4.5 Water Quality

4.5.1 Surface Water

4.5.1.1 No-Action Alternative, Surface Water

In a No-Action Alternative, no new impervious roadway surfaces would be created. However, growth in traffic demand on existing roadways in a No-Action Alternative would result in an additional 5,954 vehicles per two-way traffic volume in the AM peak hour along the primary east-west corridors (Harrison Street, Washington Street, Alexander Road) between the D&R Canal and the Northeast Corridor rail line (Voorhees, 2002). This is a 49% increase in volume over existing conditions. These additional vehicles would deposit pollutants on the existing roadways at a proportionately higher rate than existing vehicles currently contribute. In a No-Action Alternative, existing drainage patterns and runoff flow rates, and the absence of controlling mechanisms to prevent flooding and contamination of area waterbodies would persist.

The No-Action as well as the Action Alternatives could have adverse impacts due to runoff volumes. The No-Action Alternative would perpetuate existing conditions in the sense that the existing roadway system provides few to no mechanisms to control the rate or quality of runoff. The No-Action Alternative would include no such new facilities. Existing impervious surface areas would continue to contribute untreated stormwater runoff to receiving waterbodies.

Within the 20-year horizon of this EIS, two planned development activities by others in the expanded study area may affect runoff volumes and water quality. West Windsor Township has approved Sarnoff Corporation's General Development Plan, which outlines a 3 million square foot campus. By Design Year 2028, development according to the Plan could result in an additional 1.8 million square feet of additional office/research space and associated parking (60% of the total GDP), thereby creating additional stormwater runoff in the Millstone River and Little Bear Brook drainage areas. This runoff will carry pollutants from the paved surfaces. It is likely that a stormwater management plan would be incorporated into these development plans to control the additional runoff. The nature of this stormwater plan and whether it would address water quality and/or recharge is not known.

Also within the expanded study area, Princeton University has plans to develop a portion of its property between the D&R Canal and Route 1 to expand their campus facilities in the next 20 years. Although the specifics of these plans have not yet been developed, new buildings and pavement areas are likely. As with the Sarnoff Plan, it is likely that a stormwater management plan would be incorporated into the University's development plans to control the additional runoff. However, the nature of this stormwater plan and whether it would address water quality and/or recharge is not known.

4.5.1.2 Action Alternatives, Surface Water

Surface waterbodies within the expanded study area may be impacted by an Action Alternative or the No-Action Alternative. Each of the Action Alternatives would introduce new impervious roadway surface areas, thereby increasing stormwater runoff volume within the expanded study area.

Vehicular traffic using new roadways in the expanded study area would deposit pollutants on the roadway surfaces. These pollutants would be washed off paved surfaces during storm events and could have an adverse impact on receiving waterbodies. Estimates of pollutant loading of runoff from the Action Alternatives were obtained and compared to appropriate water quality standards.

Highway-Generated Runoff

Estimates of potential pollutant loading of runoff from Action Alternatives were calculated using the FHWA's *Predictive Procedure for Determining Pollutant Characteristics of Highway Runoff – Constituents of Highway Runoff* (Kobriger, 1981). The model estimated total pollutant concentrations in the Millstone River resulting from adding pollutant concentrations from Action Alternatives to the existing pollutant concentrations in the river. Technical information regarding the use of this model, including model inputs, calculations, and results are available in the *Natural Resources Technical Environmental Study, Penns Neck Area EIS.*

To undertake this analysis, one Action Alternative from each series (A through G), was selected to represent the series. As the model is relatively sensitive to the amount of impervious cover, each representative Action Alternative was selected on the basis of having the largest amount of new impervious roadway surface in its series. As a consequence, each of the representative Action Alternatives was determined to have the potential to generate the highest level of pollutants in its series. Other alternatives in each series would have less impervious surface area, and would generate relatively less pollutants. The representative Action Alternatives are: A.1, B.2, C, D, E, F.1 and G.1.

Because construction of a new roadway would be subject to stormwater management regulations, the analysis assumes that stormwater management practices would be required to control the volume, rate and quality of stormwater runoff. Pollutant reduction factors from the Center for Watershed Protection, Section 4.5.1.3, were applied to the calculated runoff pollutant concentrations to derive a median range of potential pollutant reduction that could be expected. Highway-generated pollutant concentrations are contained in Tables 4-23 and 4-24.

Table 4-24 compares the pollutant concentrations for each representative Action Alternative with existing pollutant concentrations in the Millstone River and the New Jersey State Water Quality Standards for FW2-NT waters. On the basis of the assumptions and criteria applied to the model, the alternatives which include the

greatest increase in road-related impervious surface (e.g., those that include an east-side connector road, west-side connector roads, and/or frontage roads) have a comparatively greater potential to increase pollutant-loading from new road services. All Action Alternatives would result in post-discharge pollutant concentrations below the State Surface Water Quality Standards for most pollutants. All of the Action Alternatives, except the G-series alternatives, have the potential to result in post-discharge pollutant concentrations that exceed State Surface Water Quality Standards for total phosphorus.

Chlorides

Road salt, of which the primary component is sodium chloride (NaCl), is commonly used to melt ice and snow. Potential contamination of ground and surface waters can pose a health risk for both humans and aquatic biota. The maximum contaminant levels (MCLs) of chloride in drinking water are documented in the 1994 Surface Water Quality Standards as follows: 250,000 μg/L as the maximum concentration, 860,000 μg/L as the acute aquatic life protection level and 230,000 μg/L as the chronic aquatic life protection level. According to NJDEP[5] (1994), the MCL for chloride under the drinking water standards is 250 mg/L.

Chloride Concentration Estimates Resulting from Highway Deicing Materials

The Toler analysis for estimating chlorides was employed to determine the extent of chloride loading in adjacent waterways due to each representative Action Alternative. According to the Toler analysis, Action Alternative C would result in the greatest increase in chloride within the expanded study area. Action Alternative C would yield an annual concentration of approximately 14.44 ppm of chloride (Cl), or approximately 23.79 ppm of salt as NaCl. The Action Alternative with the least proposed chloride concentration is Action Alternative G.1, with 8.37 ppm of Cl and 13.79 ppm of salt as NaCl. As shown, VDC 3 has a higher concentration of salt than some of the Action Alternatives. This is due to input variables, such as drainage contributing to the roadway in question. VDC 3 has a large drainage area compared with other Action Alternatives. A larger drainage area would yield a higher salt concentration. Another variable that influences the amount of salt concentration is the number of lane miles for the alternative. Table 4-23 summarizes the chloride concentrations calculated for each Action Alternative.

Table 4-23
Summary of Chloride Impacts per Action Alternative

Alternative	Concentration of Cl only (ppm)	Concentration of Salt as NaCl (ppm)
A.1	8.69	14.32
B.2	9.90	16.32
C	14.44	23.79
D	12.29	20.24
E	12.49	20.57
F.1	9.64	15.89
G.1	8.37	13.79
VDC 3	9.56	15.76

Potential Secondary Water Quality Impacts

Removal of native streambank vegetation can influence the aquatic environment by raising the water temperature, thereby reducing the amount of dissolved oxygen (DO) in the water column. As DO levels decrease, pollution-tolerant fish species become established to the exclusion of other species that require higher DO levels and lower water temperatures. For the Action Alternatives involving a new crossing of Little Bear Brook, the length and width of the construction disturbance area would be confined to avoid and/or minimize the amount of vegetation clearing that would be necessary on both stream banks. All the Action Alternatives include replacing the Route 1 bridge over the Millstone River with a wider structure. Stream bank clearing in this area would also be minimized to the greatest extent practicable. Furthermore, any temporarily cleared areas would be restored with indigenous vegetation and all cleared areas would be stabilized immediately following construction in accordance with NJDOT's soil erosion and sediment control standards.

Sedimentation of the streams has the potential to alter the substrate and consequently the benthic wildlife composition. However, the use and diligent maintenance of erosion control measures during construction and the revegetation of disturbed areas would minimize the likelihood of this occurring.

Construction of either crossing would require an NJDEP Stream Encroachment Permit and necessitate implementing measures during construction and operation to protect the waterways from degradation.

Runoff Volumes

The construction of the Action Alternatives would increase impervious pavement surface, with a consequent increase in the amount of runoff. Action Alternative B.2 would result in the greatest increase in impervious surface area (27.59 acres), followed by Action Alternatives F.1 with 25.04 acres, A.1 with 24.81 acres, and B and B.1 with 24.66 acres each. Action Alternatives G, G.1, and G.2 would result in the least amount of new impervious surface area, with 3.41, 4.26, and 3.24 acres, respectively. In addition, these alternatives, except G.2, would include a VDC

Alternative; VDC 3 would have the greatest amount of impervious surface area at 5.18 acres. Impervious surfaces for the Action Alternatives are listed below:

Alternative	New Impervious Surfaces (Acres)
A	23.00
A.1	24.81
A.2	23.85
A.3	23.12
A.4	24.11
B	24.66
B.1	24.66
B.2	27.59
C	13.84
C.1	11.38
D	22.66
D.1	22.33
D.2	23.12
E	20.28
F	23.01
F.1	25.04
G	3.41
G.1	4.26
G.2	3.24
VDC 1	4.35
VDC 2	5.09
VDC 3	5.18

In contrast to the No-Action Alternative, however, the Action Alternatives would be under a regulatory mandate via an NJDEP Stream Encroachment Permit to be designed with an integrated stormwater management system to control runoff rates, as well as protect or enhance water quality. The contemplated modifications to existing roadways, such as Route 1, are opportunities to introduce stormwater management systems where none currently exist. Consequently, the Action Alternatives could address both on-going stormwater concerns as well as potential new concerns. In particular, stormwater management facilities would be designed and operated according to NJDEP's requirements to provide appropriate water quality management specific to the Action Alternative, if one is selected.

Proximity Issues And Stream Corridor Buffer Guidelines

In order to provide context regarding potential water quality impacts related to the proximity of the alternatives to existing water bodies, information related to stream corridor buffering was reviewed and is summarized in this section. The two principal sources of this information were: *The Architecture of Urban Stream Buffers, Article 39*, published by the Center for Watershed Protection; and the *Revised Manual for New Jersey: Best Management Practices for Control of Non-point Source Pollution from Stormwater*, published by NJDEP, May 3, 2000. The stream corridor buffer

guidelines presented in these two sources is central to Component 1 of the water quality impact assessment approach.

