SECTION 2

—

ENVIRONMENTAL ASSESSMENT

ENVIRONMENTAL ASSESSMENT

INTRODUCTION

This section of the report is concerned with the environmental component of the Interim State Development and Redevelopment Plan Impact Assessment. It specifically deals with the assessment issue as it relates to IPLAN's environmental goals. The evaluation focuses on the State Plan's goals relating to: (1) conserving the State's natural resources (in particular open land of various types); and (2) protecting the quality of the environment (especially from air and water pollution).

The procedures for environmental impact assessment encompass CUPR's Land Capacity Model, which translates overall growth to land consumption and measures the latter; its Frail Environmental Lands Model, which tallies acreage impacted by development in steep slopes, forests, and critical sensitive watershed areas; its Agricultural Lands Model, which computes the loss of various types of agricultural land; and finally, its Air and Water Pollution Models, which estimate levels of air pollution related to lane-miles of road construction and water pollution generated primarily from acres of land developed.

The section begins with the Land Capacity Model. This Model converts household and employment growth to the demand for raw land. The developable land inventory, which includes inventories of frail and potentially salvageable agricultural lands, is reduced by the land requirements of household and employment growth under the two different scenarios of future growth: TREND versus IPLAN. Each of these growth scenarios has different development requirements for vacant land, as well as frail and agricultural lands as components of overall vacant land.

The Frail Environmental Lands Model is a series of acreage totals and consumption rates in three sensitive environmental land categories. After saving a portion of each, these individual categories of sensitive environmental lands are taken at varying rates according to the land requirements of different growth scenarios. The Agricultural Lands Model is also based on inventories and consumption rates of land. In this instance, it is three categories of agricultural land. Land is depleted from the inventory according to historic consumption rates indicative of TREND growth, or desired consumption rates reflecting IPLAN's agricultural land preservation objectives.

The Air and Water Pollution Models work primarily off the Road Model (see Section 3, "Infrastructure Assessment"). Vehicle-miles traveled (VMT) are used to gauge the air pollution effects of TREND and IPLAN; acres of development land under each scenario are used to measure the extent of water pollution caused by each. The Water Pollution Model further uses information on clustering and density under the two development scenarios to differentiate potential on-site water pollution impacts.

PART I

—

IMPACTS ON LAND CAPACITY

ENVIRONMENTAL ASSESSMENT: PART I — IMPACTS ON LAND CAPACITY

BACKGROUND

The population and employment subroutine of the Land Capacity Model enables an assessment of land fit and land consumption tallies keyed directly to the land requirements of household and employment growth. The Model converts household growth to the demand for structures and relates structures developed to land required for development. It is thus able to test the "fit" and possibly refine development as a prelude to other analyses. It is also able to evaluate the land consumption differences of TREND versus IPLAN to determine how each stands up to the environmental goal of land preservation. Development that consumes the least amount of land for a similar number of households served is preferable to development that consumes more land.

CONCEPTS

The supply of developable land in each municipality has been determined by the New Jersey Department of Treasury, Division of Taxation, Property Administration Branch (New Jersey Department of Treasury 1990, 1991).[1] This land estimation reflects local tax assessor reports of land by assessment classification (vacant, farm, residential, apartment, commercial, and industrial). There is also a category of exempt lands. These lands fall short of total municipal land area by the amount of land found in inclusive water bodies. Further, by municipality, there exists either actual or surrogate information on prime agricultural land, forests, steep slopes, and critical sensitive watersheds, with estimated consumption rates of these land types from 1980 to 1990. (See *Report I: Research Strategy—Research Design, Model Descriptions, Case Study Profiles, Variable Selection,* at Section 2, Part I.)

Each municipality thus has two large categories of vacant land,[2] the first with frail environmental lands. Gross vacant land is composed of: (1) vacant land, and (2) land that is in agricultural assessment (three categories: prime, marginal, and poor). The frail environmental lands applicable to the vacant-land category consist of (1) land that is in steep slopes; (2) forest—or if not forest, at least heavily treed; and (3) land that is in critical watersheds.

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1 Multiple estimates of vacant land currently exist for each municipality. These include the one listed above as well as land estimates from the Office of State Planning (OSP), and LANDSAT data from the New Jersey Council on Affordable Housing (COAH) and Rutgers University (Cook College).

2 An additional land category to be covered subsequently is lands available locally for redevelopment.

For the TREND analysis, land is consumed by residential and nonresidential development according to the demand for land in a municipality. (Demand for land is generated by the future growth of households and jobs reflecting historic types of residential and nonresidential development, and their requirements for land.) Land is consumed by structures and their land requirements from the vacant land category according to need, and from agricultural and frail land categories according to historic consumption rates. Excess land from each municipality is put into a regional pool (2–4 counties)[3] from which municipalities of comparable types can draw.

For the analysis of IPLAN, land-consumption objectives of Centers and environs are taken from *Communities of Place: The Interim State Development and Redevelopment Plan for the State of New Jersey* (New Jersey State Planning Commission, 1991). This information has been augmented by information from the Cross-acceptance process. Some information for particular geographic areas is incomplete and must be inferred from Planning Area objectives as well as from regional design criteria. A range of densities has been imputed for land designated as various types of Centers or as environs in the six different Planning Areas. Similar rules for pooling lands and acceptable spillover locations are observed for the IPLAN analysis, as is the case for TREND. One exception is that any nonfit spillover population and employment are redirected to the closer-in suburban and urban areas as opposed to nearly similar communities. This encompasses the redirection objectives of IPLAN.

EXPECTED DIFFERENCES BETWEEN TREND AND IPLAN

The population and employment subroutine of the Land Capacity Model serves a critical function in that it determines whether the projected growth under TREND or IPLAN can be accommodated in the settings where it has historically taken place (TREND), or where the State Plan would like it to take place (IPLAN).

Initial impressions would tend to associate more land consumption with TREND than IPLAN. This is due to the higher densities of urban areas and Regional and Town Centers, which are much more prevalent under IPLAN than TREND.

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3 Similar communities reflect the Municipal Classification Scheme shown in Exhibit 6 of *Report I: Research Strategy* (Bureau of Government Research, 1989). Regional classifications depict the six COAH Regions of the State. Each grouping contains 2–4 counties. (See Section 1, "Economic Assessment" of *Report II: Research Findings*, for a description of the regions.)

CRITICAL ASSUMPTIONS

TREND

Land Consumption

Under the TREND analysis household and job projections are assigned, respectively, to municipalities according to: (1) unique residential densities determined from New Jersey Department of Treasury data, and (2) information on nonresidential development in the pipeline as reported by Wallace Roberts & Todd county surveys (Wallace Roberts & Todd 1988; see *Report I—Research Strategy*. See also Exhibit 1 in the present chapter.)

Households and employment consume land in municipalities according to its availability from three basic sources:[4] farmland, vacant land, and land suitable for redevelopment. In the last case, it is assumed that redeveloped land, if it retains the existing use, will be developed more intensely; if the land becomes vacant through clearance, it will be developed at prevailing densities. Contained within the vacant land category are the vacant portions of frail lands to be protected. These are drawn down by development at historic rates for TREND and at one-half these historic rates for IPLAN.

Vacant Land

The source for information on vacant land by municipality comes from the New Jersey Department of Treasury, Division of Taxation, Property Administration Branch. Information is available on land held in multiple categories. Vacant land information was cross-checked against information on vacant land from the New Jersey Office of State Planning (NJOSP) as well as against LANDSAT information on vacant land being prepared for the New Jersey Council on Affordable Housing (COAH) by the Rutgers University Department of Environmental Resources at Cook College. The information on agricultural land was also checked, in this instance with similar tallies from the New Jersey Department of Agriculture (New Jersey Department of Agriculture 1990), and further partitioned by type of agricultural land: prime, marginal, and poor. This is about as accurate a land inventory by municipality as can be determined at this time.

Thus, when land is made available for development under TREND conditions, it comes from three distinct sources: agricultural land at historic consumption rates; vacant land including the consumption of frail lands at historic rates; and redevelopment land to a

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4 A fourth source—frail lands—is included within the vacant land category. See the Frail Environmental Lands section of this volume at Section 2, Part II.

EXHIBIT 1

TREND RESIDENTIAL AND NONRESIDENTIAL DEVELOPMENT DENSITIES

RESIDENTIAL DEVELOPMENT—TREND CONDITIONS (1)
(units per acre)

	Urban (RANGE)	Suburban (RANGE)	Rural (RANGE)
Residential (primarily Single-Family)	2–8	1–3	0.2–2
Apartment	12–160	5–100	3–30

NONRESIDENTIAL DEVELOPMENT DENSITIES (2)
TREND CONDITIONS
(1,000 $ft.^2$ per acre and Floor Area Ratio [FAR])

	Urban		Suburban		Rural	
	Density	*FAR*	*Density*	*FAR*	*Density*	*FAR*
Retail—Commercial	8.0	0.18	6.0	0.14	2.0	0.05
Office	15.0	0.35	8.0	0.18	2.5	0.06
Industrial	5.0	0.115	10.0	0.23	8.0	0.18

Sources:

(1) State of New Jersey, Department of Treasury, Division of Taxation, Property Administration Branch. *Line Items (Land-Use Types) by Acreage*, 1990, 1991.

(2) Wallace Roberts & Todd, "Development in the Pipeline by New Jersey County," 1988.

level of acreage determined by applying the uncollected property tax levy to the developed area of the community.[5]

IPLAN

The same three sources of developable land are available under State Plan-inspired development (IPLAN). IPLAN development takes place using the Centers' density and associated design criteria and the environs' density and associated design criteria. The environs' density criteria vary by Planning Area (see Exhibit 2). In locations (municipalities) that do not have Centers in Planning Areas 1 and 2, they revert to historic densities; in Planning Areas 3, 4, and 5, they revert to densities for environs. (See *Report I—Research Strategy.*)

New and Existing Centers

New Centers in Old Locations and New Locations

Regional Centers and Town Centers located in large municipalities are treated differently from Centers identified within older, tightly bordered municipalities that are focal points or nodes of an area (seldom, if ever, in land-rich municipalities).

Regional Centers, Town Centers, Villages, and Hamlets in the larger municipalities are allowed to consume a defined amount of land for Center development (4.0 square miles for a Regional Center, 1.5 square miles for a Town Center, 0.4 square miles for a Village Center, and 0.1 square mile for a Hamlet).

Each Center is approached in the following way. None is assumed fully vacant for development. In actuality, the area of a Center is divided into four quadrants. A Town Center encompassing 1.5 square miles will be used as an example. Two quadrants are assumed fully occupied. Thus, 0.75 square miles of potentially developable land area of a Center is left untouched and assumed already developed. The other two remaining quadrants are developed at the densities of the Center—in this case the density of a Town Center including requirements for open space. Development is permitted in each of the quadrants under the following circumstances: One of the two remaining quadrants consumes land from the vacant land category until its development objectives are satisfied or all the vacant land in the quadrant is used. The other quadrant is assumed usable for redevelopment at Center densities with the level of redevelopment allowed being equal to the difference of what the Center densities permit and what is currently found there.

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5 Each community has a unique redevelopment potential relating to more-intensive use of land over time. See *Report I: Research Strategy*, p. 132.

EXHIBIT 2

IPLAN RESIDENTIAL AND NONRESIDENTIAL DENSITIES

ENVIRONS DENSITIES

PLANNING AREA	DENSITY
Planning Area 1	3.0 Units/Acre
Planning Area 2	1.5 Units/Acre
Planning Area 3	.125 Units/Acre
Planning Area 4A	.100 Units/Acre
Planning Area 4B	.075 Units/Acre
Planning Area 5	.067 Units/Acre

CENTERS DENSITIES	URBAN	REGIONAL	TOWN	VILLAGE	HAMLET
Land Consumed	As Is	4 Sq. Mi.	1.5 Sq.Mi.	.40 Sq Mi	.10 Sq. Mi
Jobs/Housing Numbers	Up to 20,000 HH Up to 40,000 Jobs	10,000 HH 30,000 Jobs	3,000 HH 6,000 Jobs	300 HH 100 Jobs	50 HH 5 Jobs
Open Space Ratios	0.15	0.30	0.60	0.70	0.80
Density (units/net acre)	20	15	10	4	2
Jobs/Households	2:1	3:1	2:1	.33:1	.10:1
FAR	6.0	3.0	1.0	.20	.10

Source: Adapted from: State Planning Advisory Committee, *Regional Design: A Report of the Regional Design System.* Trenton NJ: New Jersey Office of State Planning, November 1990.

Existing Centers in Old Locations

In Centers in the older municipalities (all Urban Centers, some Regional Centers, and some Town Centers), vacant land is used only to the degree that it is available. This includes both its vacant land and redevelopment components.

The Number of Centers

There are numerous Centers designated throughout the State. These have been located from information from the New Jersey Interim State Development and Redevelopment Plan, lists of Centers under consideration by counties and municipalities provided by the New Jersey Office of State Planning, and by the use of design criteria and professional knowledge for areas where there are limited or insufficient Center designations. Statewide there are assumed to be 10 Urban Centers, 56 Regional Centers, 169 Town Centers, 133 Villages, and 136 Hamlets. Urban, Regional, Town, and Village Centers were individually located; Hamlets are assumed to take place in rural and suburban rural locations (see BGR classification; Rutgers University, Bureau of Government Research, 1989) at the rate of one per location. Centers are, for the most past, wholly contained within their respective municipality. (See *Report I: Research Strategy*, Section 2, Part I, Exhibits 6 and 10.)

Other Land-Related Assumptions

The Hackensack Meadowlands and the Pinelands have been assumed to develop as they have historically for TREND and under their own comprehensive management plans for IPLAN. The CAFRA areas are assumed to develop as they have historically for TREND, and under the Planning Area definitions and criteria for IPLAN. Regardless of whether they reflect past trends or future plans, The Pinelands and Meadowlands growth projections prove to be very similar under both TREND and IPLAN.

The order of land consumption is farm, vacant, frail, and redevelopment lands under both scenarios. Further, nonresidential development usually precedes residential development into a community. Land is credited as being "saved" under environs to the degree that the difference between the intensity at which the land is developed and prevailing densities is greater than five acres per unit of development.

Under both scenarios, until information is provided to the contrary,[6] it is assumed that there is no difference in the population and household growth by region. The regions for land consumption and residential/nonresidential development are the six (2- to 4-

[6] As a result of lack of land.

county) COAH-designated housing regions. (See *Report I: Research Strategy,* as well as earlier in this section.) This is a much more severe test of "fit" than using, for instance, the three (5- to 8-county) Comprehensive Housing Affordability Strategy (CHAS) regions (New Jersey Department of Community Affairs, 1991).

