road, Van Cleef Road and Blackwells Mills Road and southerly to Suydam Road and Vliet Road. This area is almost as large as the area of Franklin drained by the Raritan River system.

The other large streams which form the Millstone drainage system are as follows: Lodgins Brook just north of East Millstone drains the area between East Millstone and Weston Road, and easterly to Elizabeth Avenue; Ten Mile Run which empties into the river between Suydam Road and Butler Road and drains an area extending from Bunker Hill Road to Vliet Road and Suydam Road; Simonson Brook which empties into the river at Griggstown and drains the area between Bunker Hill Road and Cooper Mine Road; and Carters Brook which empties into the river in South Brunswick Township.

2. Development Impacts

Flood hazard is a well documented development constraint. The potential for property damage and threat to public welfare and safety require that land use planning take flood hazard into account. To gauge the impact of flood potential on development suitability, an index of flood hazard was developed. The index involved estimating the proportion of a total site area located within the 100-year floodplain as documented by flood insurance maps prepared by the U.S. Department of Housing and Urban Development (USHUD). Since these maps are used by USHUD to evaluate mortgage and property insurance applications, they are considered valid and reliable (Figure 12).

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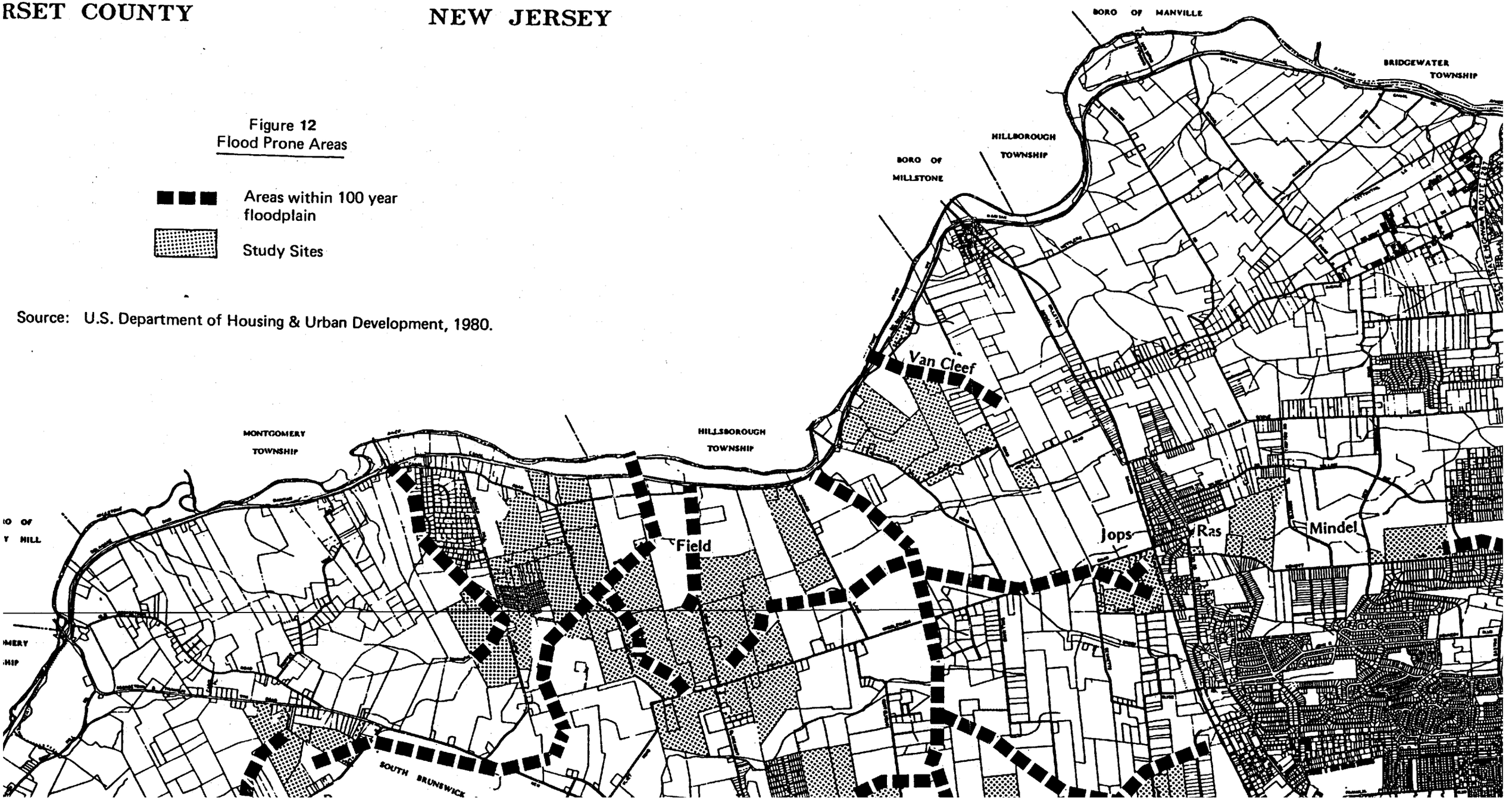
Figure 12
Flood Prone Areas