Both sources present consistent information. They describe the importance of stream corridor buffers and the important role buffer areas play in reducing impacts from stormwater runoff in developed/developing areas. The Center for Watershed Protection's Article 39 notes that "two major goals of a stream buffer network are to maintain an unbroken corridor of riparian forest and maintain the upstream and downstream passage of fish in the stream channel." However, it also notes that "from a practical standpoint, it is not always possible to meet both goals everywhere along the stream buffer network." The article acknowledges that "some provision must be made for linear forms of development that must cross the stream or the buffer, such as roads, (and) bridges..." The article suggests that "it is still possible to minimize the impact to the continuity of the buffer network and fish passage," and offers several performance criteria related to minimizing impacts.

The guidelines presented in the NJDEP's BMP manual are largely consistent with the Center's guidelines. Both sources suggest a minimum 100 foot buffer width.

The Action Alternatives were reviewed relative to various guidelines for maintaining effective stream corridor buffers. Specifically, the Action Alternatives were reviewed to determine if they maintained the recommended minimum buffer distances and whether perpendicular stream corridor/buffer crossings met the minimum performance criteria described in more detail in a previous section of this memorandum. The component of the Action Alternatives most related to stream corridor buffer concerns is the east-side connector road. With the exception of the areas potentially disturbed by the perpendicular crossing of the ESC road crossing of the Little Bear Brook and the Route 1 crossing of the Millstone River, all of the Action Alternatives meet or exceed stream corridor buffer guidelines.

Table 4-24
Comparison of Pollutant Concentrations at Discharge to the Millstone River (mg/l) from the Action Alternatives with Existing Millstone River Conditions and the NJ State Water Quality Standards

					Alternative A.1 (360 cfs)						Alternative B.2 (360 cfs)					
Parameter	State Standards FW2-NT (mg/l)	Percent Remaining With BMPs (Low) (a)	Percent Remaining With BMPs (High) (a)	Existing Millstone River Concentrations at confluence of the Millstone River and Devils Brook (mg/l)	Project Contribution Without BMPs	Total Concentration (Existing Millstone River Concentration + Project Contribution) (No BMPs)	Project Contribution With BMPs (Low)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (Low)	Project Contribution With BMPs (High)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (High)	Project Contribution Without BMPs	Total Concentration (Existing Millstone River Concentration + Project Contribution) (No BMPs)	Project Contribution With BMPs (Low)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (Low)	Project Contribution With BMPs (High)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (High)
TSS	40	24.00	5.00	7.00	157.10	120.74	37.70	32.89	7.85	10.93	242.29	180.28	58.15	47.12	12.11	13.82
VSS	--	24.00	5.00	5.00	38.08	31.70	9.14	10.40	1.90	5.08	58.64	46.03	14.07	13.79	2.93	5.74
TVS	--	24.00	5.00	32.00	66.56	72.52	15.98	35.30	3.33	25.99	102.17	97.03	24.52	40.87	5.11	26.84
TKN	--	--	--	1.22	1.37	1.91	--	--	--	--	2.11	2.41	--	--	--	--
BOD*	--	82.00	12.00	10.00	7.59	12.95	6.23	11.94	0.91	8.03	11.66	15.66	9.56	14.14	1.40	8.24
TOC	--	82.00	12.00	5.13	14.09	14.14	11.56	12.28	1.69	5.02	21.67	19.38	17.77	16.56	2.60	5.59
COD*	--	82.00	12.00	10.00	49.14	43.51	40.30	37.01	5.90	11.70	75.28	61.67	61.73	51.87	9.03	13.76
TN	10 (h)	70.00	16.00	1.79	0.33	1.56	0.23	1.49	0.05	1.36	0.50	1.66	0.35	1.55	0.08	1.35
TPO4*	0.10	66.00	30.00	0.05	0.56	0.45	0.37	0.31	0.17	0.16	0.87	0.66	0.57	0.45	0.26	0.22
Cl	250 (ol)	--	--	20.00	10.78	22.64	--	--	--	--	16.47	26.37	--	--	--	--
Pb*	0.005	33.00	2.00	0.001	0.13	0.09	0.04	0.03	0.003	0.003	0.20	0.14	0.06	0.05	0.004	0.004
Zn	--	56.00	1.00	0.163	0.15	0.23	0.08	0.18	0.001	0.12	0.23	0.28	0.13	0.21	0.002	0.12
Fe	--	60.00	40.00	0.63	4.89	4.06	2.93	2.62	1.96	1.90	7.54	5.91	4.52	3.73	3.02	2.64
Cu	--	60.00	43.00	0.034	0.08	0.08	0.05	0.06	0.03	0.05	0.12	0.11	0.07	0.08	0.05	0.06
Cd*	0.01	58.00	31.00	0.0005	0.01	0.01	0.01	0.005	0.003	0.003	0.02	0.01	0.01	0.01	0.005	0.004
Cr*	0.16	60.00	40.00	0.005	0.01	0.01	0.01	0.01	0.004	0.01	0.02	0.02	0.01	0.01	0.01	0.01

Table 4-24 (Continued)
Comparison of Pollutant Concentrations at Discharge to the Millstone River (mg/l) from the Action Alternatives with Existing Millstone River Conditions and the NJ State Water Quality Standards

					Alternative C (360 cfs)						Alternative D (360 cfs)					
Parameter	State Standards FW2-NT (mg/l)	Percent Remaining With BMPs (Low) (a)	Percent Remaining With BMPs (High) (a)	Existing Millstone River Concentrations at confluence of the Millstone River and Devils Brook (mg/l)	Project Contribution Without BMPs	Total Concentration (Existing Millstone River Concentration + Project Contribution) (No BMPs)	Project Contribution With BMPs (Low)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (Low)	Project Contribution With BMPs (High)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (High)	Project Contribution Without BMPs	Total Concentration (Existing Millstone River Concentration + Project Contribution) (No BMPs)	Project Contribution With BMPs (Low)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (Low)	Project Contribution With BMPs (High)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (High)
TSS	40	24.00	5.00	7.00	95.98	88.48	23.03	25.81	4.80	10.14	127.02	104.59	30.48	29.25	6.35	10.42
VSS	--	24.00	5.00	5.00	23.34	24.35	5.60	9.11	1.17	5.30	30.84	27.97	7.40	9.68	1.54	5.11
TVS	--	24.00	5.00	32.00	41.07	62.78	9.86	35.96	2.05	29.26	54.08	67.18	12.98	35.10	2.70	27.08
TKN	--	--	--	1.22	0.84	1.77	--	--	--	--	1.11	1.82	--	--	--	--
BOD*	--	82.00	12.00	10.00	4.69	12.62	3.84	11.89	0.56	9.08	6.17	12.62	5.06	11.75	0.74	8.38
TOC	--	82.00	12.00	5.13	8.66	11.85	7.10	10.51	1.04	5.30	11.43	12.92	9.37	11.32	1.37	5.07
COD*	--	82.00	12.00	10.00	30.44	34.75	24.96	30.04	3.65	11.73	40.01	39.03	32.81	33.41	4.80	11.55
TN	10 (h)	70.00	16.00	1.79	0.20	1.71	0.14	1.66	0.03	1.57	0.27	1.60	0.19	1.54	0.04	1.43
TPO4*	0.10	66.00	30.00	0.05	0.34	0.34	0.23	0.24	0.10	0.13	0.45	0.39	0.30	0.27	0.14	0.15
Cl	250 (ol)	--	--	20.00	6.71	22.95	--	--	--	--	8.80	22.47	--	--	--	--
Pb*	0.005	33.00	2.00	0.001	0.08	0.07	0.03	0.02	0.002	0.002	0.10	0.08	0.03	0.03	0.002	0.002
Zn	--	56.00	1.00	0.163	0.09	0.22	0.05	0.18	0.001	0.14	0.12	0.22	0.07	0.18	0.001	0.13
Fe	--	60.00	40.00	0.63	2.99	3.11	1.79	2.08	1.20	1.57	3.95	3.58	2.37	2.34	1.58	1.73
Cu	--	60.00	43.00	0.034	0.05	0.07	0.03	0.05	0.02	0.05	0.06	0.08	0.04	0.06	0.03	0.05
Cd*	0.01	58.00	31.00	0.0005	0.01	0.01	0.004	0.004	0.002	0.002	0.01	0.01	0.005	0.004	0.003	0.002
Cr*	0.16	60.00	40.00	0.005	0.01	0.01	0.004	0.01	0.003	0.01	0.01	0.01	0.005	0.01	0.004	0.01

-- No Standard or Existing Information Available
* For Existing Conditions Column the Compound was not Detected at a Concentration Exceeding the Value Shown
(a) Source: Comparative Pollutant Removal Capability of Stormwater Treatment Practices. Center for Watershed Protection, Article 64 or Technical Note 95 from Watershed Protection Techniques 2(4): 515-520; www.stormwatercenter.net. Removal rates for Fe, Cr, and Hg are from NJDEP, 2000. Revised Manual for New Jersey: Best Management Practices for Control of Nonpoint Source Pollution from Stormwater.
(h) Non-Carcinogenic Effect-Based Human Health Criteria (as a 30-Day Average)
(ol) Organoleptic Effect-Based Criteria and are Maximum Concentrations

Table 4-24 (Continued)
Comparison of Pollutant Concentrations at Discharge to the Millstone River (mg/l) from the Action Alternatives with Existing Millstone River Conditions and the NJ State Water Quality Standards