TREND FINDINGS

Land Capacity

Each of the six 2- to 4-county regions can contain residential and nonresidential development forecast for that region. In this process, households and employment are assigned to communities according to municipal-level household and employment projections. They fill these communities under TREND according to historic residential densities, or information on nonresidential densities or floor-area ratios for development in the pipeline. If a fit is not possible, they are assigned to similar communities within the same region. Thus, there is a difference in population and employment satisfaction at the municipal and county levels under TREND versus IPLAN; there is no difference at the regional and State levels.

More than 520,000 people, 408,000 households, and 654,000 new employees are contained in the six COAH regions under both TREND and IPLAN for the period 1990 to 2010 (see Exhibit 3). For the year 1995 the numbers for the two growth scenarios are 56,000 population, 80,000 households, and 100,000 jobs. For the most part, much of this growth under TREND is located in suburban and rural areas, as opposed to urban areas. This is shown in Exhibit 4. Viewing the Bureau of Government Research (BGR) Classification for types of communities (Rutgers University, Bureau of Government Research, 1989), the locational differences in the occurrence of households and jobs are striking. Under TREND, households and jobs are created to a much greater degree in suburban, suburban–rural, and rural locations.

TREND and IPLAN Development (1990–2010)

Change In: (000s)	NORTH-EAST	NORTH-WEST	WEST CENTRAL	EAST CENTRAL	SOUTH WEST	SOUTH–SOUTH-WEST	TOTAL
Households	53.3	14.4	96.7	102.7	96.7	43.9	407.8
Employment	105.0	–6.5	200.8	110.4	220.0	23.9	653.6

EXHIBIT 3

POPULATION, HOUSEHOLD, AND EMPLOYMENT CHANGE STATEWIDE AND BY REGION—TREND AND IPLAN* REGIONAL FIT

State/Region	Population 1990	1995	2010	Change 1990-1995	Change 1990-2010
State Total	7,730,198	7,786,100	8,250,202	55,912	520,014
Northeast	1,831,539	1,824,700	1,862,900	-6,839	31,361
Northwest	1,824,321	1,793,200	1,758,201	-31,121	-66,120
West Central	1,111,442	1,130,201	1,279,200	18,759	167,758
East Central	986,327	1,029,100	1,152,300	42,773	165,973
Southwest	1,453,796	1,473,799	1,603,701	20,003	149,905
South-Southwest	522,763	535,100	593,900	12,337	71,137

State/Region	Households 1990	1995	2010	Change 1990-1995	Change 1990-2010
State Total	2,794,711	2,874,156	3,202,468	79,445	407,757
Northeast	672,888	682,293	726,236	9,405	53,348
Northwest	652,035	650,948	666,425	-1,087	14,390
West Central	399,082	417,388	495,827	18,306	96,745
East Central	365,717	392,535	468,386	26,818	102,669
Southwest	511,098	529,017	607,777	17,919	96,679
South-Southwest	193,891	201,975	237,817	8,084	43,926

State/Region	Employment 1990	1995	2010	Change 1990-1995	Change 1990-2010
State Total	3,665,400	3,767,200	4,319,000	101,800	653,600
Northeast	903,500	909,300	1,008,500	5,800	105,000
Northwest	937,600	920,600	931,100	-17,000	-6,500
West Central	580,800	619,400	781,600	38,600	200,800
East Central	337,700	361,800	448,100	24,100	110,400
Southwest	648,200	690,100	868,200	41,900	220,000
South-Southwest	257,600	266,000	281,500	8,400	23,900

* Identical for both

Source: Population and employment projection subroutine of the CUPR Land Capacity Model, 1992.

EXHIBIT 4

POPULATION, HOUSEHOLD, AND EMPLOYMENT LEVELS—1990, 2010 TREND AND IPLAN SCENARIOS

Bureau of Government Research Classification	BGR Code	POPULATION			HOUSEHOLDS			EMPLOYMENT		
		1990	2010 TREND	2010 IPLAN	1990	2010 TREND	2010 IPLAN	1990	2010 TREND	2010 IPLAN
MAJOR URBAN CENTER	3	930,818	877,979	997,695	314,350	299,660	342,373	382,857	364,276	426,316
URBAN CENTER	1	878,290	869,343	960,886	332,169	343,212	378,436	496,118	502,739	556,335
URBAN-SUBURBAN	2	1,614,026	1,559,634	1,597,593	612,850	644,924	660,997	788,046	896,684	960,335
SEASHORE-RESORT	0	126.030	166,992	174,806	53,408	73,739	77,425	33,683	36,520	35,828
RURAL CENTER	7	140,050	133,744	152,391	52,265	54,656	62,351	93,753	102,704	118,902
URBAN CENTER (RURAL)	9	80,772	88,585	103,977	28,372	33,936	39,961	44,038	58,364	58,362
SUBURBAN	4	2,491,325	2,615,428	2,541,366	888,191	1,024,054	997,167	1,396,788	1,716,338	1,589,750
SUBURBAN-RURAL	5	981,622	1,317,804	1,160,290	349,655	504,167	441,416	302,656	457,336	405,325
RURAL CENTER (RURAL)	8	83,572	102,324	98,123	29,350	38,604	37,146	34,234	40,907	40,845
RURAL	6	403,683	518,369	463,074	134,101	185,517	165,196	93,227	143,131	127,003
TOTAL	1–0	7,730,188	8,250,202	8,250,202	2,794,711	3,202,468	3,202,468	3,665,400	4,319,000	4,319,000

Source: Population and employment subroutine of the CUPR Land Capacity Model (1992) as modified by Rutgers University, Bureau of Government Research (BGR) community classifications.

TREND and IPLAN Development (1990–2010)

Change In Households: (000s)	URBAN [1]	URBAN-SUBURBAN [2]	SUBURBAN [3]	RURAL [4]	TOTAL
TREND	–3.7	32.1	310.7	68.7	407.8
IPLAN	74.3	48.1	224.8	60.6	407.8

1 = Major Urban Center, Urban Center
2 = Urban-Suburban
3 = Suburban, Suburban-Rural, Seashore Resort
4 = Rural Center (various categories), Rural

TREND and IPLAN Development (1990–2010)

Change In Employment: (000s)	URBAN [1]	URBAN-SUBURBAN [2]	SUBURBAN [3]	RURAL [4]	TOTAL
TREND	–12.0	108.7	477.1	79.8	653.6
IPLAN	103.7	172.3	297.8	79.8	653.6

Source: CUPR Land Capacity Model, 1992

Land Consumption

Under traditional development consumption patterns more than 292,000 acres of land of a variety of categories are consumed (see Exhibit 5). These include 107,500 farm acres, 139,500 vacant acres, and 45,000 redevelopment acres. Of the 292,000 acres consumed, 266,500 accommodate residential development, and 25,500 accommodate nonresidential development. The bulk of the *overall* land consumption is in the Southwest (74,000 acres), with the West Central (62,500 acres), East Central (56,500 acres), and South-Southwest (48,500 acres) following. The least acreage is consumed in the Northeast (15,400 acres) and Northwest regions (35,000 acres). The heaviest *farmland* consumption is in the West Central (38,000 acres) and Southwest regions (27,000 acres). The most significant *otherwise vacant* land consumption is in the East Central (39,000 acres), Southwest (37,000 acres), and South-Southwest regions (31,000 acres). The most significant *redevelopment* land consumption is in the Southwest (9,500 acres), Northwest (9,500 acres), and Northeast regions (9,300 acres).

EXHIBIT 5

LAND CONSUMED BY CATEGORY
1990-2010
(in acres)

	Farm	Otherwise Vacant	Redevelopment	Total	Residential	Nonresidential	Total
TREND							
Total	107,484	139,572	45,024	292,079	266,491	25,588	292,079
Northeast	1,387	4,762	9,227	15,377	12,445	2,932	15,377
Northwest	15,695	9,766	9,534	34,995	34,011	984	34,995
West Central	38,135	17,998	6,325	62,457	54,435	8,022	62,457
East Central	9,424	38,858	8,163	56,445	53,313	3,133	56,445
Southwest	27,325	37,274	9,539	74,138	65,527	8,611	74,138
South-Southwest	15,518	30,915	2,235	48,668	46,761	1,907	48,668
IPLAN							
Total	78,032	46,380	40,029	164,441	147,715	16,726	164,441
Northeast	391	3,475	3,350	7,216	5,925	1,291	7,216
Northwest	13,270	2,732	2,353	18,354	17,115	1,240	18,354
West Central	21,818	4,596	10,857	37,271	30,948	6,323	37,271
East Central	7,013	20,639	10,820	38,471	35,894	2,578	38,471
Southwest	25,170	10,465	8,780	44,414	40,378	4,036	44,414
South-Southwest	10,371	4,474	3,869	18,714	17,456	1,259	18,714

Source: CUPR Land Capacity Model, 1992.

IPLAN FINDINGS

Land Capacity

Overall, under IPLAN development, the same numbers of population, households, and jobs can be fit as is the case for TREND development. Thus, 520,000 people, 408,000 households, and 654,000 jobs can be accommodated under this development scenario by the year 2010.

For the year 1995, the level of population, household, and job accommodation is again the same as the TREND numbers. The "fit"—much as is the case for the year 2010—can be achieved in all regions, for all types of communities: urban, suburban, and rural. The locations of growth within regions are much different, as shown in Exhibit 4. As can be seen from this exhibit, households and employment under IPLAN are redirected to both urban and central locations. Major urban centers, urban centers, urban–suburban locations, and rural centers of various types become the locus of household and employment growth.

Land Consumption

Under IPLAN development about 164,500 acres of land are consumed. This includes 78,000 acres of farmland, 46,500 acres of otherwise vacant land, and 40,000 acres of redevelopment land. Of the 164,500 acres consumed, 147,700 acres accommodate residential development and 16,800 acres accommodate nonresidential development. As is the case for the traditional development scenario (TREND), most of the land consumed is in the Southwest region (44,500 acres), with somewhat less consumed in the East Central (38,500), and West Central (37,300) regions. Trailing all are the Northwest (18,300 acres), South-Southwest (18,700 acres), and Northeast (7,200 acres) regions.

IPLAN VERSUS TREND FINDINGS

Interestingly, the big savings in *overall* land consumption of IPLAN compared to TREND are in the South-Southwest (30,000 acres), Southwest (30,000 acres), and West Central (25,000 acres) regions. The remaining regions fall under 20,000 acres; in the Northeast region, the saving is less than 10,000 acres.

In the case of both TREND and IPLAN development, the biggest losses in *farmland* come from the Southwest and the West Central regions. However, the West Central region also records the biggest projected saving in farmland of IPLAN over TREND (16,000 acres). Perhaps even more important than the amount of land consumed is that losses in farmland that occur under IPLAN are expected to be in poor farmlands; losses in farmland that occur under TREND are in prime, marginal, and poor farmlands.

In terms of *otherwise vacant* land, the overall savings from IPLAN compared to TREND is 93,000 acres. In the South-Southwest region the savings is 26,000 acres; in the Southwest region it is also 26,000 acres; and in the West Central region it is 13,500 acres. The least savings noted are in the Northeast region, where the total acreage saved under IPLAN development is less than 1,300 acres.

Redevelopment land under IPLAN is somewhat lower because higher-density sites in more urban areas are being redeveloped under IPLAN, whereas they are lower-density suburban sites under TREND. Redevelopment takes place on 5,000 less acres under IPLAN because infill is taking place in urban and close-in suburban areas and not at much lower suburban densities.

CONCLUSION

The differences between TREND and IPLAN in land savings are: (1) significant, (2) in the direction predicted, and (3) of considerable magnitude. They clearly show the results of more-intense/less-intense development strategies (Centers/environs) as opposed to land development observing traditional densities in communities.

Farm acres are saved, frail lands are saved (to be discussed in Part II of this section), existing vacant land is saved, and even redevelopment acreage is reduced under IPLAN versus traditional development. The implications of these findings are that there can be more efficient development patterns in land use, and these can result in truly significant land and open space savings while similar levels of household and employment growth take place.

PART II

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IMPACTS ON FRAIL ENVIRONMENTAL LANDS

ENVIRONMENTAL IMPACT ASSESSMENT: PART II — IMPACTS ON FRAIL ENVIRONMENTAL LANDS

BACKGROUND

This portion of the study is intended to identify and compare the impacts of development under TREND and IPLAN upon frail environmental land resources throughout the State of New Jersey. In earlier phases of the study, an inventory was undertaken of data that is available in a form that can be used to make this determination. All usable data were assembled, and the characteristics and limitations associated with each set of data were identified (see *Report I: Research Strategy—Research Design, Model Descriptions, Case Study Profiles, Variable Selection,* at Section 2, Part II). In this portion of the analysis, the amounts of frail land that will be directly affected by growth under two alternative land development patterns are estimated and compared. Means by which these differences could be increased or decreased are discussed, together with the implications of the findings.

CONCEPTS

What Is the Model—How Does It Work?

The Frail Environmental Lands Model answers the following questions:

1. How many acres of steeply sloped lands are likely to be developed under TREND and IPLAN?
2. How much of the State's forested lands are likely to be consumed by development under TREND and IPLAN?
3. How many acres of land in critical sensitive watersheds (Category I [pristine] waters, and trout production waters) are likely to be developed under TREND and IPLAN?

The Model addresses these questions by measuring the amount of land consumed from each resource category by the two development alternatives.

What Are the Basic Inputs and Outputs?

The basic inputs that allow a response to these questions are listed below.

1. Steeply Sloped Lands

The primary input in this portion of the analysis is acreage by municipality of areas of slope in excess of 12 percent. A hard-copy map of all areas in the State with slopes in excess of 12 percent was prepared in 1986 as part of the

Preliminary State Development and Redevelopment Plan. This information was planimetered to obtain acres of steep-sloped lands by municipality.

Data in the U.S. Department of Agriculture, Soil Conservation Service, Natural Resource Inventory indicate that steep-sloped areas in the Northeast were lost to development at a rate of 3–5 percent annually between 1982 and 1987. Information available from the New Jersey Department of Agriculture indicates that there has been a marked decline in the portions of farmlands on steep-sloped lands in the State. Over the period 1980–1990, these steep-sloped vacant lands declined 32 percent statewide, or 3.2 percent annually, for a total decrease of 120,028 acres (New Jersey Department of Agriculture, 1990). An average annual rate of loss of about 2 percent, together with the steep-sloped land inventory, are the basic inputs to this part of the analysis.

2. *FORESTED LAND*

Another input to this analysis is the acreage of land by municipality that is found in forest cover. This was obtained by using a hard-copy map of forest cover in 1969 from the New Jersey Department of Environmental Protection and Energy's Division of Forestry, and tabular data for 1970 and 1987 from the U.S. Department of Agriculture's Forest Service. The 1970 tabular data by county were divided into municipal shares by planimetering all forested lands in municipalities in a county on the hard-copy map, summing to a whole, taking their individual percentage shares of the whole, and applying them to the 1970 county tabular data. This enabled a division of the tabular data by county. Building permits were then viewed over the period 1970 to 1987 to estimate the distribution among municipalities of county-wide decreases in forested land between 1970 and 1987. Total forested lands by municipality were then reduced to municipal non-agriculture, non-park, forested lands by employing the New Jersey Department of Treasury data set (New Jersey Department of Treasury, 1990, 1991).