■■■ Areas within 100 year floodplain

Study Sites

Source: U.S. Department of Housing & Urban Development, 1980.



a. Mindel

The 196.4 acre Mindel site contains approximately 1.5 acres or 0.75 percent of its total land area within the 100-year floodplain. Only the northernmost parcel is impacted by the floodplain, which reaches the northeast edge of the site. The site is part of the Raritan River drainage basin.

b. Ras

The Ras site is also located within the Raritan drainage basin, however, no portion of the site is located within the 100-year floodplain.

c. Jops

The 87.1 acre Jops site contains approximately 4.7 acres or 5.5 percent of its total land area within the 100-year floodplain. The floodplain area bisects the site which is drained by a branch of Middlebush Brook flowing in a southerly direction into Six Mile Run. The site is part of the Millstone River drainage basin.

d. Flama

The 92.8 acre Flama site located within the Millstone drainage basin contains approximately 1.4 acres or 1.5 percent of its total area land within the 100-year floodplain. The site is drained by a tributary of Six Mile Run. The floodplain impacts the western edge of the site.

e. Woodbrook

The 40 acre Woodbrook site contains approximately 5.7 acres or 14.0 percent of its total area within the 100-year floodplain. The site is drained by two southerly flowing tributaries of the Six Mile Run. The floodplain passes through the central and western portions of the site which is within the Millstone River drainage basin.

f. Rakeco

The 100.1 acre Rakeco site contains approximately 7.5 acres or 7.5 percent of its total area within the 100-year floodplain. The site is drained by a southerly flowing tributary of the Six Mile Run. The floodplain area bisects the site which is within the Millstone drainage area.

g. Whitestone

The 82.9 acre Whitestone site contains approximately 2.1 acres or 2.5 percent of its total land area within the 100-year floodplain. This site is also drained by a small tributary of the Six Mile Run. The floodprone area is located along the western border of the site which is within the Millstone drainage area.

h. JZR Associates

The 155.76 acre JZR Associates site contains approximately 1.2 acres or 3.0 percent of its total land area within the 100-year floodplain. The site is drained by a small southerly flowing tributary of Six Mile Run. This site is also within the Millstone drainage area.

i. Van Cleef

The 373.63 Van Cleef site contains approximately 10.4 acres or 3.0 percent of its total area within the 100-year floodplain. The site is drained by two unnamed streams which lead directly into the Millstone River west of the site.

j. Field

The 1,835 acre Field site contains approximately 76.4 acres or 4.0 percent of its total land area in the 100-year floodplain. Another 4.6 acres are within the 100-500 year floodplain. Portions of Six Mile Run and Ten Mile Run and their tributaries pass through the site. The Field site contains the largest number of streams and tributaries of any of the sites. The site is part of the Millstone River drainage basin.

k. Brener

The 177.4 acre Brener site contains approximately 1.4 acres or 0.8 percent of its total land area within the 100-year floodplain. The site is drained by Carters Brook which is part of the Millstone watershed. A small segment of Carters Brook passing through the center of the site will be subject to flooding during a 100-year flood event. The site itself is within the Millstone drainage area.

Table 59 identifies the acreages found within the 100-year floodplain for each site along with the percentage of each site.

3. Site Suitability

For purposes of evaluating and comparing development suitability, the percentage of a site falling within the 100-year floodplain was considered. The higher this percentage and the potential impact of flooding, the less suitable a site is considered to be for development. Conversely, the lower the percentage and the potential impact of flooding, the more suitable a site was considered to be. The sites were then compared and ranked for the development scenarios of 1, 4, 8, and 14 dwelling units per acre. Because the variable of development density does not effect the index of percent of land area in the 100-year floodplain, the ranking outcome is the same for each development scenario.

4. Comparative Suitability

The eleven sites exhibit differences in terms of the percentage of the site falling within the 100-year floodplain and hence, their development suitability for this factor. Sites such as Field and Van Cleef, while having the highest number of acres within floodprone areas - 76.4 and 10.4 acres respectively - had a relatively low percentage of the site in floodplain as a result of their large site area. Sites such as Rakeco and Woodbrook had fairly low acreage totals within floodprone areas - 7.5 and 5.7 acres respectively - but were ranked less suitable due to their small size and high percentage of area in floodplain. The Ras, Mindel, JZR Associates, and Brener sites were ranked highest (most suitable) as a result of their low percentage of land area within the floodplain (less than 1.0 percent). The relative ranking for each site is shown in Table 60.

Table 59

Flood Risk

(Percentage of Site Within 100-Year Floodplain)

Site	Total Acres	Acreage within 100-Year Floodplain	Percentage of Site Floodprone
Mindel	196.40	1.5	0.75
Ras	11.85	0	0
Jops	87.10	4.7	5.5
Flama	92.80	1.4	1.5
Woodbrook	40.00	5.7	14.0
Rakeco	100.10	7.5	7.5
Whitestone	82.90	2.1	2.5
JZR Associates	155.76	1.2	0.8
Van Cleef	373.63	10.4	3.0
Field	1,835.00	76.4	4.0
Brener	177.40	1.4	0.8

Source: U.S. Department of Housing and Urban Development, 1980.