					Alternative E (360 cfs)						Alternative F.1 (360 cfs)					
Parameter	State Standards FW2-NT (mg/l)	Percent Remaining With BMPs (Low) (a)	Percent Remaining With BMPs (High) (a)	Existing Millstone River Concentrations at confluence of the Millstone River and Devils Brook (mg/l)	Project Contribution Without BMPs	Total Concentration (Existing Millstone River Concentration + Project Contribution) (No BMPs)	Project Contribution With BMPs (Low)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (Low)	Project Contribution With BMPs (High)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (High)	Project Contribution Without BMPs	Total Concentration (Existing Millstone River Concentration + Project Contribution) (No BMPs)	Project Contribution With BMPs (Low)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (Low)	Project Contribution With BMPs (High)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (High)
TSS	40	24.00	5.00	7.00	126.83	106.94	30.44	29.92	6.34	10.66	154.40	117.74	37.06	32.14	7.72	10.74
VSS	–	24.00	5.00	5.00	30.79	28.60	7.39	9.90	1.54	5.23	37.43	30.95	8.98	10.20	1.87	5.01
TVS	–	24.00	5.00	32.00	54.00	68.72	12.96	35.93	2.70	27.73	65.42	71.07	15.70	34.80	3.27	25.73
TKN	–	–	–	1.22	1.11	1.86	–	–	–	–	1.35	1.87	–	–	–	–
BOD*	–	82.00	12.00	10.00	6.16	12.91	5.05	12.03	0.74	8.58	7.46	12.74	6.12	11.76	0.90	7.95
TOC	–	82.00	12.00	5.13	11.41	13.22	9.36	11.58	1.37	5.19	13.85	13.85	11.36	12.03	1.66	4.95
COD*	–	82.00	12.00	10.00	39.95	39.91	32.76	34.17	4.79	11.82	48.30	42.53	39.61	36.19	5.80	11.52
TN	10 (h)	70.00	16.00	1.79	0.27	1.64	0.19	1.58	0.04	1.46	0.32	1.54	0.23	1.47	0.05	1.34
TPO4*	0.10	66.00	30.00	0.05	0.45	0.40	0.30	0.28	0.14	0.15	0.55	0.44	0.36	0.30	0.17	0.16
Cl	250 (ol)	–	–	20.00	8.78	23.00	–	–	–	–	10.59	22.32	–	–	–	–
Pb*	0.005	33.00	2.00	0.001	0.10	0.08	0.03	0.03	0.002	0.002	0.13	0.09	0.04	0.03	0.003	0.003
Zn	–	56.00	1.00	0.163	0.12	0.22	0.07	0.18	0.001	0.13	0.14	0.22	0.08	0.18	0.001	0.12
Fe	–	60.00	40.00	0.63	3.95	3.66	2.37	2.40	1.58	1.77	4.81	3.97	2.88	2.56	1.92	1.86
Cu	–	60.00	43.00	0.034	0.06	0.08	0.04	0.06	0.03	0.05	0.08	0.08	0.05	0.06	0.03	0.05
Cd*	0.01	58.00	31.00	0.0005	0.01	0.01	0.005	0.004	0.003	0.003	0.01	0.01	0.01	0.005	0.003	0.003
Cr*	0.16	60.00	40.00	0.005	0.01	0.01	0.005	0.01	0.004	0.01	0.01	0.01	0.01	0.01	0.004	0.01

Table 4-24 (Continued)
Comparison of Pollutant Concentrations at Discharge to the Millstone River (mg/l) from the Action Alternatives with Existing Millstone River Conditions and the NJ State Water Quality Standards

					Alternative G.1 (360 cfs)					
Parameter	State Standards FW2-NT (mg/l)	Percent Remaining With BMPs (Low) (a)	Percent Remaining With BMPs (High) (a)	Existing Millstone River Concentrations at confluence of the Millstone River and Devils Brook (mg/l)	Project Contribution Without BMPs	Total Concentration (Existing Millstone River Concentration + Project Contribution) (No BMPs)	Project Contribution With BMPs (Low)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (Low)	Project Contribution With BMPs (High)	Total Concentration (Existing Millstone River Concentration + Project Contribution) (High)
TSS	40	24.00	5.00	7.00	0.44	6.96	0.11	6.84	0.02	6.57
VSS	–	24.00	5.00	5.00	0.33	4.99	0.08	4.75	0.02	4.69
TVS	–	24.00	5.00	32.00	1.42	31.25	0.34	30.24	0.07	29.99
TKN	–	–	–	1.22	0.02	1.15	–	–	–	–
BOD*	–	82.00	12.00	10.00	0.16	9.50	0.14	9.48	0.02	9.37
TOC	–	82.00	12.00	5.13	0.20	4.98	0.16	4.95	0.02	4.82
COD*	–	82.00	12.00	10.00	1.42	10.68	1.16	10.44	0.17	9.51
TN	10 (h)	70.00	16.00	1.79	0.005	1.68	0.004	1.68	0.001	1.67
TPO4*	0.10	66.00	30.00	0.05	0.003	0.05	0.002	0.05	0.001	0.05
Cl	250 (ol)	–	–	20.00	0.41	19.09	–	–	–	–
Pb*	0.005	33.00	2.00	0.001	0.001	0.002	0.0003	0.001	0.00002	0.001
Zn	–	56.00	1.00	0.163	0.001	0.15	0.001	0.15	0.00001	0.15
Fe	–	60.00	40.00	0.63	0.02	0.61	0.01	0.60	0.01	0.60
Cu	–	60.00	43.00	0.034	0.001	0.03	0.0005	0.03	0.0004	0.03
Cd*	0.01	58.00	31.00	0.0005	0.0002	0.001	0.0001	0.001	0.00005	0.0005
Cr*	0.16	60.00	40.00	0.005	0.0002	0.005	0.0001	0.005	0.0001	0.005

– No Standard or Existing Information Available
* For Existing Conditions Column the Compound was not Detected at a Concentration Exceeding the Value Shown
(a) Source: Comparative Pollutant Removal Capability of Stormwater Treatment Practices. Center for Watershed Protection, Article 64 or Technical Note 95 from Watershed Protection Techniques 2(4): 515-520; www.stormwatercenter.net. Removal rates for Fe, Cr, and Hg are from NJDEP, 2000. Revised Manual for New Jersey: Best Management Practices for Control of Nonpoint Source Pollution from Stormwater.
(h) Non-Carcinogenic Effect-Based Human Health Criteria (as a 30-Day Average)
(ol) Organoleptic Effect-Based Criteria and are Maximum Concentrations

4.5.1.3 Mitigation Measures, Surface Water

The Action Alternatives have been conceptually designed to avoid impacts on water resources to the greatest extent practicable. If the preferred alternative is an Action Alternative, a stormwater management plan would be prepared that best suits the selected Action Alternative and meets NJDOT and NJDEP stormwater management requirements.

Minimizing the area of construction disturbance, protecting streamside vegetation adjacent to the construction area, and implementing soil erosion and sediment control measures would avoid or control these potentially detrimental impacts.

The stormwater management design would comply with the New Jersey Flood Hazard Area Control Regulations in effect during the design and permitting project phases (NJAC 7:13-2.8 et seq). As they pertain to water quality, the regulations require that a stormwater management design incorporate elements that would reduce runoff rates and control water quality to the maximum extent practicable prior to discharge to surface waterbodies. The stormwater management system would provide the opportunity for infiltration of runoff, would decrease recharge loss, and would enhance the quality of the treated water. With the intent of the design to maintain or to reduce pollutant loading rates equal to or below pre-construction levels, there would be no substantive adverse water quality impact.

It should be noted that proposed new rules and amendments to existing regulations pertaining to water quality and floodplain protection are under public review. If adopted in their current form, these regulations would increase the rigor of stormwater management requirements, particularly in the area of water quality protection.

Below are stormwater management and water quality control practices and soil erosion and sediment control practices available to an Action Alternative.

Best Management Practices
As required by NJDEP an Action Alternative would manage stormwater runoff, as feasible, through preventive measures, also known as Best Management Practices (BMPs). They are effective active and passive means to treat runoff. Selection and design of appropriate BMPs to accompany an Action Alternative would occur during preliminary and final design phases, commensurate with environmental permitting. BMPs would be selected and incorporated into the design according to the site specific drainage area, drainage patterns and site requirements. For example, along curbless roadway sections where runoff flows off the pavement into adjacent areas, grass swales and vegetated filter strips would be desirable to filter roadway runoff. Along curbed roadways, such as Route 1, detention basins would likely best serve to control flood flows and enhance water quality. Using a variety of BMPs in appropriate locations would yield the greatest overall runoff and water quality control benefit. In addition, these facilities may be incorporated so as to handle runoff from

some existing paved surfaces where no such treatment currently exists, thereby addressing runoff and water quality concerns that would be allowed to persist in existing and No-Action conditions.

The implementation of one or more appropriate BMPs ensures that highway runoff rates are controlled, and waterborne pollutants have time to settle and/or be filtered. BMPs, implemented one at a time or as a related grouping, can be a highly effective means for controlling runoff and water quality. These devices capture highway runoff and release it at slow rates, allowing sufficient time for many contaminants to settle out, evaporate, infiltrate, or be absorbed by vegetation or soil (FHWA website, 2002; www.tfhrc.gov/hnr20/runoff/runoff.htm). The calculation procedure summarized in Section 4.5.1.2 factored in the median effectiveness of BMPs. If an Action Alternative is selected as a result of the EIS process, a focus on "better-than-average" BMP design would be appropriate to prevent exceedances from occurring. It should be noted that proposed NJDEP stormwater management rules will likely require the use of such measures. A discussion of these proposed rules is provided in Section 4.17 of this EIS.

Best Management Practices that may be considered for implementation with an Action Alternative include detention basins, wet ponds, swales, infiltration structures, and vegetated filter strips. There is a growing body of research related to the effectiveness of stormwater management practices to remove pollutants from stormwater runoff prior to entering a water body. The Center for Watershed Protection, a Maryland-based non-profit corporation that provides local governments, activists, and watershed organizations around the country with the technical tools for protecting streams, lakes and rivers, maintains a database of more than 135 stormwater practice performance studies. The Center's database information is synthesized in an article entitled *Comparative Pollutant Removal Capability of Stormwater Treatment Practices*. The findings of this synthesis article are summarized below.

The article groups stormwater management practices into "Practice Groups" and assesses, based on empirical data, the pollutant removal performance of each relative to pollutants commonly found in stormwater runoff. The pollutants examined in the article include: phosphorus; nitrogen; suspended sediment or solids; carbon; trace metals such as copper, lead and zinc; bacteria, and hydrocarbons. The stormwater practices examined in the article include: a variety of wet and dry detention ponds, wetlands, filtering systems, infiltration structures, and water quality swales. Table 4-25 summarizes the median pollutant removal effectiveness of the various practice groups for a select number of pollutants according to the Center for Watershed Protection research.

Table 4-25
Median Stormwater Pollutant Removal Efficiencies (%)

Practice Group	TSS	TP	TN	Cd	Cu	Pb	Zn	Carbon
Ponds (including: wet ponds, wet & dry extended detention basins)	80	51	33	50	57	74	66	43
Wetlands	76	49	30	69	40	68	44	18
Infiltration	95	70	51	ND	ND	98	99	88
Water quality swales	81	34	84	42	51	67	71	69

Notes: TSS – Total Suspended Solid; TP – Total Phosphorus; TN – Total Nitrogen; Cd – Cadmium; Cu – Copper; Pb – Lead; Zn – Zinc

This data indicates that BMPs can significantly reduce pollutant concentrations in stormwater runoff. Due to their various levels of effectiveness and differing target pollutants, it is most desirable to incorporate several types of BMPs, each suited to site-specific conditions, to yield a total benefit.