Historically, the extent of forested areas of the State has fluctuated over short periods of time, as previously farmed areas have turned into old fields and new woodland growth. Over the longer range, however, a marked decline in forested areas in New Jersey has been observed. Between 1956 and 1987, the total forested area of the State declined from 2,229 million acres to 1,985 million acres (U.S. Department of Agriculture, Forest Service, 1990). This translates into an average annual loss of forested area throughout the State of 7,871 acres, or 0.35 percent, over the period. This average annual rate of loss, corrected to compensate for counting of permanently protected forested lands (i.e., 1 percent annually), as well as the forested land inventory, are inputs to this portion of the analysis.

3. Land in Critical Sensitive Watersheds

The primary input to this portion of the analysis is acreage of land by municipality in Category I (pristine) waters, and trout production waters. Critical sensitive watersheds were mapped by the New Jersey Office of State Planning from March 1986 photoquads at a scale of 1:24,000 for the entire State in three categories: watersheds of Category I (pristine) waters, trout production waters, and trout maintenance waters. This information was planimetered at exhibit scale for each municipality and entered directly as an acreage total by municipality. The first two of these three categories of information are used to estimate municipal acreages of this frail land. Historic consumption[1] rates (2 percent annually) are assumed analogous to those for steep-sloped lands. These are both inputs into this analysis.

WHAT ARE THE EXPECTED DIFFERENCES BETWEEN TREND AND IPLAN?

Statewide, it is expected that TREND will consume somewhat more land than IPLAN although the more encompassing Centers under IPLAN may result in more land consumption for this development alternative in certain municipalities.

The alternative development patterns implied by TREND and IPLAN futures will likely result in noticeable differences in consumption of both steeply sloped and forested lands. These resources are land-extensive, and many are located just beyond the fringe of the developed suburbs. It is expected that there will be marked differences between the development alternatives of TREND and IPLAN. Another area in which marked differences can be expected is the amount of lands developed in critical sensitive watersheds. These are resources that are not as fully protected as they might be under federal, State, and local laws, and are therefore vulnerable to TREND growth patterns.

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1 *Not* vacancy rates. Critical sensitive watershed land vacancy rates are assumed to be comparable to land vacancy rates throughout each municipality because they are indistinguishable from the rest of the community at the municipal scale. Steep-sloped lands, by contrast, are typically vacant to a higher degree because they typically are the most costly and difficult to develop.

How Will the Model Investigate These?

The Frail Environmental Lands Model will investigate these differences by tabulating the amount of frail land of each category that will be consumed in each municipality under TREND and IPLAN development buildout.

CUPR's Land Capacity Model projects both population and employment for the State by municipality and defines the amounts of land in each municipality that are expected to be consumed by structures housing new population and jobs. The rate of consumption of resource areas that have some protection through local land-use controls is based upon historic rates of consumption of such resources obtained from State and federal agencies, and the best field data available. The rate of consumption of resources not protected by local land-use controls are assumed to be similar to the historic rate of consumption of developable land in each municipality. TREND development is assigned historic rates of frail land loss; IPLAN development is assigned losses according to a goal of retention of these lands. This frail lands retention goal is to achieve no more than one-half the frail lands consumption rate of TREND.

CRITICAL ASSUMPTIONS

TREND AND IPLAN

As indicated in *Report I,* the analysis of frail lands concentrates on essentially three categories of land: *steep slopes, forests,* and *critical sensitive watersheds*. The latter subsumes two categories of lands within a single measure: Category I watershed and trout production waters. For the most part, Category I (pristine) watersheds either envelope or are more territorially diverse than trout production areas. The reason that the analysis focuses on the above three categories of frail lands is that they do *not* represent situations where: (1) there is almost equal future protection for the category of land being analyzed under TREND and IPLAN (i.e., floodplains and wetlands); (2) preservation of the resource is highly complex, and other factors are more critical to such preservation than acreage consumption (i.e., critical wildlife habitat and historic or cultural resources); or (3) data are unavailable to provide an adequate measure of the phenomenon involved (i.e., stream buffers).

When analyzing frail lands it is first necessary to determine the shares of the lands identified as *vacant* by municipality. This requires looking at the inverse of vacancy, or the *occupancy*— i.e., level of development—of land. Obviously, without comprehensive field inspection, this is a difficult task. Given the nature of these lands, however, certain assumptions can be made. For instance, it is assumed that the bulk of forested lands reported by municipality is vacant. It is further assumed that steep-sloped lands contain development at less of a level than nonsteep-sloped lands. The assumption used in this analysis is that steep-sloped lands are developed to a level of one-half the development of flatlands. Finally, it is assumed that critical sensitive watershed areas, being basically indistinguishable from any other lands, have about the same development level as already developed local lands.

The next issue is the degree of overlap between the three analyzed categories of frail lands. This involves knowledge of the levels of locational correspondence between frail lands, as well as their physical presence by region of the State. This will be discussed in detail shortly.

Yet another issue that must be considered in the analysis of frail lands is the incidence rate of the consumption of these lands under normal (TREND) and planned development (IPLAN) futures. Under normal development, historic consumption rates are inferred and derived from national and State data. Under IPLAN conditions an objective is set relative to consumption, and this affects the amount of land that can be drawn upon for development under that scenario. Under normal development forested lands are drawn down at 1 percent annually, steep-sloped lands at 2 percent annually, and critical sensitive watershed lands at 2 percent annually. Under IPLAN conditions the assumption is that they are consumed at one-half these drawn-down rates. The difference in these two percentages is the amount of frail land that will *not* be made available to IPLAN development objectives under its scenario of development.

THE QUESTION OF OVERLAP OF FRAIL LANDS

Even more perplexing is the reality that in many instances there is no way to determine the degree of overlap of one frail land presence versus that of another. This relates to a situation wherein multiple categories of frail lands are present in a single municipality. How does the analyst sort among them when the original purveyor of these data made no attempt to? One of the ways that the study team has chosen to deal with overlap is to try to determine coincidences of location among the above three frail land categories.

Critical Sensitive Watersheds

First, as noted before, there is a great deal of correspondence statewide between Category I watersheds and trout production areas. The former are usually more expansive, yet nonetheless in similar locations as the latter. When the two categories appear as acreages of frail land in the same municipality, the maximum value of one or the other is used. Further, as will be commented on below, in almost all cases there is very significant overlap between critical sensitive watersheds and either steep slopes or forested lands.

Steep-Sloped Lands

In the northern part of the State, particularly in Sussex, Warren, Passaic, and Morris counties—and somewhat less so, in Bergen, Essex, and Hudson counties—steep slopes are by far the dominant frail land characteristic.[2] For municipalities in these counties, it is assumed that the steep slopes acreage is the dominant category; forests and critical sensitive watersheds are subsumed within this total. Its acreage becomes the amount of non-overlapping frail land locally. As was the case for Category I watersheds and trout production waters, if there is a local frail acreage larger than steep slopes in these counties, the largest value is used to signal the extent of presence of non-overlapping frail lands.

Forests

In the central and southern portions of the State, the most dominant of the three frail land categories is forested lands. In Union, Middlesex, Mercer, Somerset, Hunterdon, Monmouth, Ocean, Burlington, Camden, Gloucester, Cumberland, Atlantic, Cape May, and Salem counties, forests are the most significant of the three frail lands investigated. Steep slopes disappear south of the northern Ocean–Burlington counties division of the State. There are some pristine waters in northern Hunterdon, Monmouth, Middlesex–Somerset, Mercer, Gloucester–Salem, and Cumberland counties. The correspondence between these areas and forested areas is highly significant. In all counties below the northern borders of Union, Somerset, and Hunterdon counties, the acreage for forested lands is used for the aggregate non-overlapping frail lands category for that community. If a larger value of acreage is present for steep-sloped lands or critical sensitive watersheds, this value replaces the forested value.

This procedure seems best to approach the issue of overlapping frail lands. It recognizes the differing influence as well as the correspondence of the three categories of frail land. It also provides a definable, non-overlapping number for frail lands locally. Obviously, when the frail lands data become digitized, this will no longer be necessary.

HISTORIC LOSS RATES OF FRAIL LANDS

Historic loss rates of frail lands are difficult to determine in that often no data are maintained, or when data are maintained they may not relate to the geographic area under

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2 There are similar areas in northern Somerset and Hunterdon counties, most of which contain a reasonable amount of forest cover.

study. Further, data may vary considerably from place to place, or they may conceal information that would render the data inappropriate for use in the task at hand (i.e., a loss rate that is determined, including a large category of permanently protected land). As a result, loss rates must be drawn from what information is available and adjusted if necessary to better interpret local conditions. The following 1990 to 2010 loss rates are assumed, as is discussed below.

	STEEP SLOPES (*Percent Annual*)	FORESTS (*Percent (Annual)*)	CRITICAL SENSITIVE WATERSHEDS (*Percent Annual*)
Consumption Rates 1990–2010			
TREND	2.0%	1.0%	2.0%
IPLAN	1.0%	0.5%	1.0%

The rationale relative to the above assumptions is as follows.

1. *Steep-sloped* areas are in decline in the Northeastern United States at a rate of 3.6 percent to 5.4 percent annually. Choosing a consumption rate of 4 percent annually, and capping the two-decade loss at one-half the observed rate, yields a TREND two-decade (1990–2010) loss rate of 40 percent. The IPLAN consumption rate (frail lands at risk) is set at no more than one-half the TREND consumption rate, or 20 percent for the period.

2. *Forests* have charted losses of .35 percent per year, including those forests that are totally protected under park systems. Thus, the forest loss rate expressed as a percent of the whole system is probably a significant understatement of unprotected forest land losses. The data set of forested lands by municipality is non-park, non-agriculturally assessed forest lands. Thus, its status is quite vulnerable. A loss rate of three times the observed decade aggregate rate (or nearly 10 percent) is assumed for TREND—20 percent for the 1990–2010 period. The IPLAN consumption rate (frail lands at risk) is set at one-half the TREND consumption rate, or 10 percent loss for the two-decade period.

3. *Critical sensitive watersheds* are some of the least protected of frail lands. Their loss is almost equivalent to developable land of any type. Critical sensitive watersheds are assumed to be consumed at a 40-percent loss over the period 1990–2010 under TREND. The IPLAN consumption rate (frail lands at risk) is also set at one-half the TREND consumption rate, or 20 percent for the period.

AN EXAMPLE OF THE FRAIL ENVIRONMENTAL LANDS CONSUMPTION CALCULATION

An example of the frail environmental lands loss calculation is shown in Exhibit 1. The exhibit depicts a community of a total size of 1,700 acres located in the northern portion of the State wherein steep slopes dominate this category of frail land. Of this total acreage, 700 acres are vacant, 300 acres are farmlands, and 500 acres are developed in residential and nonresidential uses (including 50 acres that could be used for redevelopment). Two hundred (200) acres are exempt lands of various types. The municipality contains no inclusive water bodies.

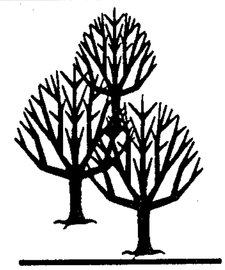
According to the various data sets noted earlier, there are 100 acres of steep slopes locally, 70 acres of forest lands, and 50 acres of critical sensitive watersheds in the above community. These lands are both overlapping and include vacant and occupied components. In order to determine how much land is vacant and non-overlapping, the procedures discussed previously are employed. Since the community is in the northern part of the State, it is assumed that steep slopes dominate, and their acreage is the major indication of exclusive or non-overlapping frail land acreage. The share that is vacant must then be determined. This is estimated at two times the rate of existing vacancy. The total acreage that is exclusively frail and vacant is determined in this example to be 82.35 acres.

These acres, in both the TREND and IPLAN scenarios, are either not allowed to be developed (lower left—Exhibit 1) or are at risk to be developed (lower right—Exhibit 1). In the first case, 65.9 acres under IPLAN and 49.4 acres under TREND cannot be developed. These nondevelopable acres each alter vacant land available under the two scenarios. In TREND vacant land is reduced from 700 to about 650 acres; in IPLAN it is reduced from 700 to 634 acres. In the second case, those frail acres at risk are put into the vacant land category, to be consumed in the following order: farmland, vacant land, frail land, and redevelopment land. In the example above, these are 16.5 acres for IPLAN and 33.0 acres for TREND. They are contained within the 634.1 acres for IPLAN and 650 acres for TREND that can be consumed as vacant land. The amount potentially available for development under TREND (33.0 acres) is twice what is available under IPLAN (16.5 acres). IPLAN has reduced by one-half the amount of frail land potentially available to be consumed.

TREND FINDINGS

The above-described procedure is used to calculate the frail land potentially available to be consumed for development in each community. How much of the frail land is consumed relates to how much other land is available and how much demand there is for

EXHIBIT 1



Vacant/Occupied Overlapping Frail Lands Conversion to Vacant, Non-Overlapping Frail Lands, and Vacant Land Reduced by Vacant Non-Consumable Frail Lands

Northern New Jersey (Sussex County)

COMMUNITY A
LAND DISTRIBUTION =
1,700 total acres

Vacant	Farmland	Developed	Redeveloped	Exempt
700 acres	300 acres	450 acres	50 acres	200 acres

Acres not Developable Under: / *New Vacant Acres for Development (including frail lands)*

IPLAN	− 65.9	=	634.1
TREND	− 49.4	=	650.6

In this community are: **220 acres of vacant/occupied, overlapping frail lands**

100 ACRES — *Steep Slope*
70 ACRES — *Forest*
50 ACRES — *Critical Sensitive Watershed*

Of these:

100 acres Steep Slope × $\frac{2 \times 700}{1,700}$ = 82.35 acres vacant, non-overlapping fragile lands *(vacant = twice existing rate)*

70 acres Forest — *Subsumed within steep-sloped category and not counted separately*

50 acres Critical Sensitive Watershed — *Subsumed within steep-sloped category and not counted separately*

82.35 acres vacant

82.35 acres vacant steep-sloped land

Acres NOT Allowed to be Consumed:

IPLAN	TREND
(.80)	(.60)
65.9	**49.4**
65.9	**49.4**

NOT AT-RISK ACRES (Saved at inverse of consumption rate)

Acres ALLOWED to be Consumed:

IPLAN	TREND
(.20)	(.40)
16.5	**33.0**
16.5	**33.0**

AT-RISK ACRES (Made available at consumption rate; consumed as needed) land under the unique development requirements for TREND or IPLAN. Under TREND development objectives approximately 36,500 acres of frail land are consumed over the period 1990 to 2010 (Exhibit 2). Most of this is forest lands in the East Central and Southwest regions of the State. There is also some consumption of steep-sloped land and critical sensitive watersheds in the northern part of the State.