Table 60

Development Suitability Ranking - Hydrology

Site	Approximate Percent of Site Within 100-Year Floodplain	Suitability Ranking
Mindel	0.75	2
Ras	0	1
Jops	5.5	8
Flama	1.5	4
Woodbrook	14.0	10
Rakeco	7.5	9
Whitestone	2.5	5
JZR Associates	0.8	3
Van Cleef	3.0	6
Field	4.0	7
Brener	0.8	3

SECTION FOUR: FINDINGS AND CONCLUSIONS

SECTION FOUR: FINDINGS AND CONCLUSIONS

A. Summary of Findings

Suitability as measured by a Composite Ranking of all the environmental and public service factors resulted in the following findings:

More Suitable: Ras, Mindel, Brener

Suitable: Van Cleef, Whitestone, JZR Associates and Jops

Less Suitable: Flama, Rakeco, Field, and Woodbrook

Suitability as measured by a ranking of only Environmental factors including air quality, water quality, ecology, geology, soils and hydrology identified:

More Suitable: Ras, Mindel, Brener

Suitable: Jops, Van Cleef, JZR Associates and, Flama

Less Suitable: Whitestone, Woodbrook, Field, and Rakeco

Suitability as measured by a ranking of only Public Service factors taking transportation, public water, sewerage, police protection, and fire protection identified:

More Suitable: Whitestone, Mindel, JZR Associates, Ras, and Brener

Suitable: Van Cleef, Rakeco, Flama, and Field

Less Suitable: Jops, and Woodbrook

B. Conclusion

In order to summarize the suitability of the 11 sites for development, three final rankings were prepared to independently compare the impact of the public service factors, environmental factors and a composite ranking of all eleven factors. The final rankings were prepared for each of four development scenarios, producing 12 rankings per site. Public service factors considered included transportation, public water, sewerage, fire protection and police service. Environmental factors considered included air quality, water quality, ecology, geology, soils, and hydrology.

As the analysis progressed, it became evident that many factors were appropriate to be considered in the "build or no build" context, with little or no impact observed for changes in density. For these factors, the construction of a very low density development would generate the same or near the same impact as a high density development. Other factors including transportation, ecology and air quality proved extremely sensitive to density and population. The different values assumed by these factors play prominently in the differences in rankings observed for each development scenario.

The comparative suitability of the sites is discussed below for the final composite, public service and environmental rankings. Sites exhibiting more or less development suitability for each final ranking are identified. The term "more suitable" refers to sites which were consistently ranked high for the greatest number of development scenarios, compared to that observed for other sites. The term "less suitable" refers to sites with consistenly low rankings for the greatest number of development scenarios, compared to other sites. The term "suitable" refers to sites ranking below "more suitable" but above "less suitable" sites. Data below compares suitability rankings by development scenario and site for each final ranking. Tables 61-64 present a comparison of the 11 indicies of suitability.

	Final Composite Ranking				Final Municipal Services Ranking				Final Environmental Ranking			
	Dwelling Units Per Acre				Dwelling Units Per Acre				Dwelling Units Per Acre			
Site	1	4	8	14	1	4	8	14	1	4	8	14
Mindel	1	2	2	2	1	2	2	2	2	3	3	2
Ras	2	1	1	1	1	1	1	1	2	4	4	3
Jops	7	4	4	5	3	3	4	4	7	10	7	7
Flama	10	6	7	8	5	5	6	7	6	9	5	5
Woodbrook	11	9	8	9	7	8	8	8	8	11	8	7
Rakeco	9	7	9	7	7	7	10	9	5	6	9	4
Whitestone	5	5	5	5	4	7	8	8	1	1	1	3
JZR Assoc.	6	5	5	4	4	6	7	6	2	6	2	1
Van Cleef	4	3	6	6	3	4	5	5	4	7	6	6
Field	8	8	8	10	6	8	9	10	5	8	7	6
Brener	3	2	3	3	2	1	3	3	4	5	3	4

1. Composite Ranking Results

Sites more suitable for development include Ras, Mindel and Brener, taking into account the 5 public service and 6 environmental factors. The Ras site had a composite rank of 2, for density of 1.0 unit per acre. The Mindel site also

Table 61

Comparative Ranking By Suitability Index

(1.0 Dwelling Unit per Acre)