Water pollution control measures and an on-site Health and Safety Plan would be developed and enforced during the construction of any Action Alternative to minimize the potential for construction material spills. Construction materials would not be stockpiled in or near adjacent streams or wetlands. If materials require stockpiling for significant durations, they would be covered with an impermeable liner to prevent runoff and leachate during precipitation.

Road Salts

The *Stormwater and Non-Point Source Pollution Control: Best Management Practices Manual* (NJDEP[3], 1994) identifies the following mitigation measures to minimize the impact of road salts in stormwater runoff. These measures are intended to address region-wide salt application practices. To the extent that some of these measures can be applied to any of the Action Alternatives, further evaluation of their utility and practicality would be undertaken during design phases:

- Delineate sensitive areas around water supplies and areas of high recharge where stringent control is desirable for the application of road salt. Levels of required maintenance could be established such that on certain designated roadways salt would not be used, other roadways would be plowed and sanded, and the most frequently traveled roadways would get straight salt application. These levels would depend on environmental considerations, road type, weather conditions, and traffic volumes.
- The application practices for deicing materials vary depending upon storm characteristics, roadway conditions, type and availability of equipment, and managing agency policy. Salt is not spread uniformly. Road intersections, hills, low points, and areas with poor drainage receive the most attention. Abrasives, such as sand and gravel, are used for traction. These substances can be added to sodium chloride, calcium chloride, or a mixture of the two to promote melting.

- Application rates could be determined for service areas. These rates could be designed to include reduced rates for important recharge areas and areas around water supply wells while considering the use of an amount of product based on highway design and traffic density. Various mixtures of sodium chloride, calcium chloride, and sand could be used depending on the sensitivity of the area. Incorporation of sand with sodium chloride and calcium chloride mixtures has proven to be economically and environmentally efficient.
- Plowed snow treated with sodium chloride has the potential to contaminate groundwater. Heavily salted snow should not be disposed of in areas around public supply wells or in areas of high or moderate recharge. Snow should not be disposed of at a sanitary landfill as added moisture would contribute to leachate. Snow should not be dumped directly into surface waters.
- New deicing materials are periodically developed that are feasible for use in sensitive areas. One such material is urea, an environmentally safer alternative to road salting. Synthesized from ammonia and carbon dioxide, this product is primarily used as a fertilizer. Urea forms a solution that functions essentially as a brine but without the corrosive effects on infrastructures or vegetation. Urea is also economically feasible, with costs at or lower than the price of road salt. Brick Township Municipal Utilities Authority in New Jersey and some municipal authorities in New York have been using this product with good results. The only drawback with urea is that it is a fertilizer, and application of such material can potentially elevate levels of nitrate entering receiving waters. If urea is used, adequate fertilizer management practices should be implemented simultaneously.
- Consideration should be given to using a combination of products for winter roadway maintenance. It is best to apply urea early in the season (prior to mid-February) and sodium chloride or calcium chloride later in the season. Early application of urea fixes nitrogen in the soil as ammonium, with release occurring in the warmer spring temperatures for plant growth. A combination of deicing materials would help to prevent soil overloading and subsequent contamination of water while providing the public with safe roadways. Additional research would help identify which environmentally safe alternative best suits the need.

Stream Corridor Buffers

Although all of the action alternatives would meet or exceed the stream corridor buffer guidelines, there may be opportunities to enhance existing buffer areas. During the design and permitting process, the feasibility of enhancing the buffer zones would be explored. Techniques to be considered may include, but would not be limited to, stabilizing pre-existing erosion conditions in the buffer area, providing supplemental vegetation to increase diversity within the buffers, and establishing a low maintenance program in buffer areas to limit human intervention over the long term. The extent to which such measures can be applied would depend on the long-term cooperation of the land owner and any current easement holders as the buffer area would extend beyond the road right-of-way. Such measures would also be subject to review and approval by the NJDEP. Finally, field conditions would shape the feasibility, type, and extent of any enhancement program.

4.5.2 Groundwater

A groundwater recharge evaluation was conducted for the No-Action and Action Alternatives. Factors examined include: increase in impervious surface area, recharge reduction, and percent decrease in area recharge resulting if the Action Alternative is selected.

Table 4-26 summarizes the findings of the recharge analysis. This data indicates that Action Alternative B.2, with the largest area of impervious cover, would reduce annual recharge in the expanded study area by approximately 8.79 million gallons per year or 1.66 percent. The additional impervious cover would constitute 1.66% of the expanded study area. While this reduction in recharge is measurable, it is small in comparison to both the overall recharge capability of the expanded study area. The estimated recharge impacts for the other Action Alternatives would be incrementally less.

Table 4-26
Summary of Proposed Paved Surfaces and Groundwater Recharge Reductions

Alternative	New Pavement per Recharge Capability Class (acres)				Recharge Reduction		Remaining Annual Recharge (mil. gal./year)
	High	Moderate	Low	Total	(mgy)	% of Total Study Area	
A	13.18	4.80	5.02	23.00	7.12	1.34	523.37
A.1	14.29	5.55	4.97	24.81	7.81	1.47	522.68
A.2	13.50	5.42	4.93	23.85	7.43	1.40	523.06
A.3	13.19	5.45	4.48	23.12	7.28	1.37	523.21
A.4	13.46	6.03	4.62	24.11	7.56	1.43	522.93
B	14.26	5.39	5.01	24.66	7.65	1.44	522.84
B.1	14.26	5.39	5.01	24.66	7.65	1.44	522.84
B.2	16.04	6.40	5.15	27.59	8.79	1.66	521.70
C	7.85	4.08	1.91	13.84	4.51	0.85	525.98
C.1	6.88	2.75	1.65	11.28	3.69	0.70	526.80
D	13.90	4.50	4.26	22.66	7.21	1.36	523.28
D.1	13.46	4.94	3.93	22.33	7.16	1.35	523.33
D.2	9.70	5.22	3.02	17.94	5.59	1.05	524.90
E	11.93	7.27	1.08	20.28	7.13	1.34	523.36
F	13.53	4.22	5.26	23.01	7.11	1.34	523.38
F.1	14.13	5.73	5.18	25.04	7.79	1.47	522.70
G	0.44	1.94	1.03	3.41	0.79	0.15	529.70
G.1	0.58	2.40	1.28	4.26	1.00	0.19	529.49
G.2	0.76	1.82	0.66	3.24	0.87	0.16	529.62
VDC 1	0.34	-0-	4.01	4.35	1.21	0.23	529.28
VDC 2	0.40	-0-	4.69	5.09	1.08	0.20	529.41
VDC 3	0.41	-0-	4.77	5.18	0.42	0.08	530.07
No-Action	-0-	-0-	-0-	-0-	-0-	-0-	530.49

Note: Existing Annual Recharge in the Study Area is 530.49 million gallons per year.
mgy -million gallons per year   mgd -million gallons per day   (a) Interpolated values.

These impact quantities do not account for implementation of stormwater management strategies, including those that would facilitate and enhance ground water recharge that would be included with any Action Alternative (Section 4.5.1.3).

4.5.2.1 No-Action Alternative, Groundwater

The No-Action Alternative would perpetuate and exacerbate existing conditions in the sense that additional traffic would operate on the existing roadway system. The more heavily burdened existing roadway system would generate runoff as it does today, but with greater quantities of pollutants due to the additional vehicles. Although no new impervious surfaces would be constructed, and no reduction in recharge would result, the existing roadways provide few to no mechanisms to control the rate or quality of runoff, or encourage groundwater recharge. The No-Action Alternative would include no such new facilities.

4.5.2.2 Action Alternatives, Groundwater

The Action Alternatives would introduce new paved surfaces in the expanded study area, and reduce recharge is indicated in Table 4-26. Design Year traffic volumes would contribute pollutants to the existing roadways, as well as new. In contrast to the No-Action Alternative, the Action Alternatives would be under a regulatory mandate via an NJDEP Stream Encroachment Permit to be designed with an integrated stormwater management system to control runoff rates, as well as protect or enhance surface and groundwater quality. In particular, stormwater management facilities would be designed and operated according to NJDEP's requirements to provide appropriate water quality management. The contemplated modifications to existing roadways, such as Route 1, are opportunities to introduce stormwater management systems where none currently exist. Consequently, the Action Alternatives could address some on-going stormwater concerns as well as potential new concerns.

Public Water Supply Wells
As presented in Section 3.7.3, 16 public community supply wells are located within or near the expanded study area. If an Action Alternative is selected, the exact location of wells would be pinpointed during design, and means to avoid impact would be examined.

4.5.2.3 Mitigation Measures, Groundwater

Wells
Wells that lie within the highway right-of-way or that would have to be removed would be legally abandoned and capped by a well driller licensed by the State of New Jersey to perform such work.

Groundwater Recharge and Quality
During design of any Action Alternative, NJDEP's policy and requirements for stormwater management would be followed. Wherever feasible, these BMPs may include over-the-shoulder roadway drainage, which would use vegetated roadside swales and stormwater management facilities. This stormwater management system would provide the opportunity for infiltration of runoff, facilitate recharge, and enhance the quality of treated stormwater.

Several of the Action Alternatives would place a portion of the Route 1 corridor in-a-cut. The cut portion of Route 1 would be located at the Washington Road crossing and would extend north and south from this intersection. Action Alternatives that propose this design are A, A.1, A.2, A.3, A.4, D, D.1, D.2, E, F, and F.1. Any groundwater seepage encountered would be controlled with sump pumps and directed to drainage ditches. The cut section would not provide infiltration opportunities within it. Stormwater would be transmitted through closed piping to the ground surface, thereby providing some groundwater quality protection.

4.6 Aquatic Ecology

4.6.1 No-Action Alternative, Aquatic Ecology

The No-Action as well as the Action Alternatives could have adverse impacts on aquatic ecology. The No-Action Alternative would perpetuate and exacerbate existing conditions in the sense that additional traffic would operate on the existing roadway system. The more heavily burdened existing roadway system would generate runoff as it does today, but with greater quantities of pollutants due to the additional vehicles. The existing roadway system provides few to no mechanisms to control the rate or quality of runoff. The No-Action Alternative would include no such new facilities.

4.6.2 Action Alternatives, Aquatic Ecology

The Action Alternatives would introduce new paved surfaces in the expanded study area. As with the No-Action Alternative, Design Year traffic volumes would contribute pollutants to the new and existing roadways. In contrast to the No-Action Alternative, however, the Action Alternatives would be under a regulatory mandate via an NJDEP Stream Encroachment Permit to be designed with an integrated stormwater management system to control runoff rates, as well as protect or enhance water quality. In particular, stormwater management facilities would be designed and operated according to NJDEP's requirements to provide appropriate water quality management to protect aquatic ecology. The contemplated modifications to existing roadways, such as Route 1, are opportunities to introduce stormwater management systems where none currently exist. Consequently, the Action Alternatives could address some on-going stormwater concerns as well as potential new concerns.