IPLAN FINDINGS

Under IPLAN there is only one-fifth as many acres of frail lands consumed for development as is the case for TREND. About 7,150 acres are lost under the IPLAN scenario between the years 1990 and 2010. The difference from TREND relates to how much land was made available in the first place, as well as the demand for that land in each municipality. Again, most of the acres consumed for frail lands are forests in the East Central and Southwest regions of the State.

Both of the development alternatives (TREND and IPLAN) experience frail land loss in the regions where development pressure is the greatest—the East Central, West Central, and Southwest regions. More land would be lost in the extreme northern and southern parts of the State if development pressure was greater there. For instance, in the Northwest region, where growth pressure is different under TREND as opposed to IPLAN, frail land losses are 6:1 under TREND.

TREND VERSUS IPLAN

There is a difference in the two alternative development scenarios in the amount of frail lands consumed for development. Nearly 30,000 acres of frail lands might potentially be saved if development limitations are imposed and growth is directed to Centers. Through selective development, these acres of frail lands are preserved. This can take place via clustering, density transfers, public land purchases, and the like.

A reasonably delicate balance must be achieved between economic development objectives and frail lands protection in certain locations of the State. In such areas, if the protection of frail lands is of paramount concern, yet economic development is also desired, Center and low-density development may strike the appropriate balance between frail lands preservation and the area's future economic development goals.

EXHIBIT 2

FRAIL LANDS CONSUMED BY DEVELOPMENT 1990-2010 IN TREND AND IPLAN

TREND DEVELOPMENT

REGION	*AMOUNT IN ACRES*
Northeast	1,709
Northwest	3,730
West Central	2,363
East Central	12,786
Southwest	8,403
South-Southwest	7,491
TOTAL	**36,482**

IPLAN DEVELOPMENT

REGION	*AMOUNT IN ACRES*
Northeast	820
Northwest	737
West Central	1,770
East Central	2,200
Southwest	1,161
South-Southwest	462
TOTAL	**7,150**

Source: CUPR Frail Environmental Lands Model, 1992.

WHAT ARE THE IMPLICATIONS OF THESE FINDINGS?

The more concentrated development patterns achievable under IPLAN are clearly more beneficial in terms of the features considered in the Frail Environmental Lands Model. In fact, if the goals of IPLAN were limited to the preservation of these lands, the most desirable alternative would be a strategy that achieved the highest concentration of development, thereby consuming the least acreage of each of the previously listed resources. However, the Plan must balance goals of environmental preservation with a wide array of other considerations, including housing affordability, fiscal balance, economic development objectives, land preservation cost considerations, and efficiency of land use. Significant amounts of land saved in particular regions will, of necessity, impact markedly on land development capacity in those regions.

PART III

IMPACTS ON AGRICULTURAL LANDS

ENVIRONMENTAL IMPACT ASSESSMENT: PART III — IMPACTS ON AGRICULTURAL LANDS

BACKGROUND

The Agricultural Lands Model classifies farmland in New Jersey into higher-quality and lesser-quality categories. Higher-quality farmland encompasses the "prime" and "marginal" classifications; lesser-quality lands comprise "poor" farmland. This taxonomy is driven by New Jersey's agricultural lands usage and critical crop characteristics (see *ReportI: Research Strategy—Research Design, Model Descriptions, Case Study Profiles, Variable Selection,* at Section 2, Part III).

The Agricultural Lands Model is a component of the environmental assessment of TREND and IPLAN. The environmental assessment also includes the air and water pollution impacts of TREND and IPLAN. The Frail Environmental Lands Model is also part of the environmental assessment; categories developed in the Agricultural Lands Model are assigned to agricultural land and incorporated into the Frail Environmental Lands Model. Agricultural acreage in each municipality is categorized into more- (i.e., "prime" and "marginal") versus less-desirable ("poor") agricultural land. These lands are then offered for, or not made available to, development according to the differing land consumption assumptions of TREND and IPLAN.

CONCEPTS

In many instances farmland is classified by soil type, that is, better farmland is identified by the presence of Groups A and B soils while inferior farmland is characterized by soil Groups D and E (see *Report I*). A soils-based farmland taxonomy in New Jersey was not used for a number of reasons. First, soils information is not readily available at the municipal level. Second and more critically, the diversity of crops grown in this State makes it problematic to automatically determine farmland quality by soil type since the situation varies by area and crop grown. Instead of linking farmland quality to soil type, the taxonomy was based on farmland according to the criteria set forth below.

The New Jersey Department of Treasury maintains records on the use of farmland for every community in the State by five categories.

1. *Cropland Harvested.* This land is the heart of a farming enterprise and represents the highest use of land in agriculture. All land from which a crop was harvested in the current year falls into this category.

2. *Cropland Pastured.* This land can and often is used to produce crops, but its maximum income may not be realized in a particular year. Land that is fallow or in cover crops as part of rotational programs falls into this classification.

3. *Permanent Pasture.* This land is not cultivated because its maximum economic potential is realized from grazing or as part of erosion-control programs. Animals may or may not be part of the farm operation for land to be qualified in this category.

4. *Nonappurtenant Woodland.* This land includes woodland that can qualify for farmland assessment only on the basis of being in compliance with a woodland management plan filed with the Department of Environmental Protection. It is actively devoted to the production of tree and forest products for sale.

5. *Appurtenant Woodland.* This category includes land restricted to woodlots because of slopes, drainage capability, soil type, or topography. Appurtenant woodland has limited productive use but it provides a windbreak, watershed, buffer, or controls soil erosion.

In brief, to identify prime- and lesser-quality farmland in New Jersey municipalities, encompassing all five use categories noted above (which amount to a total of 1.2 million acres as of 1990), the critical product-mass approach is taken. That is, harvested cropland, pastured cropland, and nonappurtenant woodland required to support the 1990 level of production of major commodities produced in a given location, together with portions of permanently pastured farmland and appurtenant woodland required to support critical grazing, erosion control, and crop rotation needs, are considered to be prime farmland in 1990. All cropland harvested, cropland pastured, and nonappurtenant woodland not classified as prime in 1990 fall into the marginal category. The remaining groups—permanent pasture and appurtenant woodland not considered prime in 1990—fall into the marginal or poor categories, respectively, depending on their need to provide erosion control.

This classification was conducted for every community in the State for both 1980 and 1990. Over the decade New Jersey lost about 78,000 acres of farmland. This was comprised of sharp losses in the prime and marginal groups that more than offset a gain in the inventory of poor farmland. Details on the basis of the farmland taxonomy and the full results of the 1980 to 1990 farmland analysis for New Jersey are reported in *Report I*.

EXPECTED DIFFERENCES BETWEEN TREND AND IPLAN

Under TREND, New Jersey agricultural land will likely continue to be lost. Under IPLAN the State's higher-quality (prime and marginal) farmland would be protected. It is assumed that only the poor-quality farmland would be made available for development. From a statewide perspective, the total acreage in farms would decline but by a lesser magnitude relative to TREND. Additionally, IPLAN's farmland diminution would be limited to poor farmland while TREND's loss would affect all categories—including the better-quality farmland groups.

The converse of farmland acres lost to development is the dollar value realized by the owners of farmland from the sale of their land for development purposes. The greater the number of acres sold, the greater the gain; the more farmland is preserved, the lesser the dollar sum from farmland sales. Farmland sales (at 1990 land prices) can be calculated for both TREND and IPLAN for the 1990 to 2010 period. Since IPLAN will likely witness a lesser offering of farmland for development relative to TREND, farmland sales will be lower for IPLAN. The dollar difference in farmland sales between IPLAN and TREND is termed the "agricultural preservation cost."

CRITICAL ASSUMPTIONS AND DATA PARAMETERS

The critical assumption and data parameters for assessing the impacts on agricultural land under TREND and IPLAN are listed below.

1. For both TREND and IPLAN, land available for development is derived from three sources: farmland, vacant land, and redevelopment of existing parcels. Additionally, for both TREND and IPLAN, the sequence of drawing upon land is that as just listed: first from farmland, then vacant land, then frail lands, and finally from redevelopment lands. These assumptions are detailed in the Land Capacity Model (see Section 2, Part I of this volume).

2. It is assumed that farmland can be classified into prime, marginal, and poor categories based on the land's usage and critical crop characteristics. The same farmland taxonomy is followed for TREND and IPLAN; the two scenarios differ, however, with respect to the availability for development of the different farmland categories, as explained below.

3. For TREND *all* categories of farmland—prime, marginal, and poor—are offered for development. For IPLAN the prime and marginal groups are protected and *only* the poor farmland category can be tapped. This

distinction goes to the heart of the planning and land-use differences between TREND and IPLAN.

4. While all farmland can be tapped under TREND, there is a ceiling, or cap, to the amount of farmland that can be drawn upon as opposed to the other land pools of vacant land and redevelopment land. The farmland loss cap is set at the historical rate of attrition. In the ten years between 1980 and 1990, New Jersey lost 6 percent of the State's farmland (including woodlands in the total base). Consequently, for the next twenty years, 1990 to 2010, the farmland loss cap is set at 12 percent. This cap is applied both statewide and to every municipality. As will be discussed shortly, the farmland draw-down ceiling applied to TREND is conservative—that is, it restrains the projected farmland loss under this scenario.

5. It is finally assumed that farmland sold for development can be determined as follows. Farmland sold in New Jersey for *all purposes*—development, agricultural use, and open space—has an average value of $4,140 per acre as of 1990. To identify the value of farmland sold for *development purposes solely* as of 1990, optimally one would have a current data source on just such transactions; this does not exist, however. Consequently, for lack of better information, 1990 data from the New Jersey State Agricultural Development Committee (SADC) was utilized. The data from the SADC indicate the appraised value of farmland before versus after farmland has been deed-restricted from development. The "before" (i.e., nondeed-restricted prices) from the SADC provide a rough measure of the value of farmland sold for development. These values are developed for each county in the State. As might be expected, these prices vary significantly by area from a very high amount per acre in counties such as Bergen and Middlesex, to much lower sums in Cumberland and Salem.

   These farmland prices per acre by county are then applied to the number of acres of farmland sold for development reasons by county under TREND and IPLAN, respectively, to calculate the total sales under each scenario over the study period from 1990 to 2010. The difference in sales realized (expected to be lower for IPLAN since it is assumed that IPLAN will not offer the significant inventory of prime and marginal farmland acreage for development) is termed the agricultural preservation cost.

6. Agricultural preservation costs are estimated only for IPLAN. Under TREND, all farmland is assumed offered for development, so the historical attrition of farmland continues. Existing farmland preservation programs are not expected to play a significant role under TREND beyond their current effect in historical farmland attrition rates.

TREND FINDINGS

Loss of Farmland

Exhibit 1 indicates the projected loss in farm acreage for New Jersey from the 1990 base year to first 1995 and then 2010. The information is shown both statewide and then for the six regions defined in the State Plan evaluation—the Northeast, Northwest, West Central, East Central, Southwest, and South-Southwest. The attrition in farmland is shown in terms of total acres and then differentiated by category of cropland—better-quality (encompassing the prime and marginal groups) and lesser-quality (encompassing the poor group).

In 1990, New Jersey contained 1,167,000 acres of farmland (including woodlands in the total base). Historically, this resource has been depleted. It is projected under TREND that the attrition will continue. From 1990 to 1995, it is estimated that development in the State will draw down on 22,000 acres of farmland, or 2 percent of the 1990 total.

Of the total 1990 to 1995 loss of 22,000 acres, the largest depletion will occur in the West Central (loss of 8,000 acres) and Southwest (loss of 6,000 acres) compared to a drop of 300 acres in the Northeast region. These differences, reflecting the varying levels of farmland available in the region as well as the varying levels of development activity, are detailed below.

As of 1990, of the State's total 1,167,000 acres of farmland, 361,000 acres were found in the West Central and 295,000 acres in the Southwest regions—together comprising about 60 percent of the State's total farmland. By contrast, there were only 12,000 acres of farmland in the more urbanized Northeast—comprising only 1 percent of the State's total farmland inventory. Not surprisingly, the regions with the most farmland—such as the West Central and Southwest—are most vulnerable to farmland loss in contrast to areas with few remaining farms, such as the Northeast.

Another factor concerns the intensity of development projected for the different regions. From 1990 to 1995, of the total projected increase in households statewide of almost 80,000, half is expected to occur in the West Central and Southwest regions

EXHIBIT 1

FARMLAND ACREAGE LOSS BY TYPE AND REGION
TREND CONDITIONS: 1990-2010
(in thousands of acres)

	Total Farmland Acreage (in 000s)	*Change—Loss of Farmland Acreage (in 000s) for Development Purposes*			
	1990 Total	1990-1995[1]		1990-2010	
		Total	Percent	Total	Percent
STATEWIDE					
Total Farmland	1,167.3	21.5	1.8	107.5	9.2
Prime and Marginal	947.6	18.0	1.9	89.9	9.5
Poor	219.7	3.5	1.6	17.6	8.0
NORTHEAST					
Farmland	11.7	0.3	2.6	1.4	12.0
Prime and Marginal	11.1	0.3	2.7	1.3	11.7
Poor	0.6	0.0	0.0	0.1	16.7
NORTHWEST					
Farmland	150.8	3.1	2.1	15.7	10.4
Prime and Marginal	115.1	2.7	2.3	13.5	11.7
Poor	35.7	0.4	1.1	2.2	6.2
WEST CENTRAL					
Farmland	360.5	7.6	2.1	38.1	10.6
Prime and Marginal	302.3	6.4	2.1	31.9	10.6
Poor	58.2	1.2	2.1	6.2	10.7
EAST CENTRAL					
Farmland	88.4	1.9	2.1	9.4	10.6
Prime and Marginal	73.8	1.7	2.3	8.4	11.4
Poor	14.6	0.2	1.4	1.0	6.8
SOUTHWEST					
Farmland	295.1	5.5	1.9	27.3	9.3
Prime and Marginal	230.0	4.4	1.9	22.1	9.6
Poor	65.1	1.0	1.5	5.2	8.0
SOUTH-SOUTHWEST					
Farmland	260.8	3.1	1.2	15.5	5.9
Prime and Marginal	215.3	2.6	1.2	13.0	6.0
Poor	45.5	0.5	1.1	2.5	5.5

1 The farmland consumption for 1990-1995 is estimated by applying a 1990-1995 apportioned share (i.e., 1990-1995 household growth as a percentage of the total 1990-2010 household growth) to the total 1990-2010 farmland loss.

Notes: Of the combined prime and marginal farmland, prime comprises about 90 percent. Items may not add to indicated totals because of rounding.

Source: CUPR Land Capacity Model and CUPR Agricultural Lands Model, 1992.

compared to only 10 percent in the Northeast. (See the detailed discussion of the Housing Demand/Supply Model in Section 4, Part II of this volume.) In short, the West Central and Southwest regions of New Jersey will experience the sharpest loss of farmland over the 1990 to 1995 period because: (1) they are growing the most rapidly; and (2) the first draw-down of land for development purposes comes from their relatively plentiful stock of farmland.