	Municipal Services					Natural Environment						Ranking		
	Transportation	Public Water	Sewerage	Fire	Police	Air Quality	Water Quality	Ecology	Geology	Soils	Hydrology	Municipal Services	Natural Envir.	All Indicies
Mindel	1	1	2	2	3	1	5	1	1	2	2	1	2	1
Ras	1	1	3	1	3	1	7	1	1	2	1	1	3	2
Jops	1	2	5	3	3	2	8	1	1	2	8	3	7	7
Flama	3	1	6	7	6	2	10	1	1	2	4	5	6	10
Woodbrook	1	2	7	9	6	2	9	1	1	2	10	7	8	11
Rakeco	1	3	8	8	5	2	2	1	1	2	9	7	5	9
Whitestone	1	1	9	5	5	2	1	1	1	1	5	4	1	5
JZR Associates	1	1	10	5	4	2	4	1	1	1	3	4	2	6
Van Cleef	2	3	4	4	1	3	3	1	1	2	6	3	4	4
Field	4	1	11	6	2	3	4	1	1	1	7	6	5	8
Brener	1	1	1	3	4	2	6	1	1	3	3	2	4	3

Table 62

Comparative Ranking By Suitability Index

(4.0 Dwelling Units per Acre)

	Municipal Services					Natural Environmment						Ranking		
	Transportation	Public Water	Sewerage	Fire	Police	Air Quality	Water Quality	Ecology	Geology	Soils	Hydrology	Municipal Services	Natural Envir.	All Indicies
Mindel	3	1	2	2	3	2	5	1	1	2	2	2	3	2
Ras	1	1	3	1	3	2	7	1	1	2	1	1	4	1
Jops	1	2	5	3	3	3	8	1	1	2	8	3	10	4
Flama	4	1	6	7	6	1	10	1	1	2	4	5	9	6
Woodbrook	6	2	7	9	6	1	9	1	1	2	10	8	11	9
Rakeco	5	3	8	8	5	1	2	1	1	2	9	7	6	7
Whitestone	9	1	9	5	5	1	1	1	1	1	5	7	1	5
JZR Associates	8	1	10	5	4	1	4	1	1	1	3	6	2	5
Van Cleef	7	3	4	4	1	4	3	1	1	2	6	4	7	3
Field	10	1	11	6	2	4	4	1	1	1	7	8	8	8
Brener	2	1	1	1	4	1	6	1	1	3	3	1	5	2

Table 63

Comparative Ranking By Suitability Index

(8.0 Dwelling Units per Acre)

	Municipal Services					Natural Environment						Ranking		
	Transportation	Public Water	Sewerage	Fire	Police	Air Quality	Water Quality	Ecology	Geology	Soils	Hydrology	Municipal Services	Natural Envir.	All Indicies
Mindel	3	1	2	2	3	2	5	1	1	2	2	2	3	2
Ras	1	1	3	1	3	2	7	1	1	2	1	1	4	1
Jops	2	2	5	3	3	3	8	1	1	2	8	4	7	4
Flama	5	1	6	7	6	1	10	1	1	2	4	6	5	7
Woodbrook	6	2	7	9	6	1	9	1	1	2	10	8	8	8
Rakeco	8	3	8	8	5	1	2	1	1	2	9	10	9	9
Whitestone	10	1	9	5	5	1	1	1	1	1	5	8	1	5
JZR Associates	9	1	10	5	4	1	4	1	1	1	3	7	2	5
Van Cleef	7	3	4	4	1	4	3	6	1	2	6	5	6	6
Field	11	1	11	6	2	4	4	6	1	1	7	9	7	8
Brener	4	1	1	3	4	1	6	1	1	3	3	3	3	3

Table 64

Comparative Ranking By Suitability Index

(14.0 Dwelling Units per Acre)

	Municipal Services					Natural Environment						Ranking		
	Transportation	Public Water	Sewerage	Fire	Police	Air Quality	Water Quality	Ecology	Geology	Soils	Hydrology	Municipal Services	Natural Envir.	All Indicies
Mindel	3	1	2	2	3	3	5	1	1	2	2	2	2	2
Ras	1	1	3	1	3	3	7	1	1	2	1	1	3	1
Jops	2	2	5	3	3	4	8	6	1	2	8	4	7	5
Flama	8	1	6	7	6	1	10	6	1	2	4	7	5	8
Woodbrook	5	2	7	9	6	1	9	6	1	2	10	8	7	9
Rakeco	6	3	8	8	5	1	2	6	1	2	9	9	4	7
Whitestone	9	1	9	5	5	1	1	6	1	1	5	8	3	5
JZR Associates	6	1	10	5	4	1	4	1	1	1	3	6	1	4
Van Cleef	10	3	4	4	1	4	3	11	1	2	6	5	6	6
Field	11	1	11	6	2	4	4	11	1	1	7	10	6	10
Brener	4	1	1	3	4	2	6	6	1	3	3	3	4	3

ranked 1 or 2 for the four scenarios, but the rank of 2 was observed more frequently. The Brener site ranked 2 or 3 for all scenarios, with the rank of 3 being most frequent.

Sites suitable for development are Van Cleef, Whitestone, JZR Associates, and Jops. These sites were ranked significantly lower than the more suitable sites, but significantly higher than the lowest ranked sites. The Van Cleef site was ranked between 3 and 6 for each development scenario with 6 the modal rank. The Whitestone site was ranked 5 for all four scenarios. The JZR Associates site was ranked between 4 and 6 with 5 the most frequent rank. The Jops site was ranked 4-7, with 4 the most frequent rank.