All Action Alternatives, except Action Alternatives C, C.1, D.2, G, G.1, and the VDC Alternatives, would include an east-side connector road that would traverse Little Bear Brook. All Action Alternatives would also replace the existing Route 1 bridge over the Millstone River. Construction of structures to carry the roadways over these two watercourses has the potential to temporarily increase erosion, turbidity, and biological oxygen demand (BOD) while decreasing light penetration and dissolved oxygen in the affected waterways. Discussion of required soil erosion and sediment control strategies that would be implemented to avoid or minimize construction impacts is provided in Section 4.13.1.

Permanent impacts associated with constructing these crossings would include localized modification of the stream morphology, loss of vegetation, and shading of the waterway within the right-of-way. In the immediate vicinity of the crossing structures, these changes would alter the plant and animal species composition such that shade intolerant species would be replaced by shade-tolerant species and organisms that prefer cooler habitats. These changes would not be as pronounced in areas that are currently shaded, such as those under a dense forest or understory canopy. The crossing over Little Bear Brook would cause the shading of approximately 3,575 square feet (0.08 acres) of waterway in Action Alternatives A, A.2, A.2, A.3, A.4, B, B.1, B.2, D, D.1, F and F.1. This structure would be approximately 55 feet long by 65 feet wide.

The Millstone River bridge replacement would result in the shading of approximately 12,100 square feet of waterway (110 x 100 feet), which constitutes an increase of 3,300 square feet (0.08 acres) over existing conditions. All of the Action Alternatives include replacement of this structure. The replacement bridge would be wider than the existing bridge and would be supported by one pier rather than two piers.

Although shading would result in the loss of associated primary productivity under structures, this effect would be localized and would not adversely impact aquatic biota in the waterway as a whole. Wetland and waterbody impacts are quantified and discussed in more detail in Section 4.8.

Loss of vegetation within the right-of-way would occur during the construction phase of this project. Temporary bank stabilization would be a focal point of a required soil erosion and sediment control plan. A permanent re-vegetation plan would be developed and implemented to restore bank stability, if an Action Alternative is selected. Vegetation stabilizes the stream bank, regulates temperature through shading, provides shelter for fish, and serves as a nutrient source to the aquatic environment.

4.6.3 Mitigation Measures, Aquatic Ecology

To avoid and/or minimize impacts, consideration would be given in the design phases of an Action Alternative to:

- Protect areas that are particularly susceptible to erosion and sediment loss;
- Limit impervious surface area wherever possible;
- Limit land disturbance activities such as clearing and grading and cut and fill; and
- Limit disturbance of natural drainage features and vegetation.

Impacts to the aquatic ecosystem as a result of the construction and operation of an Action Alternative would be reduced by employing the following strategies prescribed in NJDEP's regulatory program:

- Minimize the area disturbed by construction activity,
- Implement an erosion and sediment control plan,
- Properly design bridges and crossings to maintain stream velocities, and
- Re-vegetate stream banks immediately following construction.

Protection against possible pollutant overloads from bridges and crossings may be afforded by minimizing the use of scuppers on the bridges and conveying deck drainage to land for treatment prior to discharge.

BMPs described Section 4.5.1.3 would be utilized to minimize impacts to aquatic ecology.

4.7 Floodplains

4.7.1 No-Action Alternative, Floodplains

The No-Action Alternative would involve no new construction activities or right-of-way acquisition, and would have no impact on floodplains.

4.7.2 Action Alternatives, Floodplains

Development within floodplains is regulated at the federal level by the *Floodplain Management Executive Order 11988* and at the state level by the Flood Hazard Area Control Act (NJSA 58:16A-50 et seq.). Additional regulatory measures include the Flood Hazard Area Control Act Rules (NJAC 7:13-1.1 et seq.). Floodplain impacts from Action Alternatives discussed in this section, means impacts to the flood hazard area design flood, which is the regulatory floodplain limit in New Jersey.

Placing fill within a floodplain can result in adverse impacts to its function, including a reduction in flood storage capacity, an increase in the flood height of the stream, and an increase in flood hazards extending to areas beyond the disturbed area. To avoid such impacts, the NJDEP Flood Hazard Area Control Act Rules (NJAC 7:713-1.1 et seq.) would require an Action Alternative, if one is selected, to provide adequate stormwater management. Specifically, the rules require that the volume of stormwater discharged from the site and the runoff rate of the two-, 10-, and 100-year storm events in post-construction conditions do not exceed the volumes and rates in

pre-construction conditions. In addition, post-construction peak runoff rates must be less than peak rates in pre-construction conditions. These requirements ensure that flood control following construction is the same as, or improved over pre-construction conditions.

Floodplain concerns were a key factor in the conceptual design of the Action Alternatives. Construction in floodplains, particularly the placement of fill material, has been minimized in the conceptual design to the greatest extent practicable. This includes placement of the Action Alternatives outside of the flood hazard area design flood, except where absolutely necessary for a stream crossing (e.g., the Millstone River and Little Bear Brook). Stream crossings have been designed to be perpendicular to waterways and at locations where the floodplain is narrow.

Each Action Alternative includes replacing the Route 1 bridge over the Millstone River and therefore, would impact the river's floodplain. Action Alternatives A, A.1, A.2, A.3, A.4, B, B.1, B.2, D, D.1, D.2, F, and F.1 include a west-side connector road that would impact floodplains south of Harrison Street, associated with the Millstone River. A structure would also be required for the east-side connector road crossing of Little Bear Brook, including fill within the floodplain in Action Alternatives A, A.1, A.2, A.3, A.4, B, B.1, B.2, D, D.1, E, F, and F.1. Both the Millstone River and Little Bear Brook floodplain impacts would necessitate a NJDEP Stream Encroachment Permit. Part 7:13-3.6 of the NJDEP Flood Hazard Area Control Act Rules requires that any new or modified channel of a watercourse be designed and constructed so that the water depth is at least as deep as the existing channel during low flow conditions to enable the passage of fish. The new structure over the Millstone River, and all activities occurring within regulated floodplains, must be designed in accordance with these regulations. Permit regulations require demonstration that impacts have been avoided or minimized to the greatest extent practicable, and that effective mitigation strategies would be undertaken to compensate for unavoidable impacts. Mitigation measures to be examined during the design phases to avoid or minimize floodplain impacts are discussed in Section 4.7.3. Figures 4-33 through 4-46 illustrate floodplain impacts from each Action Alternative. Floodplain impacts for each of the Action Alternatives are summarized in Table 4-27.

Executive Order 11988, Flood Plain Management (1977), requires agencies to reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. The Order is intended to ensure that where impacts to floodplains cannot be avoided, every reasonable effort is made to minimize the impact such that an existing flooding condition is not exacerbated and a new flooding condition is not created. Examination of the Action Alternatives in the context of this Order and the federal guidance promulgated from that Order, 23 CFR 650, has determined that the floodplain impacts contemplated constitute perpendicular crossings. These crossings would be minimized in terms of their scope of floodplain impact so as not to cause or exacerbate a flooding problem. This conclusion is based on the understanding that any Action Alternative would require an NJDEP Stream Encroachment Permit and

that the permit review process mandates a demonstration of the effectiveness of planned minimization efforts. Moreover, none of the impacts contemplated under the Action Alternatives would constitute a longitudinal, or parallel, physical impact on floodplains. For these two reasons, none of the Action Alternatives would constitute a significant floodplain encroachment as defined in the Federal Aid Policy Guide 23 CFR 650, Subpart A.

A Action Alternatives (A, A.1, A.2, A.3, A.4)
All the A Action Alternatives would result in perpendicular crossings of the floodplain of the Little Bear Brook and the Millstone River. Each would include a new crossing of Little Bear Brook for the east-side connector roadway and replacing the Route 1 bridge over the Millstone River with a wider span. The west-side connector roadway would connect to Harrison Street, thereby impacting the Millstone River floodplain at this location. Action Alternatives A.3 and A.4 would impact approximately 3.92 acres of study area floodplains, as compared with 3.58 acres for Action Alternatives A and A.2, and 3.51 acres for Action Alternative A.1. Therefore, a maximum of 0.48% of study area floodplains would be impacted by the A Action Alternatives (A.3 or A.4). This would comprise 1.54 acres of the Millstone River floodplain and 2.38 acres of the Little Bear Brook floodplain.

B Action Alternatives (B, B.1, B.2)
All the B Action Alternatives would result in the largest perpendicular crossings of the floodplains of the Little Bear Brook and the Millstone River of all the Action Alternatives. All the B Action Alternatives would include a new crossing of Little Bear Brook for the east-side connector roadway and replacing the Route 1 bridge over the Millstone River with a wider span. The west-side connector roadway would connect to Harrison Street, thereby impacting the Millstone River floodplain at this location. Action Alternatives B and B.1 would impact approximately 4.10 acres, or 0.50% of study area floodplains, as compared with 3.98 acres of 0.48% for Action Alternative B.2. This comprises a maximum floodplain impact of 1.72 acres of the Millstone River and 2.38 acres of the Little Bear Brook floodplain.

C Action Alternatives (C, C.1)
Action Alternatives C and C.1 would impact the Millstone River floodplain by replacing the Route 1 bridge over the Millstone River with a wider span. Both these alternatives would result in total impacts of approximately 0.72 acres of the Millstone River floodplain, which comprises approximately 0.09% of total study area floodplains. The C Action Alternatives would not impact the Little Bear Brook floodplain.

D Action Alternatives (D, D.1, D.2)
Action Alternatives D and D.1 would impact the floodplain of the Millstone River and Little Bear Brook. D and D.1 would include a new crossing of Little Bear Brook All D alternatives would replace the Route 1 bridge over the Millstone River with a wider span. In addition, all D Action Alternatives would include a west-side

connector road to Harrison Street, thereby potentially impacting the Millstone River floodplain at this location.

Action Alternative D would impact a total of approximately 3.60 acres of floodplains, comprising about 1.22 acres associated with the Millstone River and 2.38 acres of the Little Bear Brook floodplain. This comprises approximately 0.44% of total study area floodplains. Action Alternative D.1 would impact 3.58 acres of floodplains. Action Alternative D.2 would impact 1.22 acres of floodplains.