A regional pattern similar to that of 1995 is repeated for 2010. Under TREND it is projected that the State will lose 108,000 acres of farmland by 2010—a drop of 9 percent from the 1990 base. While percentage-wise, all regions will experience a similar near 10-percent attrition from the 1990 inventory of farmland, there are dramatic regional differences in the number of farm acres lost. Of the total 108,000-acre statewide reduction, the West Central and Southwest areas are impacted the most, with losses of 38,000 and 27,000 acres, respectively. The Northeast, by contrast, has a loss of only 1,400 acres. These regional differences reflect the characteristics observed for 1995. Those areas that are anticipated to grow most and have largest base-year (1990) inventories of farmland are the most vulnerable to farmland loss. Thus the West Central and Southwest regions—which have the largest caches of farmland in New Jersey and which will house about half the State's 408,000 household growth from 1990 to 2010—lose the most farmland over these two decades.

By contrast, other regions do not have the combination of conditions just described. To illustrate, the Northeast, which has little farmland left as of 1990, has little inventory at stake and drops as noted by only 1,400 acres. The South-Southwest, although containing a large amount of farmland (261,000 acres as of 1990), has only a moderate loss of 16,000 acres of farmland between 1990 and 2010 because of its anticipated moderate growth over the two-decade period (accommodating about one-tenth of the State's households.) Thus demand (growth) and land supply (farmland acreage) explain the regional differences in the farmland losses projected for New Jersey under TREND.

Loss of Farmland by Type

As described earlier, farmland in New Jersey is classified into better-quality and lesser-quality categories. The former encompasses prime and marginal farmland, the latter poor farmland. Of the total 1,167,000 acres of farmland in New Jersey as of 1990, 948,000 acres, or about 80 percent, are prime or marginal; the remaining 220,000 acres, or 20 percent, comprises poor farmland. There is roughly a similar distribution between the better- and lesser-quality groups for the different regions. Since both statewide and by region the prime and marginal groups are approximately four times the size of the poor, more prime and marginal farmland will be vulnerable to loss—if all are available to be drawn upon. The vulnerability of the better-quality farmland in New Jersey is borne out by the figures reported in Exhibit 1.

From 1990 to 1995 the State under TREND is anticipated to lose roughly 22,000 acres of farmland. Of this total, 18,000 acres, or 82 percent of the total, is estimated to come from the prime and marginal groups; the remaining 4,000 acres, or 18 percent, will be drawn from the poor farmland category. The heaviest losses of prime and marginal farmland are in those areas experiencing the sharpest reduction in farmland that were described in the previous section—the West Central and Southwest Regions.

A similar pattern is observed for 2010. From 1990 to 2010, the State under TREND is projected to lose 108,000 acres of farmland. That figure is comprised of 90,000 acres, or a four-fifths share, of prime and marginal land, and 18,000 acres, or a one-fifth contribution, of poor farmland. As in 1995, the most severe loss of the better-quality farmland is experienced by the West Central and Southwest regions. Prime and marginal lands in these two areas are reduced by 32,000 and 22,000 acres respectively.

Farmland Sales

Thus far the analysis has considered the farmland acreage drawn down from the starting inventory to provide land consumed by development. By assigning an average dollar value of farmland in New Jersey that is offered for development by county to the number of acres disposed of by county for development purposes, an order-of-magnitude total value of the farmland sold can be determined.

These figures, aggregated from the individual counties to the six regional groupings, are shown in Exhibit 3. From 1990 to 1995 it is projected that the 22,000 acres of farmland in New Jersey transferred for development will realize $108 million to their sellers. (All financial figures are in 1990 dollars.) Most of this gain will go to where there are the most sales—the West Central and Southwest regions. From 1990 to 2010 these figures are higher because they encompass a longer time period with higher cumulative land sales. Over the two-decade span, the transfer of 108,000 acres of farmland will realize to the sellers a gain of $1,135 million. Of that amount, $758 million is captured in the West Central and Southwest regions—where the most transfers occur and farmland prices are moderately high—while sales are lowest in the Northeast ($8 million) and South–Southwest ($12 million) regions. In the Northeast, the price per acre of farmland is high, but relatively few acres of farmland are disposed. In the South–Southwest, more farm acreage is lost, but in this area farm land prices per acre are low.

EXHIBIT 2

FARMLAND ACREAGE BY TYPE AND REGION IPLAN CONDITIONS: 1990-2010 (in thousands of acres)

	Total Farmland Acreage (in 000s)	*Change—Loss of Farmland Acreage (in 000s) for Development Purposes*			
		1990-1995[1]		1990-2010	
	1990 Total	Total	Percent	Total	Percent
STATEWIDE					
Farmland	1,167.3	15.6	1.3	78.0	6.7
Prime and Marginal	947.6	0.0	0.0	0.0	0.0
Poor	249.7	15.6	6.2	78.0	31.2
NORTHEAST					
Farmland	11.7	0.1	0.9	0.4	3.4
Prime and Marginal	11.1	0.0	0.0	0.0	0.0
Poor	0.6	0.1	16.7	0.4	66.7
NORTHWEST					
Farmland	150.8	2.7	1.8	13.3	8.8
Prime and Marginal	115.1	0.0	0.0	0.0	0.0
Poor	35.7	2.7	7.6	13.3	37.3
WEST CENTRAL					
Farmland	360.5	4.4	1.2	21.8	6.0
Prime and Marginal	302.3	0.0	0.0	0.0	0.0
Poor	58.2	4.4	7.6	21.8	37.5
EAST CENTRAL					
Farmland	88.4	1.4	1.6	7.0	8.0
Prime and Marginal	73.8	0.0	0.0	0.0	0.0
Poor	14.6	1.4	9.6	7.0	48.0
SOUTHWEST					
Farmland	295.1	5.0	1.7	25.2	8.5
Prime and Marginal	230.0	0.0	0.0	0.0	0.0
Poor	65.1	5.0	7.7	25.2	38.7
SOUTH-SOUTHWEST					
Farmland	260.8	2.1	0.1	10.4	4.0
Prime and Marginal	215.3	0.0	0.0	0.0	0.0
Poor	45.5	2.1	4.6	10.4	22.9

1 The farmland consumption for 1990-1995 is estimated by applying a 1990-1995 apportioned share (i.e., 1990-1995 household growth as a percentage of the total 1990-2010 household growth) to the total 1990-2010 farmland loss.

Notes: Of the combined prime and marginal farmland, prime comprises about 90 percent.

Items may not add to indicated totals because of rounding.

Source: CUPR Land Capacity Model and CUPR Agricultural Lands Model, 1992.

EXHIBIT 3

DOLLAR VALUE OF FARMLAND SALES FOR DEVELOPMENT PURPOSES BY REGION: IPLAN AND TREND, 1990-2010

	Farmland Sales for Development Purposes[1] (acres in thousands)		Dollar Gain from Farmland Sales[2] (dollars in millions)		Agricultural Preservation Cost (dollars in millions)	
	1990-1995	1990-2010	1990-1995	1990-2010	1990-1995	1990-2010
TREND						
Statewide	21.5	107.5	$226.9	$1,134.6	NA	NA
Northeast	0.3	1.4	7.5	37.4	NA	NA
Northwest	3.1	15.7	29.6	148.2	NA	NA
West Central	7.6	38.1	100.3	501.7	NA	NA
East Central	1.9	9.4	25.7	128.6	NA	NA
Southwest	5.5	27.3	51.3	256.3	NA	NA
South-Southwest	3.1	15.5	12.4	62.2	NA	NA
IPLAN						
Statewide	15.6	78.0	$156.4	$782.1	$70.5	$352.5
Northeast	0.1	0.4	2.3	11.7	5.2	25.7
Northwest	2.7	13.3	22.8	113.8	6.8	34.4
West Central	4.4	21.8	61.2	306.4	39.1	195.3
East Central	1.4	7.0	18.5	92.6	7.2	36.0
Southwest	5.0	25.2	44.1	220.4	7.2	35.9
South-Southwest	2.1	10.4	7.4	37.2	5.0	25.0

NA = Not applicable. Existing farmland preservation programs considered to be part of the baseline for TREND farmland loss rates.

Notes: Items may not add to indicated totals because of rounding.
Sales are in 1990 dollars; price inflation and appreciation are not factored. The sales figures give an order-of-magnitude sense of the scale of the financial transactions and are most useful for comparing the *relative* differences between TREND and IPLAN.

Source: [1]Exhibits 1 and 2

[2]Equals farmland sales by county multiplied by the average county price per acre of farmland with development rights.

IPLAN FINDINGS

Exhibits 2 and 3 report the farm acreage loss and farmland sales for IPLAN. As shall be elaborated shortly, there is less farmland lost under IPLAN relative to TREND; in parallel, IPLAN compared to TREND has a lower sales tally from farmland offered for development. For the moment, the discussion will focus on the IPLAN figures alone.

From 1990 to 1995, it is projected that under IPLAN New Jersey will experience an attrition of 16,000 acres of farmland, or a little more than 1 percent of the 1990 base. As with TREND, the largest losses are recorded in the regions (West Central and Southwest) with the most significant inventories of farmland and that are experiencing the most rapid growth.

From 1990 to 2010, the farmland reduction under IPLAN will grow to 78,000 acres, or 7 percent of the 1990 starting inventory of 1,167,000 acres. Of the 78,000-acre drop, the largest declines are in the Southwest (25,000 acres) and West Central (22,000 acres) regions.

Farmland sales flow directly from the transfers at the farmland prices by area. From 1990 to 1995, farmland sales in New Jersey under IPLAN will realize $156 million (see Exhibit 3). The gain from 1990 to 2010, when a larger volume of sales will occur, is $782 million. The most significant dollar sums captured are in those areas with the highest volume of land transfers and at least moderately expensive farmland. Thus, of the $782 million statewide sales from 1990 to 2010, $306 million will be realized in the West Central region compared to less than $40 million in the South–Southwest and just over $10 million in the Northeast.

COMPARISON OF TREND AND IPLAN

There is a sharp differentiation between TREND and IPLAN with respect to agricultural land loss and preservation cost. Under TREND, all farmland is assumed offered for development so the historical attrition of farmland continues. Over the 1990 to 2010 period, 108,000 acres of farmland are removed for development purposes. IPLAN preserves prime and marginal farmland and offers only poor land for development. Consequently, its attrition of farmland is less—78,000 acres over the 1990 to 2010 period, or about 70 percent of the TREND figure.

This statewide difference is repeated, on an order-of-magnitude basis, for the different regions. For instance, whereas the 1990 to 2010 farmland reduction under TREND is 38,000 acres in the West Central region, the loss drops to 22,000 acres, or about 60 percent, under IPLAN. In the East Central region IPLAN's agricultural lands attrition is about 70 percent that of TREND.

Perhaps even more significant is the incidence of the loss by category of farmland. TREND draws upon the full inventory of farmland and, as such, the largest loss comes from the largest components of farmland—the prime and marginal groups. IPLAN, by contrast, is assumed to lose farmlands only from the poor-quality group and to preserve prime and marginal lands. These differences result in a drastic departure of IPLAN from TREND.

Under TREND, of the State's 108,000-acre reduction in farmland from 1990 to 2010, 90,000 acres come from the prime and marginal farmland categories. Under IPLAN there is *no* loss from these better-quality groups. Thus, there are two consequences resulting from IPLAN drawing only from poor farmland. First, PLAN's total loss of farmland (78,000 acres) is less relative to TREND (108,000 acres). Second, there is no attrition under IPLAN from the prime and marginal farmlands, whereas TREND loses 90,000 acres of these better-quality lands over the 1990 to 2010 period.

The converse of the greater protection accorded to farmland by IPLAN is a lower dollar amount realized from land sales. The statewide return from such transactions over the two-decade period is estimated roughly at $782 million for IPLAN compared to $1,135 million for TREND—a difference of some $350 million. This difference is termed the "agricultural preservation cost," or the expense in reduced farmland sales for development because the best quality farmland is protected from development. In short, from 1990 to 2010, IPLAN's farm acreage loss is about 70 percent that of TREND's (78,000 versus 108,000 acres); in parallel, IPLAN's farmland sales are about 30 percent lower relative to TREND.

Under alternate conditions or assumptions, these differences could be narrowed or expanded. For instance, as described in the assumptions, a 12-percent cap on farmland loss for TREND was established not only for the State but for all municipalities. Changing these assumptions would affect the outcome. For instance, permitting the 12-percent drawn-down to be exceeded in *individual* communities as long as the *statewide* loss is maintained could mean that farmland acreage reduction for TREND over the projection period would be larger than the figures reported in Exhibit 1. This would further the gap between TREND and the farmland preservation focus of IPLAN. Another change could be to apply a different—i.e., a higher—farmland loss cap, either on a statewide or individual municipality basis. The cap that is used in the analysis is based on a historical 12-percent loss of farmland of all groups (cropland harvested, cropland pastured, permanent pasture, and appurtenant and nonappurtenant woodlands) from 1980 to 1990—0.6 percent annually. From a longer historical perspective, and looking at different farmlands, the farmland attrition rate is higher. For instance, according to the U.S. Department of

Agriculture, Economic Research Service, from 1964 to 1987 New Jersey lost 32 percent of its total cropland and pasture land, or a loss of almost 1.5 percent per year—double the 0.6 percent annual cap that is applied in the State Plan Impact Assessment. Had the higher cap (i.e., 1.5 percent annual loss) been factored, then more farmland could have been drawn down under TREND. This would have furthered the gap between TREND and the farmland preservation orientation of IPLAN.

Alternatively, the farmland made available for development under IPLAN would be altered. In the analysis described earlier, both prime and marginal farmlands are conserved. In a change, the marginal farmland would join the poor farmland inventory as the combined land pool from which development would draw. Since more farmland would then be available, the farmland loss from IPLAN would exceed the acreage indicated in Exhibit 2. Such a change would narrow the TREND versus IPLAN differences described earlier.

While altering assumptions would affect the specific numerical outcome from analysis, the basic finding would not change. More farmland is preserved under IPLAN, and the attrition of better-quality farmland ceases. This fosters many of the benefits described in the agricultural case study: Open space will be preserved. A basic resource (better farmland) is protected. Threats to continued efficient agricultural production in the State from the "impermanence syndrome" and the diseconomies of scale are lessened. There is a financial consequence, however, to these many benefits—an estimated farmland preservation cost over TREND of approximately $350 million over the 1990 to 2010 period.

PART IVA

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IMPACTS ON AIR POLLUTION

ENVIRONMENTAL ASSESSMENT: PART IVA—IMPACTS ON AIR POLLUTION

BACKGROUND

The conceptual basis of the transportation-based Air Pollution Model is straightforward. The amount of traffic generated within a region is a function of the types and amounts of land use and the intensity of activities. This kind of traffic can be labeled "internally generated" flows. However, a region is also subject to the amount of traffic passing through—"externally produced" flows. Middlesex County, for example, has a great deal of externally generated traffic with the New Jersey Turnpike, many State roads, and the Garden State Parkway. Both affect air pollution levels and must be accounted for.