Sites less suitable for development include Flama, Rakeco, Field, and Woodbrook. The Flama site was ranked between 6 and 10, while the Rakeco site was ranked 7-9. The Field site was ranked 8-10, with 8 being the most frequent ranking. Finally, the Woodbrook site was ranked 9-11, with 9 the most frequent rank.

Sites exhibited only minor variation in development suitability for each development scenario. Some sites received higher rankings for lower density scenarios while others achieved lower ranks of higher density scenarios.

2. Public Service Ranking Results

Taking into account only the 5 public service factors, the more suitable sites are Ras, Mindel and Brener. This is consistent with the Composite Rankings findings. The rankings for development density scenarios were identical, to the Composite Findings except for a slightly higher ranking observed for the Brener site at 1.0 and 4.0 units per acre and a rank of 1 for the Ras site at 1.0 unit per acre. These cannot be considered significant.

Sites suitable for development are Jops, Van Cleef, JZR Associates and Flama. Three of these sites - Jops, Van Cleef, and JZR Associates - were also rated suitable under the composite ranking, while Flama was rated least suitable. The Jops site was ranked 3 or 4 for the density scenarios while Van Cleef was ranked between 3 and 5 and Flama between 5 and 7. The JZR Associates site ranked 4-7. The site ranked 4 for a density of 1.0 unit per acre; 6 for a density of 4.0 units per acre; 7 for a density of 8.0 units per acre; and 6 for a density of 14.0 units per acre.

Sites less suitable for development are Whitestone, Woodbrook, Field, and Rakeco. For the various development scenarios, Whitestone ranked 4-8 with higher densities receiving lower ranks; Woodbrook ranked 7 or 8; Field ranked 6-10 with higher densities receiving lower ranks; and Rakeco 7-10.

The impact of density is observed to be more significant for the public service variables. In general, the higher the density, the lower the rank. Conversely, the lower the density, the higher the rank.

3. Environmental Ranking Results

Sites more suitable for development included Whitestone, Mindel, JZR Associates, Ras, and Brener. The Whitestone site was ranked least environmentally sensitive (rank of 1) for a density of 1.0-8.0 units per acre and 3 for a density of 14.0 units per acre. The Mindel site was ranked 2 and 3. The JZR Associates site was ranked variably for each density scenario. The Ras site was ranked 2-4. The Brener site was ranked 2-5.

Sites suitable for development included Van Cleef, Rakeco, Flama, and Field. The Van Cleef site had density scenario rankings of between 4-6 while the Rakeco site ranked between 4 and 9. The Flama site ranked 5, 6 and 9. The Field site ranked 5, 8, 7, and 6.

Sites least suitable for development include Jops and Woodbrook. The Jops site was ranked 10 for 9.0 units per acre and 7 for the others. Woodbrook ranked between 7 and 11.

APPENDIX A: REFERENCES

APPENDIX A

REFERENCES

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B. Personal Communications

1. Amron, Eugene, Township Engineer, South Brunswick Township, October 3, 1984.

2. Baab, John, Fire Inspector, Franklin Township, September - October 1984.

3. Bale, Kenneth, Engineer, Delaware and Raritan Canal Commission, October 10, 1984.

4. Barr, Robert, Public Protection Division, National Fire Protection Association, October 23, 1984.

5. Black, Peter, Project Engineer, Goodkind and O'Dea, October 15, 1984.

6. Blazakus, John, Chief of Records Division, Franklin Township Police, October 1984.

7. Brown, James, Police Chief, Franklin Township, September - October 1984.

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9. Cesanek, William, Principal Environmental Planner, Middlesex County Planning Board, October 3, 1984.

10. Chadwick, John, Consulting Planner, E. Eugene Oross and Associates, New Brunswick, New Jersey.

11. Colpini, Frank, Secretary to the Planning Board, Franklin Township, October 1984.

12. Darida, Charles, Plant Superintendent, Middlesex County Utilities Authority, October 4, 1984.

13. Haimowitz, Jerry, Authority Engineer, Franklin Township Sewerage Authority, October 1984.

14. Merk, Larry, Water Supervisor, South Brunswick Township, October 11, 1984.

15. Metz, Frank, Senior Engineer, Franklin Township , October 1984.

16. Oliver, Al, Engineer, Hillsborough Township Municipal Utilities Authority, October 16, 1984.

17. Pettit, James, Township Engineer/Planner, Franklin Township, September 1984.

18. Pollard, Myron A., Water Superintendent, North Brunswick Township, October 4, 1984.

19. Sarya, T., Principal Engineer, State of New Jersey, Division of Water Resources, Office of Potable Water, October 12, 1984.