E Action Alternative

Action Alternative E would impact the floodplain of the Millstone River and Little Bear Brook. These impacts would be necessary to replace the existing bridge over the Millstone River with a wider span and provide a new crossing of Little Bear Brook for the east-side connector road. Floodplain impacts for Action Alternative E would total approximately 3.15 acres, comprising 0.77 acres of Millstone River floodplain and 2.38 acres of Little Bear Brook floodplain. This comprises approximately 0.39% of total study area floodplains.

F Action Alternatives (F, F.1)

Both F Action Alternatives would result in perpendicular crossings of the floodplains of the Millstone River and Little Bear Brook. These alternatives would include replacing the existing bridge over the Millstone River with a wider span, a new crossing of Little Bear Brook for the east-side connector road, and the west-side connector road to Harrison Street. Both F Action Alternatives would impact a total of approximately 3.94 acres of floodplains, including 1.56 acres of the Millstone River floodplain and 2.38 acres of the Little Bear Brook floodplain. This comprises approximately 0.48% of total study area floodplains.

G Action Alternatives (G, G.1, G.2)

The G Action Alternatives would include replacement of the existing bridge over the Millstone River. Action Alternative G.1 would impact approximately 1.02 acres of the Millstone River floodplain, as compared with 0.98 acres for Action Alternative G and 0.63 acres for Action Alternative G.2. This would comprise a maximum of 0.12% of study area floodplains. None of the G Action Alternatives would impact the Little Bear Brook floodplain.

Unavoidable floodplain impacts have been minimized in the conceptual design wherever possible. Mitigation measures, as warranted by the regulations would further minimize these impacts.

The VDC Alternatives would not impact any floodplains.

Table 4-27
Summary of Floodplain Impacts

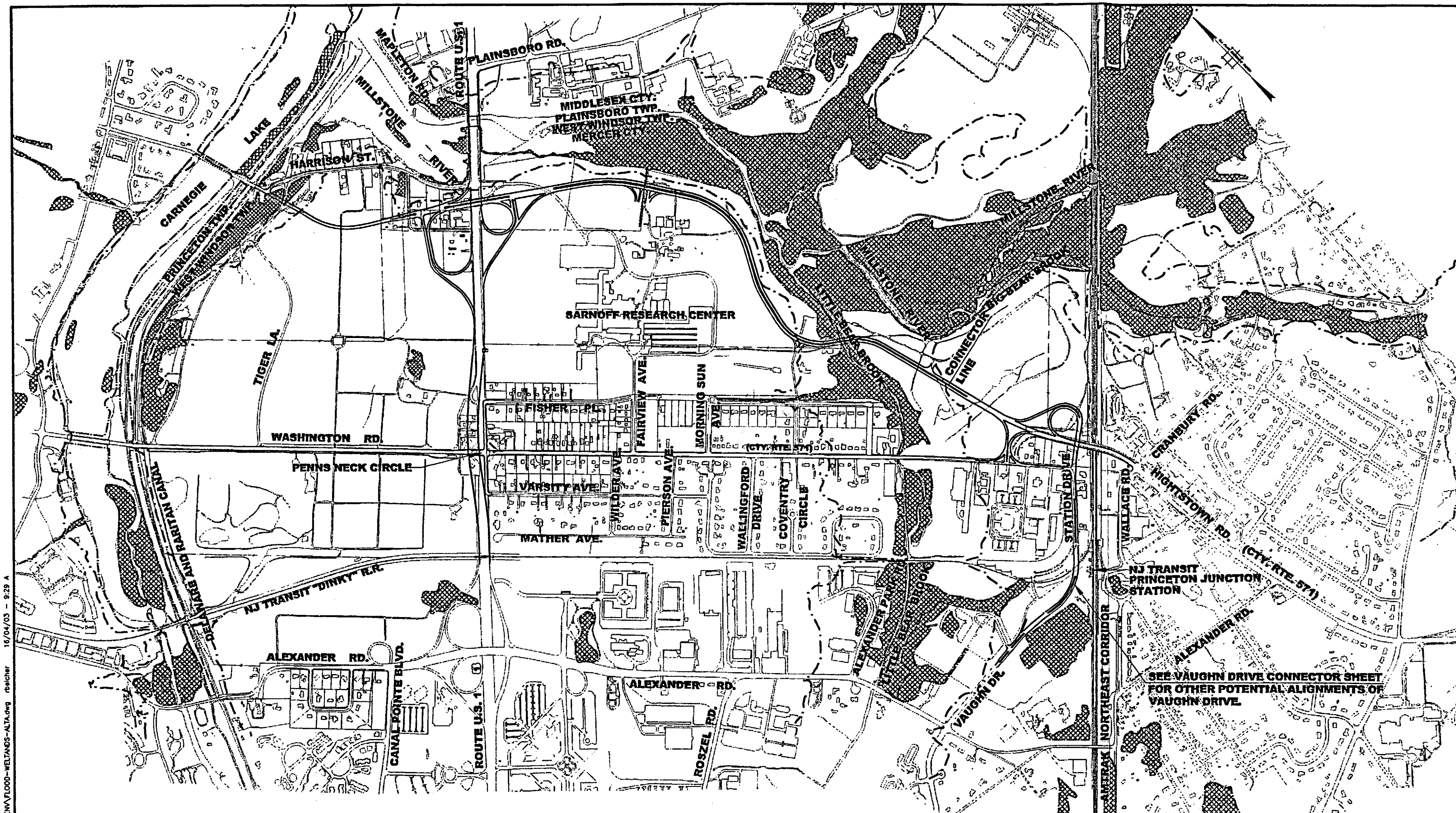
Alternative	Millstone River	Little Bear Brook	Total	% of Total Study Area Floodplains (821.16 ac.)
A	1.2	2.38	3.58	0.44%
A.1	1.13	2.38	3.51	0.43%
A.2	1.20	2.38	3.58	0.44%
A.3	1.54	2.38	3.92	0.48%
A.4	1.54	2.38	3.92	0.48%
B	1.72	2.38	4.10	0.50%
B.1	1.72	2.38	4.10	0.50%
B.2	1.60	2.38	3.98	0.48%
C	0.72	-0-	0.72	0.09%
C.1	0.72	-0-	0.72	0.09%
D	1.22	2.38	3.60	0.44%
D.1	1.20	2.38	3.58	0.44%
D.2	1.22	0	1.22	0.14%
E	0.77	2.38	3.15	0.38%
F	1.56	2.38	3.94	0.48%
F.1	1.56	2.38	3.94	0.48%
G	0.98	-0-	0.98	0.12%
G.1	1.02	-0-	1.02	0.12%
G.2	0.63	-0-	0.63	0.08%
VDC 1	-0-	-0-	-0-	-0-
VDC 2	-0-	-0-	-0-	-0-
VDC 3	-0-	-0-	-0-	-0-
No-Action	-0-	-0-	-0-	-0-

4.7.3 Mitigation Measures, Floodplains

An Action Alternative, if one is selected, would be required to comply with all applicable stream encroachment regulations. Various forms of mitigation could be implemented to maintain the function and quality of the affected floodplain during construction of an Action Alternative. All Action Alternatives would have to meet NJDEP's requirements for a Stream Encroachment Permit. These requirements include detailed hydrologic and hydraulic analyses demonstrating that new structures would not constrict normal or 100-year flood flows, or alter the flood storage capacity of the regulated floodplain. Moreover, an Action Alternative would have to meet the following design guidelines prescribed by the NJDEP as part of the permitting process to protect floodplains and avoid creating or exacerbating a flooding condition:

- Bridges and crossings should be designed and constructed so that the natural stream bed is maintained and not replaced by an artificial floor.
- Culverts should be designed with the capacity to pass the 100-year flood.
- Culverts should be designed to allow for the passage of fish during periods of low flow if such passage exists before the encroachment occurs.

- Any proposed swales or channels that would discharge into an existing stream should incorporate one or more of the following:
  - Settling basins to filter sediment prior to discharge into stream;
  - Swales and channels stabilized with riprap, sod, or appropriate vegetative cover prior to receiving stream flow; and
  - Swales and channels designed to discharge into a stream in the direction of the existing stream flow at a velocity so as not to cause erosion or interfere with the stream's natural flow pattern.
- Once construction within a stream is complete, disturbed areas should be stabilized and re-vegetated. Selected vegetation should be ground cover species that are indigenous to the site and appropriate for the soil and wetness conditions.
- Construction materials should not be stockpiled in floodplain areas.
- If stream crossings result in a floodplain impact exceeding 20 percent of the existing flood storage, the following measures should be considered:
  - Acquisition of areas within the floodplain being filled and their preservation as perpetual floodplain areas. Such acquisition could reduce the net fill volume to the maximum 20 percent allowed; and
  - Excavation of areas within each of the floodplains to be crossed to produce a greater floodplain storage capacity, thus compensating for flood storage capacity lost due to fill.
- Use of detention and/or retention basins would function to settle out sediment and some pollutants, thus improving the quality of water discharged downstream.
- Vegetative buffers, natural or man-made, function to absorb sediment and pollutants from overland runoff, provide food and cover for wildlife, stabilize soil to minimize erosion, and can provide shade and suitable temperature regimes for aquatic life when they are present along a stream. At all stream encroachments, vegetative buffers should be restored if they are disturbed during construction. Trees, shrubs, and herbaceous matter native to the existing stream should be planted and non-native species should be controlled.