CONCEPTS

The CUPR Air Pollution Model has a traffic component and a pollution component. The traffic component generates five-year projections of traffic at the county level on the basis of the county's future population and lane-miles of State highway. Traffic is expressed in vehicle-miles traveled (VMT) in a year. This is the principal component of the Model.

The pollution component, which uses projections of traffic as inputs, computes the amounts of carbon monoxide, non-methane hydrocarbons, and nitrogen oxide that the projected traffic will pump into the air of the county. The amount of a pollutant transmitted to the air in a county in a particular year is projected by multiplying the emission factor for that pollutant by the VMT projection for the county in that particular year.

EXPECTED DIFFERENCES BETWEEN TREND AND IPLAN

In the TREND scenario, development will be most intense at the fringe of cities and in hitherto undeveloped rural areas. In addition, residential development is likely to occur in more scattered locations possibly at a distance from nonresidential development. In contrast, IPLAN encourages the redevelopment of urban and close-in suburban areas of the State. IPLAN further targets development to existing Centers and new Centers, in both cases emphasizing some mixed-use development or, more probably, the development of residential and nonresidential facilities in close proximity.

It is likely that clustered development and the greater correspondence between residence and workplace under IPLAN will lead to the construction of fewer lane-miles of roads and fewer vehicle-miles traveled than is the case under TREND. Thus, there is a potential that IPLAN will generate a slightly smaller statewide total amount of air pollutants than TREND.

CRITICAL ASSUMPTIONS AND PARAMETERS FOR TREND AND IPLAN

1. The distribution of population among the various regions will remain the same under TREND and IPLAN. Under both development scenarios, the population of New Jersey will increase essentially the same from 7.73 million in 1990 to 8.25 million in 2010, representing a growth rate of 6.7 percent for the 1990-2010 period. In addition, the East Central region is projected to have the fastest growth rate (16.8 percent) while a population decline of 3.6 percent is projected for the Northwest region. Population changes in the 1990-2010 period are presented in Exhibit 1.

2. The number of vehicle-miles traveled (VMT) in a county can be predicted on the basis of an observed functional relationship between VMT and the population and lane-miles of State highway in the county.This functional relationship has been established by multiple regression using 1990 VMT,[1] 1990 population, and 1987 number of lane-miles, and has the following parameter estimates:

   VMT = -676.43644 + .00597 **POP** + 2.99958 **LMILES**

   Regression statistics

   R-square =.92542

   F-ratio = 111.68552, significant at .0001

   Standard error of the estimate = 493.64177

   VMT is in units of one million miles.

3. In the future automobiles will be less polluting, and the use of cleaner automobiles will increase over time.This state of affairs will come about as a result of increased use of cleaner fuels, more efficient (low-emitting) engines, more stringent emission inspection, and a larger proportion of the fleet equipped with and served by antipollution devices and cleaner fuel. Average amounts of non-methane hydrocarbons, carbon monoxide, and nitrogen oxide emitted per vehicle mile, therefore, will decline steadily over the projection period. The following table presents the critical values for automobile emissions that are used in the projection of transportation-based air pollution.

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1 VMT was estimated by the New Jersey Department of Transportation on the basis of Average Daily Traffic (ADT). County ADT by road type is multiplied by the number of lane-miles of this road type in the county and by 365 (days) to arrive at the county VMT for the road type in question.

The VMT data were supplied by Data Resources Section, New Jersey Department of Transportation. Information received from Louis C. Whiteley, Section Chief, Data Resources Section, and Mike Savage of the Section was of great assistance in completing this analysis.

EXHIBIT 1
PROJECTIONS OF POPULATION CHANGES
TREND CONDITIONS

STATE/ COUNTY	1990 U.S. Census Total Persons	1995 Projected Total Persons	2010 Projected Total Persons	1990-1995 Change	1990-2010 Change	1990-1995 Growth Rate (in percent)	1990-2010 Growth Rate (in percent)
NEW JERSEY	7,730,188	7,786,100	8,250,202	55,912	520,014	0.72	6.73
Northeast	1,831,539	1,824,700	1,862,900	-6,839	31,361	-0.37	1.71
Northwest	1,824,321	1,793,200	1,758,201	-31,121	-66,120	-1.71	-3.62
West Central	1,111,442	1,130,201	1,279,200	18,759	167,758	1.69	15.09
East Central	986,327	1,029,100	1,152,300	42,773	165,973	4.34	16.83
Southwest	1,453,796	1,473,799	1,603,701	20,003	149,905	1.38	10.31
South-Southwest	522,763	535,100	593,900	12,337	71,137	2.36	13.61

IPLAN CONDITIONS

STATE/ COUNTY	1990 U.S. Census Total Persons	1995 Projected Total Persons	2010 Projected Total Persons	1990-1995 Change	1990-2010 Change	1990-1995 Growth Rate (in percent)	1990-2010 Growth Rate (in percent)
NEW JERSEY	7,730,188	7,786,100	8,250,201	55,912	520,013	0.72	6.73
Northeast	1,831,539	1,824,700	1,862,900	-6,839	31,360	-0.37	1.71
Northwest	1,824,321	1,793,200	1,758,201	-31,121	-66,120	-1.71	-3.62
West Central	1,111,442	1,130,201	1,279,200	18,759	167,758	1.69	15.09
East Central	986,327	1,029,100	1,152,300	42,773	165,973	4.34	16.83
Southwest	1,453,796	1,473,799	1,603,701	20,003	149,905	1.38	10.31
South-Southwest	522,763	535,100	593,900	12,337	71,137	2.36	13.61

Source: Employment and population projection subroutine of the Land Capacity Model, 1992.

EPA EMISSION FACTORS FOR 1990-2010[2]
(in grams/vehicle/mile)

YEAR	Non-Methane Hydrocarbon (NMHC)	Carbon Monoxide (CO)	Nitrogen Oxide (NO_x)
1990	3.03	23.08	2.30
1995	2.12	14.96	1.64
2010	1.62	10.50	1.34

4. As a stringent test of IPLAN, throughout the projection period there will be no significant changes relative to the base in the availability of public transit, the propensity to use public transit, and the level of usage of high-occupancy vehicles. The AVO implementation measures taken in response to the federal Clean Air Act are projected to reduce only marginally—by 2 percent—growth in the volume of traffic, which is expressed in terms of vehicle-miles traveled (VMTs). The changes in the volume of traffic in subsequent locations, therefore, will be not so much a result of changes in travel behavior, but rather a direct consequence of changes in the types and amounts of land use and intensity of activities in these locations.

   Projections of total lane-miles of State highway in the various regions of the State in the years 1995 and 2010 under TREND and under IPLAN conditions are presented in Exhibit 2. Together with the population projections contained in Exhibit 1, they provide the basis for the projection of vehicle-miles traveled (VMTs) under the two development scenarios. Projections of VMTs are presented in Exhibit 3.

TREND FINDINGS

The major finding is that under both scenarios for future growth—TREND and IPLAN—there will be more of a decrease in air pollution from the general population related to conditions that they are experiencing than there will be from an increase in air pollution attributable to the incremental population over that period. There will be a net decrease in air pollution levels over the time period.

Under TREND, the amounts of air pollutants emitted by automobiles will decline between 1990 and 1995, and will decrease even more between 1990 and 2010.

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2 The emission factors are drawn from U.S. Environmental Protection Agency, *Supplement A to Compilation of Air Pollutant Emission Factors, Volume II: Mobile Sources*, AP-42, Washington, D.C., January 1991. Information received from Jeff Alson, Motor Vehicle Emission Laboratory, U.S. Environmental Protection Agency, Ann Arbor, Michigan was critical in this analysis.

EXHIBIT 2
PROJECTIONS OF LANE-MILES OF STATE HIGHWAY
TREND CONDITIONS

STATE/ COUNTY	1990 Current Lane-Miles	1995 Projected Lane-miles	2010 Projected Lane-miles	1990-1995 Change in Lane-miles	1990-2010 Change in Lane-miles
NEW JERSEY	8,951	8,977	9,110	26	159
Northeast	1,046	1,046	1,048	0	2
Northwest	1,666	1,673	1,693	7	27
West Central	1,674	1,679	1,725	5	52
East Central	1,355	1,356	1,370	1	15
Southwest	1,984	1,990	2,024	6	39
South-Southwest	1,227	1,232	1,252	6	25

IPLAN CONDITIONS

STATE/ COUNTY	1990 Current Lane-Miles	1995 Projected Lane-miles	2010 Projected Lane-miles	1990-1995 Change in Lane-Miles	1990-2010 Change in Lane-Miles
NEW JERSEY	8,951	8,971	9,083	21	132
Northeast	1,046	1,046	1,049	1	4
Northwest	1,666	1,671	1,684	5	18
West Central	1,674	1,679	1,718	5	44
East Central	1,355	1,356	1,370	1	15
Southwest	1,984	1,989	2,018	5	34
South-Southwest	1,227	1,230	1,244	4	18

Source: CUPR Road Model, 1992.

EXHIBIT 3
PROJECTIONS OF VEHICLE-MILES TRAVELLED
TREND CONDITIONS

STATE/ COUNTY	1990 VMT	1995 VMT	2010 VMT	1990-1995 Change in VMT	1990-2010 Change in VMT
NEW JERSEY	58,792,727,780	59,195,916,015	62,303,883,277	403,188,235	3,511,155,497
Northeast	12,041,069,396	12,002,446,144	12,230,715,476	-38,623,251	189,646,080
Northwest	13,182,420,936	13,022,311,479	12,873,955,065	-160,109,457	-308,465,872
West Central	8,949,660,068	9,074,493,866	10,083,249,783	124,833,798	1,133,589,715
East Central	8,599,360,290	8,853,843,341	9,613,790,012	254,483,051	1,014,429,722
Southwest	11,925,932,891	12,059,767,368	12,918,169,952	133,834,477	992,237,061
South-Southwest	4,094,284,199	4,183,053,817	4,584,002,989	88,769,618	489,718,790

IPLAN CONDITIONS

STATE/ COUNTY	1990 VMT	1995 VMT	2010 VMT	1990-1995 Change in VMT	1990-2010 Change in VMT
NEW JERSEY	58,792,727,780	59,180,501,623	62,224,331,030	387,773,843	3,431,603,250
Northeast	12,041,069,396	12,003,847,017	12,235,488,607	-37,222,379	194,419,211
Northwest	13,182,420,936	13,014,132,046	12,847,954,371	-168,288,891	-334,466,565
West Central	8,949,660,068	9,074,446,817	10,061,486,219	124,786,749	1,111,826,151
East Central	8,599,360,290	8,853,896,965	9,613,734,283	254,536,675	1,014,373,993
Southwest	11,925,932,891	12,057,023,482	12,902,847,971	131,090,591	976,915,080
South-Southwest	4,094,284,199	4,177,155,297	4,562,819,578	82,871,098	468,535,379

Source: CUPR Road Model, 1992.

Exhibits 4, 5, and 6 present the projections of transportation-based emissions of, respectively, non-methane hydrocarbons (NMHC), carbon monoxide (CO), and nitrogen oxides (NO_X) in 1995 and 2010 under TREND conditions.

Statewide Findings

Between 1990 and 2010, statewide reductions in transportation-based air pollution projected under TREND are 77,210 metric tons of NMHC, 702,745 metric tons of CO, and 51,736 metric tons of NO_X. These amounts represent, respectively, 43.3 percent, 51.8 percent, and 38.3 percent of the quantities emitted in 1990.

Thus, under TREND, the largest reduction in emission, in both absolute and relative terms, is projected for carbon monoxide. The other reductions are nonetheless significant.

Findings by Region

The Northwest region will experience the largest reductions of transportation-based NMHC, CO, and NO_X: 19,087 metric tons, 169,074 metric tons, and 13,068 metric tons, respectively, in the 1990-2010 period. In percentage terms, these amounts represent also the largest reductions over time among the six regions in the State: 47.8 percent, 55.6 percent, and 43.1 percent, respectively, of the amounts emitted in 1990.

In absolute terms, the South-Southwest region will experience the smallest reductions in transportation-based emission: 4,980 metric tons of NMHC, 46,364 metric tons of CO, and 3,274 metric tons of NO_X. However, in relative terms, the reductions are smallest in the West Central region.

IPLAN FINDINGS

Under IPLAN, the amounts of air pollutants emitted by automobiles will also decline between 1990 and 1995, and will decrease even more between 1990 and 2010. Exhibits 4, 5, and 6 contain the projections of transportation-based emissions of NMHC, CO and NO_X in 1995 and 2010 under IPLAN conditions.

Statewide Findings

Between 1990 and 2010, statewide reductions in NMHC, CO, and NO_X projected under IPLAN are, respectively, 77,339 metric tons (or 43.4 percent), 703,581 metric tons (or 51.9 percent), and 51,843 metric tons (or 38.3 percent). In other words, under IPLAN, the reductions are about the same as they are under TREND.

EXHIBIT 4
EMISSION OF TRANSPORTATION-BASED NON-METHANE HYDROCARBONS (NMHC)
TREND CONDITIONS

STATE/ COUNTY	1990 Estimate (in metric tons)	1995 Projection NMHC	2010 Projection NMHC	1990-1995 Change NMHC	1990-2010 Change NMHC	1990-1995 Change (percent)	1990-2010 Change (percent)
NEW JERSEY	178,142	125,495	100,932	-52,647	-77,210	-29.55	-43.34
Northeast	36,484	25,445	19,814	-11,039	-16,671	-30.26	-45.69
Northwest	39,943	27,607	20,856	-12,335	-19,087	-30.88	-47.79
West Central	27,117	19,238	16,335	-7,880	-10,783	-29.06	-39.76
East Central	26,056	18,770	15,574	-7,286	-10,482	-27.96	-40.23
Southwest	36,136	25,567	20,927	-10,569	-15,208	-29.25	-42.09
South-Southwest	12,406	8,868	7,426	-3,538	-4,980	-28.52	-40.14

IPLAN CONDITIONS

STATE/ COUNTY	1990 Estimate (in metric tons)	1995 Projection NMHC	2010 Projection NMHC	1990-1995 Change NMHC	1990-2010 Change NMHC	1990-1995 Change (percent)	1990-2010 Change (percent)
NEW JERSEY	178,142	125,463	100,803	-52,679	-77,339	-29.57	-43.41
Northeast	36,484	25,448	19,821	-11,036	-16,663	-30.25	-45.67
Northwest	39,943	27,590	20,814	-12,353	-19,129	-30.93	-47.89
West Central	27,117	19,238	16,300	-7,880	-10,818	-29.06	-39.89
East Central	26,056	18,770	15,574	-7,286	-10,482	-27.96	-40.23
Southwest	36,136	25,561	20,903	-10,575	-15,233	-29.26	-42.16
South-Southwest	12,406	8,856	7,392	-3,550	-5,014	-28.62	-40.42

Source: CUPR Air Pollution Model, 1992.