20. Walinczak, Benjamin, Director, Public Works Department, Franklin Township, October 1984.

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State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF
FISH, GAME AND WILDLIFE
RUSSELL A. COOKINGHAM
DIRECTOR

PLEASE REPLY TO:
CN 400
TRENTON, NEW JERSEY 08625

October 15, 1984

Northern District Office
Hedge Haven Farm
RR #1, Box 383, Route 173 W
Hampton, NJ 08827

Mr. Robert J. Nardi
Louis Berger and Assoc., Inc.
100 Halsted Street
P.O. Box 270
East Orange, NJ 07019

Dear Mr. Nardi:

This is in response to your letter of September 28, 1984 requesting information on endangered and threatened species sightings for eleven sites within Franklin Township, Somerset County. These sites have not been completely surveyed by our Program for the presence of endangered and threatened species. THose endangered (E) and threatened (T) species which may be expected to occur on these sites if proper habitat exists are: Bog Turtles (E), Vesper Sparrow (E), Upland Sandpiper (E), Wood Turtles(T), Long-tailed Salamanders (T), Grasshopper Sparrow (T), and Bobolink (T).

The Program does have records of Upland Sandpipers (E), Vesper Sparrows (E), Grasshopper Sparrows (T), and Bobolinks (T) occurring extensively on site #2. These are all grassland bird species that prefer the field habitats found on site #2. These species should be expected to occur in all the other areas in Franklin Township that contain similar habitat.

If you have any further questions, please contact our office.

Sincerely,

James C. Sciascia

James C. Sciascia
Northern Regional Zoologist
Endangered and Nongame Species Program

JCS:pjd

cc: J. Frier-Murza

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

NEW BRUNSWICK • NEW JERSEY 08903

October 19, 1984

Dr. Joseph A. Maser
Principal Environmental Scientist
Louis Berger & Associates, Inc.
100 Halsted Street
East Orange, N. J. 07019

Dear Dr. Maser:

A comparison of the several sites in the Township of Franklin, Somerset County, New Jersey, designated on the map of Franklin Township Engineering Dept., revised Jan. 1982 and left by you on Oct. 18, has been made. These designated areas were compared with published literature, maps, and species location overlays which indicate the rare, endangered and threatened species of vascular plants growing in New Jersey. References used were: "Rare and Endangered Vascular Plants of N.J.", by Fairbrothers and Hough, Science Notes #14, N.J. State Museum, Nov. 1975, and "Rare and Endangered Vascular Plant Species in N.J.", by Snyder and Vivian, 1981, U.S. Fish and Wildlife Service".

To the best of my knowledge based on the sources stated above, no rare, endangered, or threatened vascular plants have been reported for the several designated sites in the Township of Franklin, Somerset County, New Jersey.

The charge for this service is [redacted] and must be made payable to the Botany Research Fund - Account #0-24051.

Sincerely,

David E. Fairbrothers

David E. Fairbrothers
Professor of Botany
and
Director of Chrysler Herbarium

enc. map of Township of Franklin

DEF:jm

APPENDIX B: TRAFFIC VOLUME PROJECTIONS

APPENDIX B

TRAFFIC VOLUME PROJECTIONS

Project and Road Segment	Daily Volume	Peak Hour Capacity	Current Peak Hour Volume	Percent Load on Link	Total Trips Alt. 1	Alt. 2	Alt. 3	Alt. 4
Project: JOPS			Total Trips		87	348	557	731
Route 615, Middlebush Road	3000	1500	285	0.33	314	400	469	526
Bennetts Lane	2500	1500	238	0.33	266	352	421	479
Daheer Road	2000	1500	190	0.33	219	305	374	431
Route 514, Amwell Rd West	9900	1500	941	0.20	958	1010	1052	1087
Rt 514,Amwell Rd Betwn	9900	1500	941	0.13	952	986	1013	1036
Rt 514,Amwell East	9900	1500	941	0.50	984	1115	1219	1306
Project: Mindel			Total Trips		196	784	1254	1646
Demott Ave South	3000	1500	285	0.52	387	693	937	1141
Demott Avenue Center	3000	1500	285	0.40	363	599	787	944
Demott Ave North	3000	1500	285	0.48	379	661	887	1075
Project: RAS			Total Trips		11	44	70	92
Demott Lane South	3000	1500	285	0.90	295	325	348	368
Demott Lane North	3000	1500	285	0.10	286	289	292	294
Project:Van Cleef			Total Trips		373	1492	2387	3133
Grouser Rd,W of site	2000	1500	190	0.10	227	339	429	503
Grouser Rd, E of site	2500	1500	238	0.50	424	984	1431	1804
Blackwells Mills,W of site	2000	1500	190	0.40	339	787	1145	1443
Blackwells Mills, E of site	2500	1500	238	0.30	349	685	954	1177
Van Cleef Rd	2000	1500	190	0.30	302	638	906	1130
Canal Rd, S of Blackwells	2500	1500	238	0.10	275	387	476	551
Canal Rd,bet Black&Grouser	2500	1500	238	0.20	312	536	715	864
Middlebush Rd, S of Black	3000	1500	285	0.05	304	360	404	442
Middlebush Rd,N of Black	3000	1500	285	0.35	416	807	1121	1382
Rt 514,Amwell,W of Canal	7800	1500	741	0.20	816	1039	1218	1368
Rt 514,Amwell,E of Canal	7800	1500	741	0.10	778	890	980	1054
Rt 514,Amwell, E of Grouser	7800	1500	741	0.40	890	1338	1696	1994
Rt 514,Amwell,E of Middlebu	7800	1500	741	0.65	983	1711	2293	2778
Project:WoodBrook			Total Trips		40	160	256	336
Rt 27,N of Bennetts	17000	1700	1615	0.75	1645	1735	1807	1867
Rt. 27, S of Bennetts	14000	1700	1330	0.25	1340	1370	1394	1414
Bennetts Lane	2500	1500	238	1.00	278	398	494	574
Project: Flama			Total Trips		92	368	589	773
Rt 27,N of Bennetts	17000	1700	1615	0.75	1684	1891	2057	2195
Rt. 27, S of Bennetts	14000	1700	1330	0.25	1353	1422	1477	1523
Bennetts Lane	2500	1500	238	1.00	330	606	826	1010
Project:Rakeco			Total Trips		100	400	640	840
Rt 27, N of site	14000	1700	1330	0.70	1400	1610	1778	1918
Rt 27, S of site	14000	1700	1330	0.30	1360	1450	1522	1582