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

	WETLANDS (ACRES)			WATERBODIES (ACRES) (SHADING)		
ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A	0.18	0.11	0.29	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE A ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A	1.20	2.38	3.58

NEW JERSEY DEPARTMENT OF TRANSPORTATION

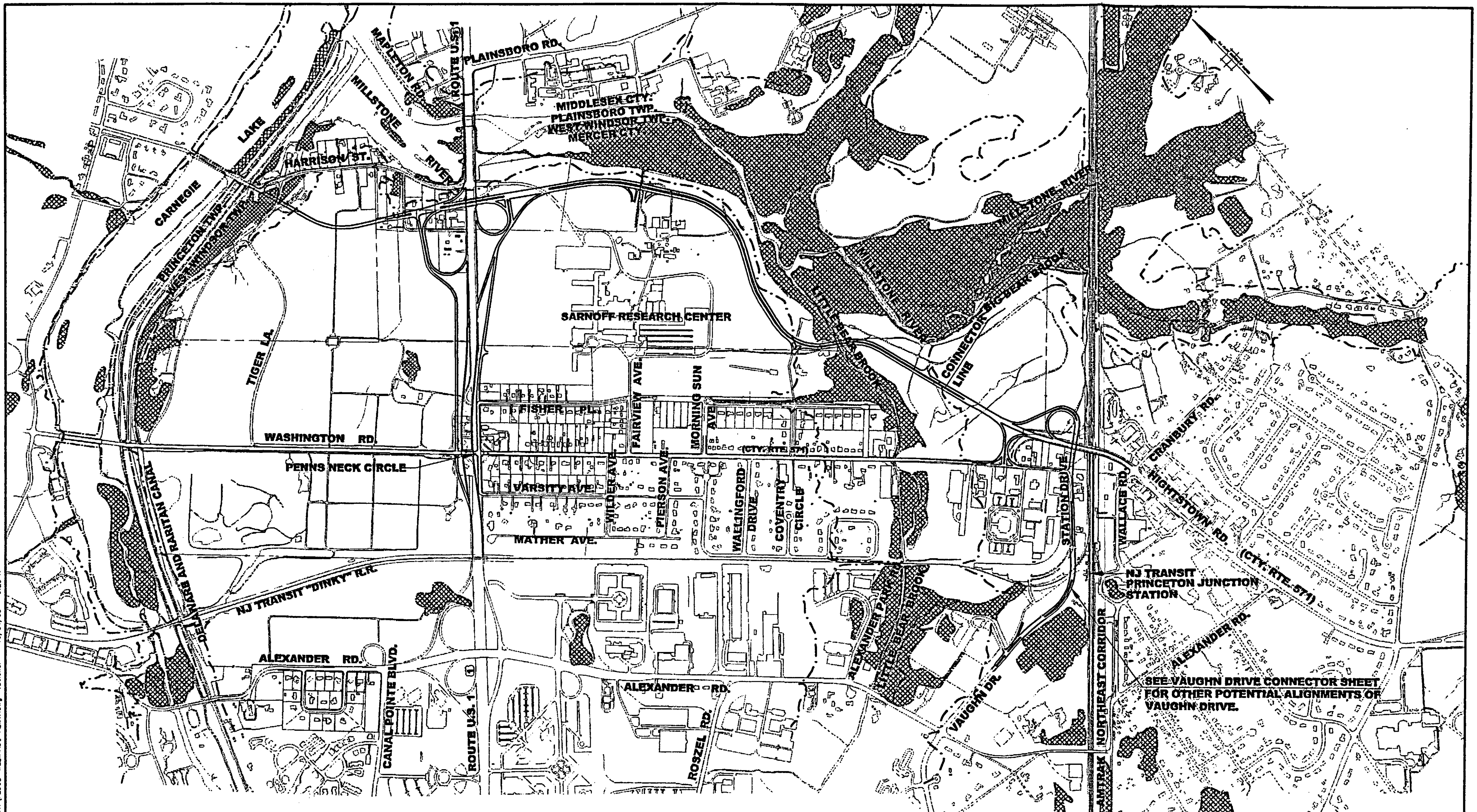
PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT

ACTION ALTERNATIVE A WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-33c

DMJM HARRIS P:\1356\22\ENV\FLOOD-WETLANDS-ALTA.dwg rbelcher 16/04/03 - 9:29 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLANDS (ACRES)			WATERBODIES (ACRES) (SHADING)		
	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A.1	0.18	0.11	0.29	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE A.1 ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A.1	1.20	2.38	3.58

NEW JERSEY DEPARTMENT OF TRANSPORTATION

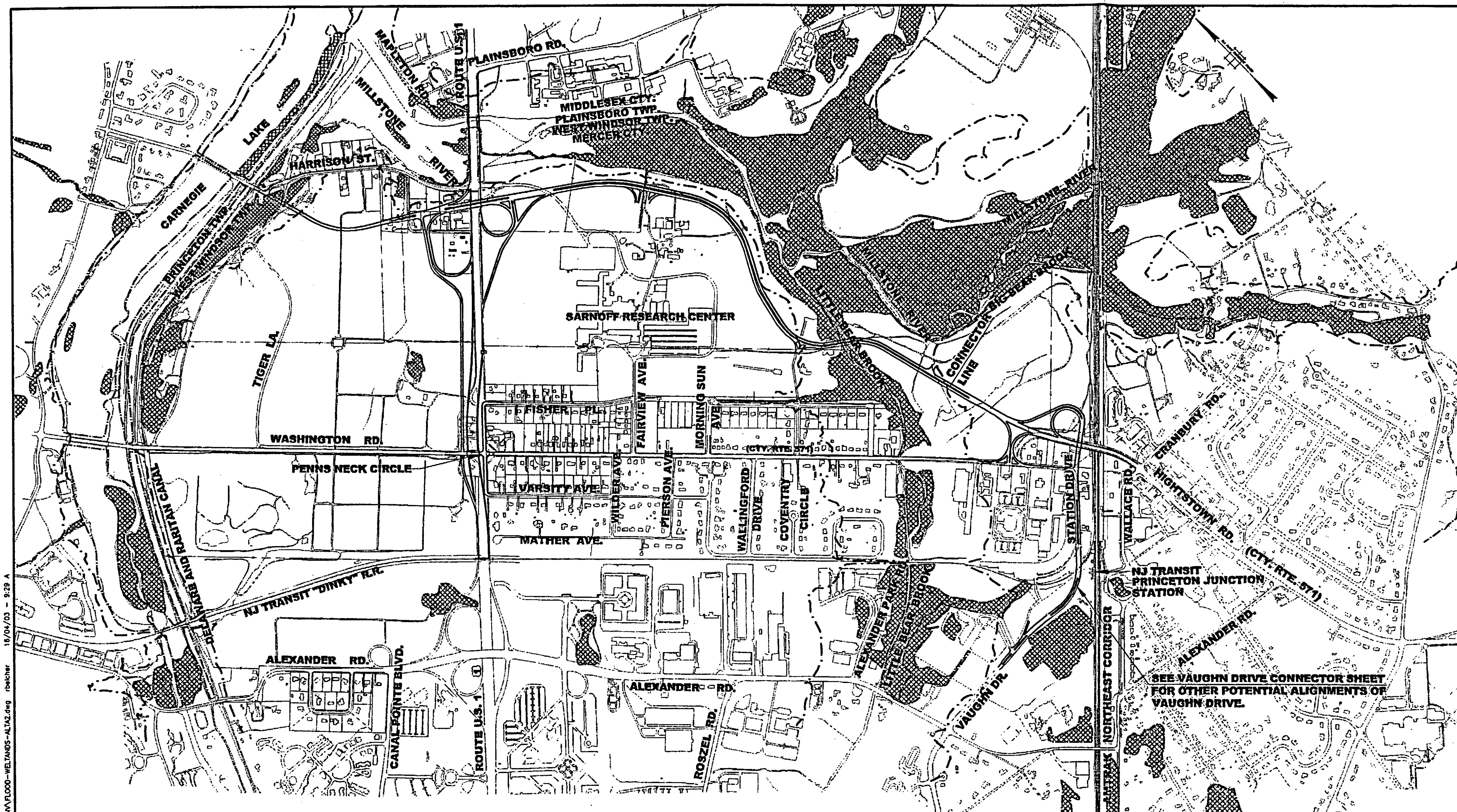
PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT

ACTION ALTERNATIVE A.1
WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-34

DMJM HARRIS P:\1366\22\ENV\FLOOD-WETLANDS-ALTA1.dwg rbelcher 16/04/03 - 9:28 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS						
	WETLANDS (ACRES)			WATERBODIES (ACRES) (SHADING)		
ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A.2	0.18	0.11	0.29	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE A.2 ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

FLOODPLAIN IMPACTS			
ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A.2	1.20	2.38	3.58

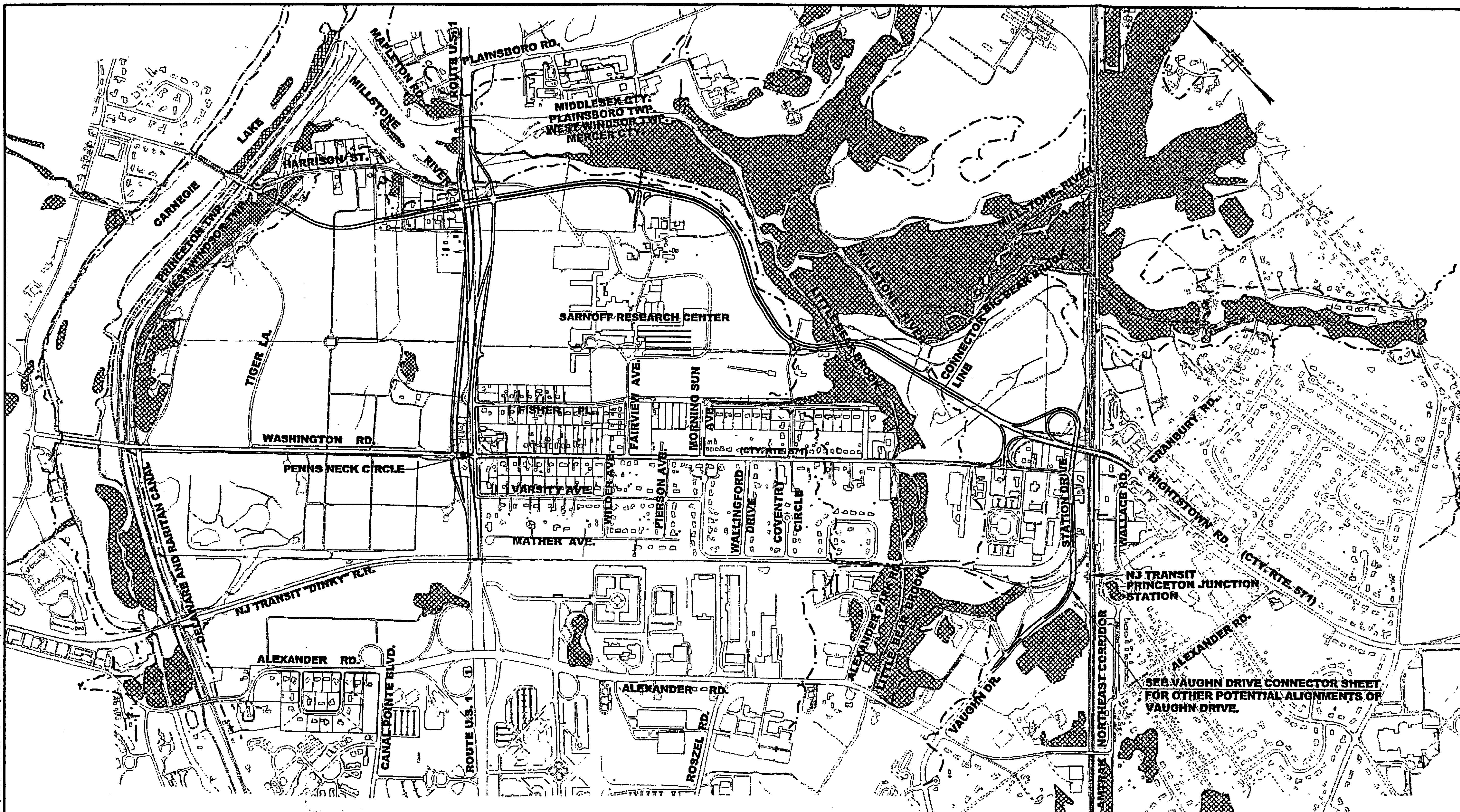
NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT
ACTION ALTERNATIVE A.2
WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-35