EXHIBIT 5
EMISSION OF TRANSPORTATION-BASED CARBON MONOXIDE (CO)
TREND CONDITIONS

STATE/ COUNTY	1990 Estimate (in metric tons)	1995 Projection CO	2010 Projection CO	1990-1995 Change CO	1990-2010 Change CO	1990-1995 Change (percent)	1990-2010 Change (percent)
NEW JERSEY	1,356,936	885,571	654,191	-471,365	-702,745	-34.74	-51.79
Northeast	277,908	179,557	128,423	-98,351	-149,485	-35.39	-53.79
Northwest	304,250	194,814	135,177	-109,436	-169,074	-35.97	-55.57
West Central	206,558	135,754	105,874	-70,804	-100,684	-34.28	-48.74
East Central	198,473	132,453	100,945	-66,020	-97,528	-33.26	-49.14
Southwest	275,251	180,414	135,641	-94,836	-139,610	-34.45	-50.72
South-Southwest	94,496	62,578	48,132	-31,918	-46,364	-33.78	-49.06

IPLAN CONDITIONS

STATE/ COUNTY	1990 Estimate (in metric tons)	1995 Projection CO	2010 Projection CO	1990-1995 Change CO	1990-2010 Change CO	1990-1995 Change (percent)	1990-2010 Change (percent)
NEW JERSEY	1,356,936	885,340	653,355	-471,596	-703,581	-34.75	-51.85
Northeast	277,908	179,578	128,473	-98,330	-149,435	-35.38	-53.77
Northwest	304,250	194,691	134,904	-109,559	-169,347	-36.01	-55.66
West Central	206,558	135,754	105,646	-70,804	-100,913	-34.28	-48.85
East Central	198,473	132,454	100,944	-66,019	-97,529	-33.26	-49.14
Southwest	275,251	180,373	135,480	-94,877	-139,771	-34.47	-50.78
South-Southwest	94,496	62,490	47,910	-32,006	-46,586	-33.87	-49.30

Source: CUPR Air Pollution Model, 1992.

EXHIBIT 6
EMISSION OF TRANSPORTATION-BASED NITROGEN OXIDES (NOx)
TREND CONDITIONS

STATE/ COUNTY	1990 Estimate (in metric tons)	1995 Projection NOx	2010 Projection NOx	1990-1995 Change NOx	1990-2010 Change NOx	1990-1995 Change (percent)	1990-2010 Change (percent)
NEW JERSEY	135,223	97,081	83,487	-38,142	-51,736	-28.21	-38.26
Northeast	27,694	19,684	16,389	-8,010	-11,305	-28.92	-40.82
Northwest	30,320	21,357	17,251	-8,963	-13,068	-29.56	-43.10
West Central	20,584	14,882	13,512	-5,702	-7,073	-27.70	-34.36
East Central	19,779	14,520	12,882	-5,258	-6,896	-26.59	-34.87
Southwest	27,430	19,778	17,310	-7,652	-10,119	-27.90	-36.89
South-Southwest	9,417	6,860	6,143	-2,557	-3,274	-27.15	-34.77

IPLAN CONDITIONS

STATE/ COUNTY	1990 Estimate (in metric tons)	1995 Projection NOx	2010 Projection NOx	1990-1995 Change NOx	1990-2010 Change NOx	1990-1995 Change (percent)	1990-2010 Change (percent)
NEW JERSEY	135,223	97,056	83,381	-38,167	-51,843	-28.23	-38.34
Northeast	27,694	19,686	16,396	-8,008	-11,299	-28.92	-40.80
Northwest	30,320	21,343	17,216	-8,976	-13,103	-29.61	-43.22
West Central	20,584	14,882	13,482	-5,702	-7,102	-27.70	-34.50
East Central	19,779	14,520	12,882	-5,258	-6,896	-26.59	-34.87
Southwest	27,430	19,774	17,290	-7,656	-10,140	-27.91	-36.97
South-Southwest	9,417	6,851	6,114	-2,566	-3,303	-27.25	-35.07

Source: CUPR Air Pollution Model, 1992.

Findings by Region

IPLAN also projects the largest absolute reductions of NMHC, CO, and NO_X for the Northwest region: 19,129 metric tons, 169,347 metric tons, and 13,103 metric tons, respectively, in the 1990-2010 period. In percentage or relative terms, these amounts represent the largest reductions among the six regions in the State: 47.9 percent, 55.7 percent, and 43.2 percent, respectively, of the amounts emitted in 1990.

In absolute terms, the South-Southwest region will experience the smallest reductions in all three air pollutants: 5,014 metric tons of NMHC, 46,586 metric tons of CO, and 3,303 metric tons of NO_X, respectively. However, the West Central and South-region has the lowest percent reductions in the emission of all three pollutants in the 1990-2010 period.

COMPARISON OF TREND AND IPLAN

TREND VERSUS IPLAN

1. In both development scenarios, substantial reductions are projected for all three major transportation-based air pollutants and for all regions of the State.Statewide, projected reductions in emission in the 1990-2010 period range from 38.3 percent (for NO_X) to 51.9 percent (for CO). No region will experience an increase in emission under either development scenario or projection period. The lowest levels of reduction projected at the regional level are for the East Central and West Central regions of the State, as well as the South-Southwest region. The highest levels of reduction are in the Northeast and Northwest regions. The Southwest region in overall air pollution reductions parallels very closely the central and extreme southern portion of the State.

2. For New Jersey as a whole, the reduction in transportation-based air pollution under IPLAN will be only slightly greater than under TREND. The differential effects of IPLAN are dwarfed by the aforementioned general changes taking place under TREND conditions. Exhibits 7, 8, and 9 present statistics comparing the ameliorative impacts of TREND and IPLAN on transportation-based emissions of, respectively, NMHC, CO, and NO_X. While transportation-based air pollution in the 1990-2010 period will be reduced under both development scenarios, implementation of IPLAN means that an additional 129 metric tons of NMHC, 835 metric tons of CO, and 107 metric tons of NO_X will be removed from the air in the State, beyond the reductions that are expected to occur if present development patterns are allowed to continue. These amounts represent, respectively, 0.17 percent, 0.12

EXHIBIT 7

COMPARISON OF TREND AND IPLAN REDUCTION IN TRANSPORTATION-BASED EMISSION OF NON-METHANE HYDROCARBONS (NMHC)

STATE/ COUNTY	Additional Reduction due to IPLAN (in metric tons)		Additional Reduction due to IPLAN (as percent of reduction under TREND)	
	1990-1995	1990-2010	1990-1995	1990-2010
NEW JERSEY	-33	-129	0.06	0.17
Northeast	3	8	-0.03	-0.05
Northwest	-17	-42	0.14	0.22
West Central	0	-35	0.00	0.33
East Central	0	0	0.00	0.00
Southwest	-6	-25	0.06	0.16
South-Southwest	-13	-34	0.35	0.69

Source: CUPR Air Pollution Model, 1992.

EXHIBIT 8

COMPARISON OF TREND AND IPLAN REDUCTION IN TRANSPORTATION-BASED EMISSION OF CARBON MONOXIDE

STATE/ COUNTY	Additional Reduction due to IPLAN (in metric tons)		Additional Reduction due to IPLAN (as percent of reduction under TREND)	
	1990-1995	1990-2010	1990-1995	1990-2010
NEW JERSEY	-231	-835	0.05	0.12
Northeast	21	50	-0.02	-0.03
Northwest	-122	-273	0.11	0.16
West Central	-1	-229	0.00	0.23
East Central	1	-1	0.00	0.00
Southwest	-41	-161	0.04	0.12
South-Southwest	-88	-222	0.28	0.48

Source: CUPR Air Pollution Model, 1992.

EXHIBIT 9

COMPARISON OF TREND AND IPLAN REDUCTION IN TRANSPORTATION-BASED EMISSION OF NITROGEN OXIDES (NOx)

STATE/ COUNTY	Additional Reduction due to IPLAN (in metric tons) 1990-1995	Additional Reduction due to IPLAN (in metric tons) 1990-2010	Additional Reduction due to IPLAN (as percent of reduction under TREND) 1990-1995	Additional Reduction due to IPLAN (as percent of reduction under TREND) 1990-2010
NEW JERSEY	-25	-107	0.07	0.21
Northeast	2	6	-0.03	-0.06
Northwest	-13	-35	0.15	0.27
West Central	0	-29	0.00	0.41
East Central	0	0	0.00	0.00
Southwest	-4	-21	0.06	0.20
South-Southwest	-10	-28	0.38	0.87

Source: CUPR Air Pollution Model, 1992.

percent, and 0.21 percent of the reductions projected statewide under TREND in the 1990-2010 period.

3. Four out of six regions will experience greater reduction in transportation-based air pollution under IPLAN than under TREND. The Northwest, West Central, Southwest and South-Southwest regions will benefit under IPLAN. The Northwest is projected to gain the most; further reductions in NMHC (42 metric tons), CO (273 metric tons), and NO_X (35 metric tons) are projected for this region under IPLAN, beyond the reductions experienced in 2010 under TREND conditions.
4. Two regions will experience less reduction in transportation-based air pollution under IPLAN than under TREND. In the 1990-2010 period, the Northeast and East Central regions are projected to benefit from IPLAN to a lesser extent than from TREND. The Northeast region, in particular, will benefit the least from the ameliorative impacts of IPLAN. Reductions in transportation-based air pollutants under IPLAN in the region will be lower than under TREND by 8 metric tons of NMHC, 50 metric tons of CO, and 6 metric tons of NO_X.

IMPLICATIONS OF FINDINGS

The projected reduction in transportation-based air pollution is due mainly to the use of less-polluting automobiles. This has a much greater effect than land-use induced measures affecting only the growth increment in the population. Under TREND as well as IPLAN, the volume of traffic—expressed in vehicle miles traveled (VMT)—is projected to decrease between 1990 and 2010 in only one region—the Northwest. Yet, under both development scenarios, transportation-based air pollution is projected to fall in all regions in the State. Thus, the projected reductions are due much more to the decrease over time in the EPA emission factors than to any change in land-use patterns.

Between 1990 and 2010, the amount of carbon monoxide emitted by a car traveling one mile is projected to fall from 23.08 grams to 10.50 grams. For NMHC and NOx, the projected decreases are, respectively, from 3.03 to 1.62 grams, and from 2.30 to 1.34 grams. These projected decreases reflect the expectations that automobiles in the future will be progressively less polluting than those currently on the road (U.S. Environmental Protection Agency, 1991).

If the volume of traffic is reduced, or its growth slowed down, greater reductions in emission can be expected. The implementation of employer-employee measures (such as mandatory employer trip reduction, reserved carpool/vanpool spaces, and telecommuting) and transit and travel demand measures (for example, capital improvement in public transportation, high-occupancy vehicles [HOV], summer rail, summer rail HOV and toll bypass, midday shuttles, suburban bus and rail), and pricing measures (such as gas tax increase, toll and parking fee increases, urban parking tax, transit fare reduction, and federal transit benefit increase) may augment the basic trends in air pollution fostered by tighter emissions controls.[3] Even so, they would pale in comparison to the emission achievements.

The increment of transportation-based air pollution follows growth. There may be some larger differences observable at the subregional level. This is related to which subregions will grow or decline. At the regional level, the differences between TREND and IPLAN with respect to impacts on transportation-based air pollution are basically insignificant. This is because, as indicated in Exhibits 1 and 2, TREND and IPLAN projections for population and lane-miles are essentially the same at the regional level. However, the situation may be different at the subregional level. Greater reductions in transportation-based air pollution can be expected under IPLAN than under TREND among areas projected to decline; lesser reductions are expected in those areas projected to grow. The average regional increment is only one-quarter of one percent compared to the changes taking place in the overall population. Even if local effects were ten times this level, at 2.5 percent, the differential effects of land-use patterns would be relatively small.

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3 These measures are discussed in the Final Report of the Regional Plan Association Project: CLEAN AIR (RPA, October 1991).

PART IV B

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IMPACTS ON WATER POLLUTION

ENVIRONMENTAL ASSESSMENT: PART IVB — IMPACTS ON WATER POLLUTION

BACKGROUND

The Water Pollution Model is used to determine the differences in the impacts that new residential and nonresidential development under TREND and IPLAN will have on the quality of stormwater runoff in the various counties[1] of New Jersey. This undertaking is a component of the environmental assessment of the Interim State Plan.

The Water Pollution Model uses output of the Land Capacity Model. Its own output is used in the overall ranking of alternative development scenarios.

CONCEPTS

How The Model Works

The Water Pollution Model involves the following steps:

- Project the acreages of new residential and nonresidential development by type and density of development and by degree of imperviousness.
- Determine the proportions of the various hydrologic soil groups in the county.
- Determine the hydrologic soil groups of the new land uses.
- Assess the quality of the stormwater runoff from the new land uses, where quality is affected by land use and soil group, and measured in terms of loadings for biochemical oxygen demand, total nitrogen, total phosphorus, zinc, and lead in the stormwater runoff from the land use.
- Compare the amounts of water pollutants generated by new development under TREND with those generated by new development under IPLAN.

Basic Model Inputs and Outputs

The basic inputs for the Water Pollution Model are:

- Number of new housing units and new employment by type under IPLAN and TREND
- Density and imperviousness levels by type and location of new residential and nonresidential development
- Percent distribution of hydrologic soil groups in a county

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1 Soil composition information is at the county level. Development takes place at the municipal level. Development at the municipal level is aggregated to the county level to enable use of the soil composition information.

- Loadings rates (for biochemical oxygen demand, total nitrogen, total phosphorus, zinc, and lead) of the stormwater runoff from the various land use-soil group combinations

The basic outputs of the Water Pollution Model are:

- the pollutant loadings of the new development under TREND and IPLAN
- the differences between TREND and IPLAN with respect to pollutant loadings

EXPECTED DIFFERENCES BETWEEN TREND AND IPLAN

It is anticipated that:

- The more compact and higher-density pattern of development favored by IPLAN will consume much less land than under TREND, although such land will pollute more per acre. The net result, however, is that new development under IPLAN will cause less water pollution than new development under TREND.
- At an individual county level, the stormwater runoff from an area that is designated as a growth area under IPLAN may be more polluted under IPLAN than under TREND.

The Model investigates the first possibility by comparing the statewide total pollutant loadings under TREND and IPLAN, while the second possibility is verified by examining the differences in loadings between TREND and IPLAN in areas that are designated growth areas.

CRITICAL ASSUMPTIONS AND PARAMETERS

FOR BOTH DEVELOPMENT SCENARIOS

1. The Water Pollution Model does not take into account the impact of best management practices (BMPs)—which include land-use management practices and pollution abatement management practices—on the amounts of water pollutants that will be generated under TREND and IPLAN. The amounts projected by the Model represent the uncontrolled nonpoint-source pollution that will be generated by new development in the absence of BMPs.