APPENDIX B

TRAFFIC VOLUME PROJECTIONS

Project and Road Segment	Daily Volume	Peak Hour Capacity	Current Peak Hour Volume	Percent Load on Link	Total Trips Alt. 1	Alt. 2	Alt. 3	Alt. 4
Project: JZR Associates			Total Trips		155	620	992	1302
Rt 27, N of site	14000	1700	1330	0.60	1423	1702	1925	2111
Rt 27, S of site	14000	1700	1330	0.40	1392	1578	1727	1851
Project:Whitestone			Total Trips		82	328	525	689
Rt 27,N of site	14000	1700	1330	0.60	1379	1527	1645	1743
Rt 27, S of site	14000	1700	1330	0.40	1363	1461	1540	1606
Project:Brenner			Total Trips		177	708	1133	1487
Rt 27, N of Trkpk	10000	1700	950	0.50	1039	1304	1516	1693
Rt 27, S of Trnpk	8000	1700	760	0.40	831	1043	1213	1355
Georgetown Trnpk	6500	1500	618	0.10	635	688	731	766
Project: Field			Total Trips		1835	7340	11744	15414
Jacques Lane	1500	1500	143	0.05	234	510	730	913
Suydam Rd	1500	1500	143	0.38	840	2932	4605	6000
Butler Rd	1500	1500	143	0.26	620	2051	3196	4150
Bunkerhill Rd	2300	1500	219	0.09	384	879	1275	1606
Middlebush	3000	1500	285	0.24	725	2047	3104	3984
Middlebush	3000	1500	285	0.50	1203	3955	6157	7992
Claremont	2000	1500	190	0.23	612	1878	2891	3735
Vliet Rd	2500	1500	238	0.32	825	2586	3996	5170
Canal Rd	2500	1500	238	0.02	274	384	472	546
Canal Rd	2500	1500	238	0.04	311	531	707	854
Rt 514,W of Middlebush	9900	1500	941	0.10	1124	1675	2115	2482
Rt 514,E of Middlebush	9900	1500	941	0.17	1252	2188	2937	3561
Rt 27,N of site	14000	1700	1330	0.27	1825	3312	4501	5492
Rt 27,S of site	14000	1700	1330	0.32	1917	3679	5088	6262

APPENDIX B

TRAFFIC VOLUME PROJECTIONS

Project and Road Segment	Percent Increase in Traffic				Existing Volume/ Capacity Ratio	Projected Volume/Capacity Ratio			
	Alt. 1	Alt. 2	Alt. 3	Alt. 4		Alt. 1	Alt. 2	Alt. 3	Alt. 4
Project: JOPS									
Route 615, Middlebush Road	10%	40%	64%	85%	0.19	0.21	0.27	0.31	0.35
Bennetts Lane	12%	48%	77%	102%	0.16	0.18	0.23	0.28	0.32
Dahmer Road	15%	60%	97%	127%	0.13	0.15	0.20	0.25	0.29
Route 514, Amwell Rd West	2%	7%	12%	16%	0.63	0.64	0.67	0.70	0.72
Rt 514,Amwell Rd Betwn	1%	5%	8%	10%	0.63	0.63	0.66	0.68	0.69
Rt 514,Amwell East	5%	19%	30%	39%	0.63	0.66	0.74	0.81	0.87
Project: Mindel									
Demott Ave South	36%	143%	229%	300%	0.19	0.26	0.46	0.62	0.76
Demott Avenue Center	28%	110%	176%	231%	0.19	0.24	0.40	0.52	0.63
Demott Ave North	33%	132%	211%	277%	0.19	0.25	0.44	0.59	0.72
Project: RAS									
Demott Lane South	3%	14%	22%	29%	0.19	0.20	0.22	0.23	0.25
Demott Lane North	0%	2%	2%	3%	0.19	0.19	0.19	0.19	0.20
Project:Van Cleef									
Grouser Rd,W of site	20%	79%	126%	165%	0.13	0.15	0.23	0.29	0.34
Grouser Rd, E of site	79%	314%	503%	660%	0.16	0.28	0.66	0.95	1.20
Blackwells Mills,W of site	79%	314%	503%	660%	0.13	0.23	0.52	0.76	0.96
Blackwells Mills, E of site	47%	188%	302%	396%	0.16	0.23	0.46	0.64	0.78
Van Cleef Rd	59%	236%	377%	495%	0.13	0.20	0.43	0.60	0.75
Canal Rd, S of Blackwells	16%	63%	101%	132%	0.16	0.18	0.26	0.32	0.37
Canal Rd,bet Black&Grouser	31%	126%	201%	264%	0.16	0.21	0.36	0.48	0.58
Middlebush Rd, S of Black	7%	26%	42%	55%	0.19	0.20	0.24	0.27	0.29
Middlebush Rd,N of Black	46%	183%	293%	385%	0.19	0.28	0.54	0.75	0.92
Rt 514,Amwell,W of Canal	10%	40%	64%	85%	0.49	0.54	0.69	0.81	0.91
Rt 514,Amwell,E of Canal	5%	20%	32%	42%	0.49	0.52	0.59	0.65	0.70
Rt 514,Amwell, E of Grouser	20%	81%	129%	169%	0.49	0.59	0.89	1.13	1.33
Rt 514,Amwell,E of Middlebu	33%	131%	209%	275%	0.49	0.66	1.14	1.53	1.85
Project:WoodBrook									
Rt 27,N of Bennetts	2%	7%	12%	16%	0.95	0.97	1.02	1.06	1.10
Rt. 27, S of Bennetts	1%	3%	5%	6%	0.78	0.79	0.81	0.82	0.83
Bennetts Lane	17%	67%	108%	141%	0.16	0.19	0.27	0.33	0.38
Project: Flama									
Rt 27,N of Bennetts	4%	17%	27%	36%	0.95	0.99	1.11	1.21	1.29
Rt. 27, S of Bennetts	2%	7%	11%	15%	0.78	0.80	0.84	0.87	0.90
Bennetts Lane	39%	155%	248%	325%	0.16	0.22	0.40	0.55	0.67
Project:Rakeco									
Rt 27, N of site	5%	21%	34%	44%	0.78	0.82	0.95	1.05	1.13
Rt 27, S of site	2%	9%	14%	19%	0.78	0.80	0.85	0.90	0.93

APPENDIX B

TRAFFIC VOLUME PROJECTIONS

Project and Road Segment	Percent Increase in Traffic				Existing Volume/ Capacity Ratio	Projected Volume/Capacity Ratio			
	Alt. 1	Alt. 2	Alt. 3	Alt. 4		Alt. 1	Alt. 2	Alt. 3	Alt. 4
Project: JZR Associates									
Rt 27, N of site	7%	28%	45%	59%	0.78	0.84	1.00	1.13	1.24
Rt 27, S of site	5%	19%	30%	39%	0.78	0.82	0.93	1.02	1.09
Project:Whitestone									
Rt 27,N of site	4%	15%	24%	31%	0.78	0.81	0.90	0.97	1.03
Rt 27, S of site	2%	10%	16%	21%	0.78	0.80	0.86	0.91	0.94
Project:Brenner									
Rt 27, N of Trkpk	9%	37%	60%	78%	0.56	0.61	0.77	0.89	1.00
Rt 27, S of Trnpk	9%	37%	60%	78%	0.45	0.49	0.61	0.71	0.80
Georgetown Trnpk	3%	11%	18%	24%	0.41	0.42	0.46	0.49	0.51
Project: Field									
Jacques Lane	64%	258%	412%	541%	0.10	0.16	0.34	0.49	0.61
Suydam Rd	489%	1957%	3132%	4110%	0.10	0.56	1.95	3.07	4.00
Butler Rd	335%	1339%	2143%	2812%	0.10	0.41	1.37	2.13	2.77
Bunkerhill Rd	76%	302%	484%	635%	0.15	0.26	0.59	0.85	1.07
Middlebush	155%	618%	989%	1298%	0.19	0.48	1.36	2.07	2.66
Middlebush	322%	1288%	2060%	2704%	0.19	0.80	2.64	4.10	5.33
Claremont	222%	889%	1422%	1866%	0.13	0.41	1.25	1.93	2.49
Vliet Rd	247%	989%	1582%	2077%	0.16	0.55	1.72	2.66	3.45
Canal Rd	15%	62%	99%	130%	0.16	0.18	0.26	0.31	0.36
Canal Rd	31%	124%	198%	260%	0.16	0.21	0.35	0.47	0.57
Rt 514,W of Middlebush	20%	78%	125%	164%	0.63	0.75	1.12	1.41	1.65
Rt 514,E of Middlebush	33%	133%	212%	279%	0.63	0.83	1.46	1.96	2.37
Rt 27,N of site	37%	149%	238%	313%	0.78	1.07	1.95	2.65	3.23
Rt 27,S of site	44%	177%	283%	371%	0.78	1.13	2.16	2.99	3.68