   Both development scenarios are expected to encourage BMPs. Thus, if IPLAN and TREND differ with respect to water pollution from new development, such differences are not caused by the extent to which BMPs are encouraged in one scenario but disregarded in the other. They reflect differences in the two scenarios with respect to the amount, type, and location of new development.

2. The amounts of pollutants in stormwater runoff from a land use are determined by the type of land use, which takes into account the level of density and imperviousness, and the hydrologic characteristics of the soil on which the land use is sited. The Water Pollution Model uses loading rates that have been estimated in a comprehensive non-point sampling and modeling study performed by the Northern Virginia Planning District Commission, and adopted by the New Jersey Department of Environmental Protection. These loading rates are presented in Exhibit 1, which indicates that the higher the density of the land use and the greater the degree of imperviousness, the higher the pollutant loading of the stormwater runoff will be. In addition, of the four hydrologic soil groups (A, B, C, and D)[2], group A has the lowest loading for any land use and type of water pollutant.

3. How much land belonging to a particular hydrologic soil group will be taken up for new development in a county depends on how much land of that soil group there is in the county. In the absence of data, it is not possible to determine the soil group and acreage of the land in a county that is available for a particular type of development or redevelopment. It is, therefore, not possible to determine the soil group of the various new land uses that are projected for a county under TREND and IPLAN.

   The Water Pollution Model allocates a new land use to a particular soil group in a county in proportion to the percentage share of this soil group in the acreage of land available for development or redevelopment. For example, if 100 acres will be taken up by new single-family development in a county where 25 percent of the acreage is Soil Group A, then 25 acres of the new residential development in the county will be sited on Soil Group A.

4. The pollutants from roadway stormwater runoff reflects the characteristics of the land use traversed by or adjacent to the roadway. In the Water Pollution Model, the amount of land taken up by a new land use includes the amount set aside for roadways that will serve the mobility and utility purposes of those who will live or work in the development. In this manner, the model takes into account the additional impacts of roadways on water pollution. The "platting coefficient" or overage of land

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2 Groups A, B, C, and D correspond to sandy loam, loam, silt loam, and clay loam, respectively.

consumption is 5 percent in an urban setting, 10 percent in a suburban area, and 25 percent in a rural setting.

5. The amount of land consumed by new development in a community reflects the density that will prevail in that community. Communities in New Jersey are classified into urban, suburban, and rural in descending order of development density. It follows from Assumption 4 that new development—for example, new single-family detached housing in an urban community—is likely to have higher density than a new single-family detached housing development in a suburban community.

   In the Water Pollution Model, the amount of land consumed by a new land use is computed on the basis of the residential density that will prevail in the local community and may differ between TREND and IPLAN. The Model assigns to each new land use the loading rate that reflects the density of the community in which the land use is developed. Thus, a new land use in an urban community is assigned the loading rates for the most densely developed (which is also the most impervious) variation of that land use. Exhibit 1 shows, for example, that the BOD loading rates for single-family detached housing in an urban area used in the Model are 25 lbs./acre/year on soil group A (sandy loam), and 32 lbs./acre/year on soil groups B, C, and D (loam, silt loam, and clay loam, respectively).

6. Negative projections for new development imply that current land uses will be either rendered inactive or demolished and the land left idle. The inactive half will continue to pollute at the loading rates of the current land uses while the idled half will pollute at the rates applicable to idle land. Since loading rates for idle land are lower than those of other land uses for all types of pollutants and on all soil groups, a negative projection for new development implies a reduction in water pollution on half of the projected acreage. Such a reduction is equivalent to half of the acreage projected times the difference between the loading rates of current land uses and the rates for the new land use, i.e., idle land.

7. In Essex and Hudson counties, new development is expected to have the highest density and degree of imperviousness applicable to a land use. Essex and Hudson, which lack soil surveys, are two very densely developed counties. New development in these counties are assigned the "urban" loading rates, whether or not the municipalities where such development will take place are designated as urban.[3] In

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[3] Communication with Ralph Lund, New Jersey Assistant State Soil Scientist.

EXHIBIT 1

UNCONTROLLED NONPOINT POLLUTION LOADING RATES FOR URBAN LAND USES
(lbs./acre/year)

	LAND USE	BOD	TP	TN	Zn	Pb
SOIL GROUP A	Single-Family Detached	25	1.1	9.7	0.38	0.48
	Single-Family Attached	25	1.1	9.7	0.38	0.48
	2 to 4 Units	32	1.5	10.8	0.44	0.79
	5 Units or more	137	1.4	11.6	0.69	1.72
	Industrial	145	1.4	12.2	1.83	2.29
	Retail	163	1.6	13.2	2.06	2.58
	Office	206	2.7	24.6	2.71	5.42
SOIL GROUPS B, C AND D	Single-Family Detached	32	1.3	10.4	0.42	0.54
	Single-Family Attached	32	1.3	10.4	0.42	0.54
	2 to 4 Units	41	1.6	12.4	0.53	0.93
	5 Units or more	138	1.4	11.6	0.88	1.74
	Industrial	146	1.5	12.2	1.84	2.31
	Retail	163	1.6	13.2	2.06	2.58
	Office	206	2.7	24.6	2.71	5.42

EXHIBIT 1 (CONTINUED)

UNCONTROLLED NONPOINT POLLUTION LOADING RATES FOR SUBURBAN LAND USES
(lbs./acre/year)

	LAND USE	BOD	TP	TN	Zn	Pb
SOIL GROUP A	Single-Family Detached	17	0.7	6.7	0.21	0.24
	Single-Family Attached	17	0.7	6.7	0.21	0.24
	2 to 4 Units	32	1.5	10.8	0.44	0.79
	5 Units or more	36	1.7	12.5	0.55	0.97
	Industrial	111	1.2	10.1	1.38	1.73
	Retail	163	1.6	13.2	2.06	2.58
	Office	206	1.6	13.2	2.06	2.58
SOIL GROUPS B,C AND D	Single-Family Detached	25	0.9	7.5	0.26	0.25
	Single-Family Attached	25	0.9	7.5	0.26	0.25
	2 to 4 Units	41	1.6	12.4	0.53	0.93
	5 Units or more	43	1.8	13.9	0.62	1.08
	Industrial	113	1.2	10.1	1.40	1.77
	Retail	163	1.6	13.2	2.06	2.58
	Office	206	2.7	24.6	2.71	5.42

EXHIBIT 1 (CONTINUED)

UNCONTROLLED NONPOINT POLLUTION LOADING RATES FOR RURAL LAND USES
(lbs./acre/year)

	LAND USE	BOD	TP	TN	Zn	Pb
SOIL GROUP A	Single-Family Detached	13	0.5	5.1	0.11	0.12
	Single-Family Attached	13	0.5	5.1	0.11	0.12
	2 to 4 Units	26	1.2	9.9	0.39	0.70
	5 Units or more	36	1.7	12.5	0.55	0.97
	Industrial	111	1.2	10.1	1.38	1.73
	Retail	163	1.6	13.2	2.06	2.58
	Office	206	2.7	24.6	2.71	5.42
SOIL GROUPS B,C AND D	Single-Family Detached	22	0.8	6.1	0.17	0.14
	Single-Family Attached	22	0.8	6.1	0.17	0.14
	2 to 4 Units	40	1.5	11.7	0.48	0.85
	5 Units or more	43	1.8	13.9	0.62	1.08
	Industrial	113	1.2	10.1	1.40	1.77
	Retail	163	1.6	13.2	2.06	2.58
	Office	206	2.7	24.6	2.71	5.42

Source: Regional Resources Division, Northern Virginia Planning District Commission, *Guidebook for Screening Urban Nonpoint Pollution Management Strategies* (prepared for the Metropolitan Washington Council of Governments, November 1979.

addition, the loading rates selected are for development on soil groups B, C, and D, which generally are higher than those of soil group A.

TREND FINDINGS

Statewide, new development that occurs between 1990 and 2010 under TREND will generate 12,201 tons of BOD, 177 tons of total phosphorus, 2,469 tons of total nitrogen, 132 tons of zinc, and 184 tons of lead a year in 2010. Thus, most of the water pollutants generated by new development will be in the form of organic matters and plant nutrients.

Of the six regions in the State, the West Central region will receive the largest amounts of all type pollutants from new development in the region: 3,288 tons of bio-chemical oxygen demand (BOD), 39 tons of total phosphorus, 635 tons of total nitrogen, 35 tons of zinc, and 50 tons of lead. The amounts generated in the Northwest Region will be the lowest in the State. TREND outputs are presented in Exhibit 2.

IPLAN FINDINGS

Under IPLAN, new development will produce 8,818 tons of BOD, 100 tons of total phosphorus, 1,417 tons of total nitrogen, 103 tons of zinc, and 165 tons of lead a year in 2010. Organic matter and plant nutrients will figure most prominently in the water pollutants from new development under IPLAN, a situation comparable to TREND.

The West Central Region is also projected to receive the largest amounts of pollutants under IPLAN: 2,557 tons of BOD, 22 tons of total phosphorus, 389 tons of total nitrogen, 31 tons of zinc, and 51 tons of lead. Again, the Northwest Region will have the smallest amounts of pollutants from new development in the region. IPLAN outputs are presented in Exhibit 2.

COMPARISON OF TREND AND IPLAN

1. Water pollution from new development will be much lower under IPLAN than under TREND for all categories of pollutants. Exhibit 3 shows that IPLAN development scenario will lead to a pollution level that is much lower than what can be expected from new development under current conditions. Pollution from new development under TREND conditions is projected to exceed the development-related pollution under IPLAN by 3,382 tons of BOD, 77 tons of total phosphorus, 1,052 tons of total nitrogen, 29 tons of zinc, and 19 tons of lead.

EXHIBIT 2
PROJECTIONS OF NONPOINT SOURCE POLLUTION
(in tons)
TREND CONDITIONS

	1995					2010				
STATE/REGION	BOD	TP	TN	ZN	PB	BOD	TP	TN	ZN	PB
NEW JERSEY	1,359	36	408	25	32	12,201	177	2,469	132	184
Northeast	95	2	41	2	4	1,551	15	254	20	35
Northwest	77	3	30	1	-1	980	17	265	8	7
West Central	327	7	63	7	10	3,288	39	635	36	52
East Central	276	8	64	4	5	1,609	30	342	17	22
Southwest	398	10	163	7	10	3,198	48	589	35	50
South-Southwest	187	6	47	3	4	1,575	28	384	16	18

IPLAN CONDITIONS

	1995					2010				
STATE/REGION	BOD	TP	TN	ZN	PB	BOD	TP	TN	ZN	PB
NEW JERSEY	922	19	195	18	28	8,818	100	1,417	103	165
Northeast	68	1	10	2	3	1,333	11	183	17	32
Northwest	17	1	13	0	-1	514	8	127	5	5
West Central	241	4	34	6	9	2,557	22	389	31	51
East Central	200	5	40	3	4	1,180	19	218	13	19
Southwest	312	6	83	6	9	2,537	31	371	30	48
South-Southwest	84	2	16	2	3	697	10	128	8	10

Source: CUPR Water Pollution Model, 1992.

EXHIBIT 3
CHANGES IN POLLUTANT LOADINGS 1990-2010
AS A RESULT OF IPLAN IMPLEMENTATION
(in tons)

STATE/	1990-1995					1990-2010				
COUNTY	BOD	TP	TN	ZN	PB	BOD	TP	TN	ZN	PB
NEW JERSEY	-437	-17	-213	-7	-5	-3,382	-77	-1,052	-29	-19
Northeast	-27	-1	-31	-1	-1	-218	-5	-71	-3	-3
Northwest	-60	-2	-18	-1	0	-465	-9	-138	-4	-2
West Central	-86	-4	-29	-1	-1	-731	-17	-246	-6	-2
East Central	-76	-3	-24	-1	-1	-429	-11	-124	-4	-3
Southwest	-86	-4	-80	-1	-1	-661	-17	-218	-5	-2
South-Southwest	-103	-4	-32	-2	-2	-878	-18	-256	-8	-8

Source: CUPR Water Pollution Model, 1992.

2. The meliorative impact of IPLAN on water pollution is significant. One indicator of the improvement in water quality that IPLAN may bring about is the difference between TREND-generated pollution and IPLAN-generated pollution expressed as a percent of the amount generated under TREND conditions. Exhibit 4 shows that the reductions in water pollution brought about by IPLAN range from ten percent (for lead) to over 40 percent (for total phosphorus and total nitrogen) of the amounts projected for new development under TREND.

3. The West Central Region, followed by the Southwest Region, will benefit the most from the meliorative impacts of IPLAN. In absolute terms, the differential impacts of IPLAN on water quality will be most noticeable in the West Central and Southwest regions. Exhibit 3 shows that these two regions together account for nearly half of the improvement in water quality that IPLAN will bring about. However, in percentage terms, the most profound impact of IPLAN on water quality will be felt in the South-Southwest region where the the gain in water quality will amount to between 43 and 67 percent of the amounts of pollutants generated under TREND conditions.

These findings, which highlight the meliorative effect of IPLAN on water pollution in the State, comport with intuitive feelings about the close relationship between land-use patterns and water pollution. A development scenario that encourages the conservation of open space as well as the redevelopment of existing residential and nonresidential space is likely to produce a smaller amount of new impervious space statewide, which in turn will reduce the amount of runoff and pollutants from new development.

It is also likely, however, that the channeling of people and economic activities to selected communities and areas in the State will lead to an increase in pollutant generation, hence a deterioration in the quality of stormwater runoff in these areas. However, the Water Pollution Model is not specifically designed to detect changes in water pollution at the municipal level.

EXHIBIT 4

REDUCTIONS IN NONPOINT SOURCE POLLUTION UNDER IPLAN CONDITIONS
(as a percentage of reductions under TREND)

	1995					2010				
STATE/REGION	BOD	TP	TN	ZN	PB	BOD	TP	TN	ZN	PB
NEW JERSEY	-32.2	-48.0	-52.1	-27.2	-14.0	-27.7	-43.5	-42.6	-21.9	-10.2
Northeast	-27.9	-45.4	-75.8	-25.2	-18.1	-14.1	-29.9	-27.9	-13.1	-8.0
Northwest	-77.8	-63.8	-58.3	-106.3	44.8	-47.5	-53.9	-51.9	-42.6	-22.5
West Central	-26.3	-50.8	-45.9	-19.1	-5.3	-22.2	-43.2	-38.7	-15.3	-3.0
East Central	-27.4	-37.5	-37.4	-22.8	-14.0	-26.7	-37.8	-36.2	-21.4	-12.4
Southwest	-21.6	-37.5	-48.9	-17.6	-6.6	-20.7	-35.1	-36.9	-15.3	-4.9
South-Southwest	-55.0	-69.1	-66.9	-51.8	-39.0	-55.7	-65.6	-66.7	-51.9	-43.5

Source: CUPR Water Pollution Model, 1992.