DMJMHARRIS P:\1366\22\ENV\FLOOD-WETLANDS-ALT2.dwg rbelcher 18/04/03 - 8:29 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- 100 YEAR FLOOD LIMITS
- WETLANDS

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLANDS (ACRES)			WATERBODIES (ACRES) (SHADING)		
	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A.3	0.40	0.11	0.51	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE A.3 ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A.3	1.54	2.38	3.92

NEW JERSEY DEPARTMENT OF TRANSPORTATION

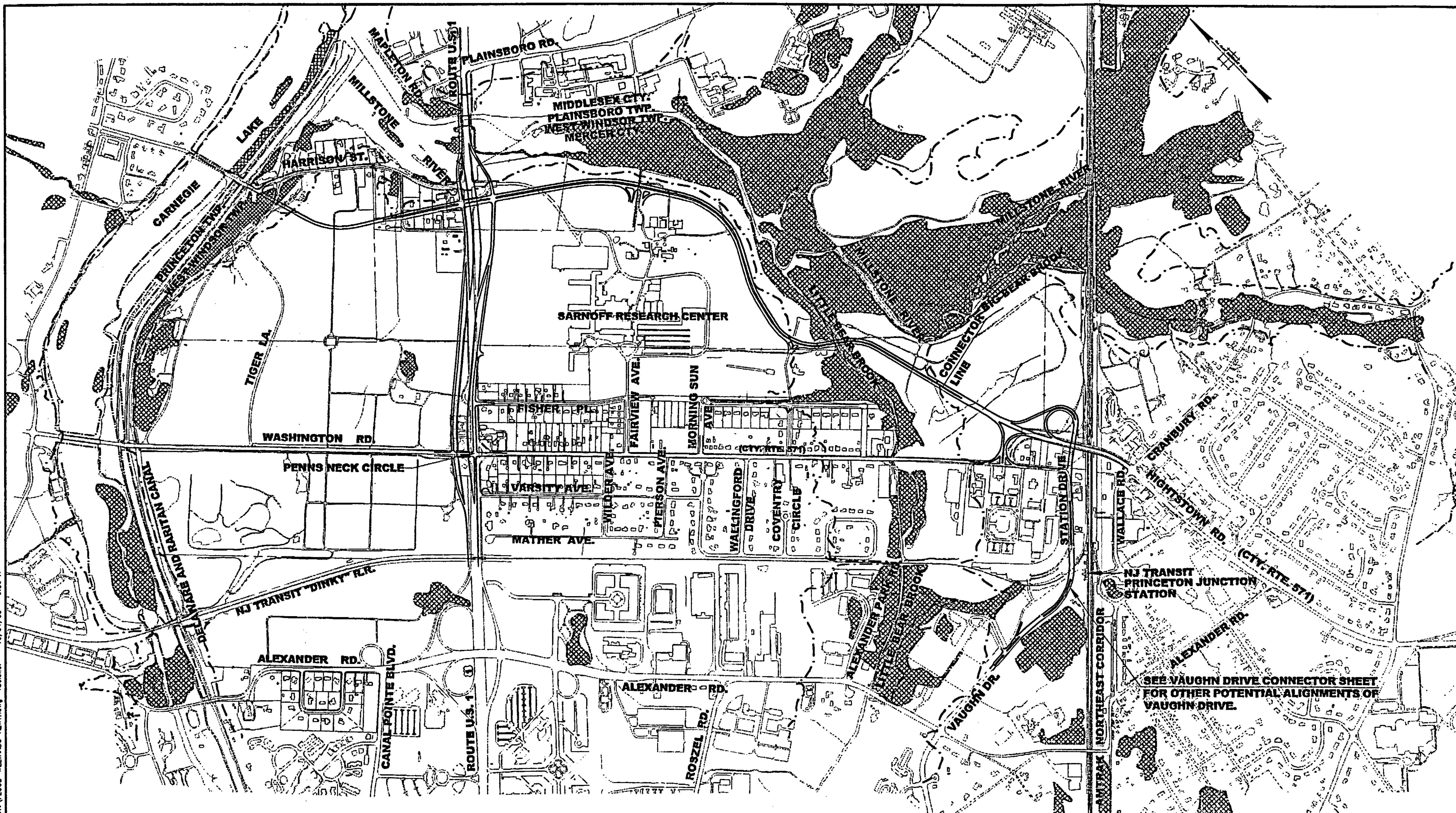
PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT

ACTION ALTERNATIVE A.3
WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-36

DMJMHARRIS P:\1366\22\ENV\FLOOD-WETLANDS-ALTA3.dwg rbelcher 16/04/03 - 9:29 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

	WETLANDS (ACRES)			WATERBODIES (ACRES) (SHADING)		
ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A.4	0.40	0.11	0.51	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE A.4 ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

FLOOD PLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
A.4	1.54	2.38	3.92

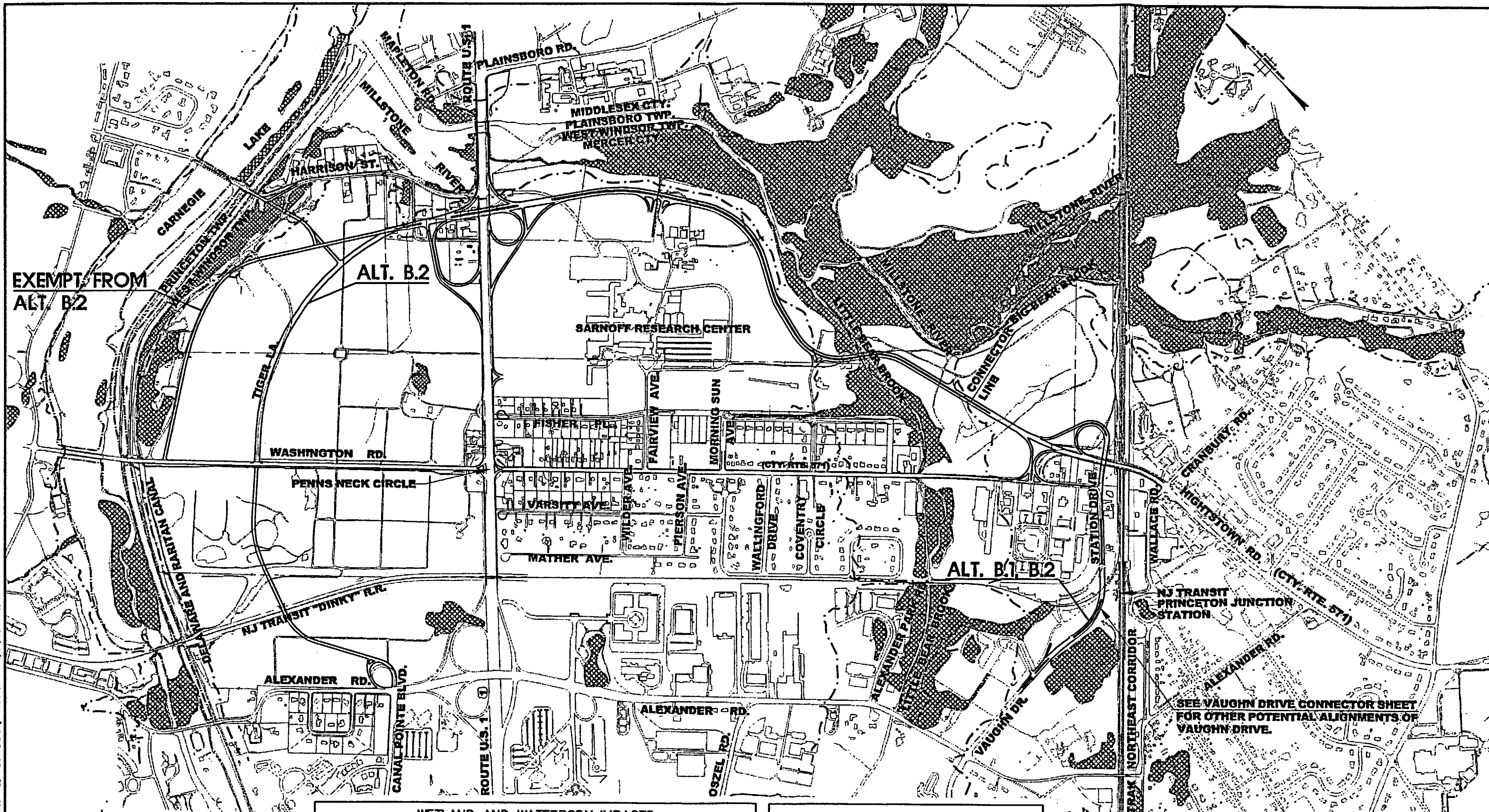
NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT
ACTION ALTERNATIVE A.4
WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-37

DMJM HARRIS P:\1366\22\ENV\FLOOD-WELTANDS-ALTA4.dwg rbelcher 16/04/03 - 9:30 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLAND (ACRES) MILLSTONE RIVER	WETLAND (ACRES) LITTLE BEAR BROOK	WETLAND (ACRES) TOTAL	WATERBODIES (ACRES) (SHADING) MILLSTONE RIVER	WATERBODIES (ACRES) (SHADING) LITTLE BEAR BROOK	WATERBODIES (ACRES) (SHADING) TOTAL
B	0.20	0.11	0.31	0.08	0.08	0.16
B.1	0.20	0.11	0.31	0.08	0.08	0.16
B.2	0.20	0.11	0.31	0.08	0.08	0.16

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
B	1.72	2.38	4.10
B.1	1.72	2.38	4.10
B.2	1.60	2.38	3.98

NOTE: IMPACTS FOR ALTERNATIVES B, B.1 & B.2 ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

NEW JERSEY DEPARTMENT OF TRANSPORTATION

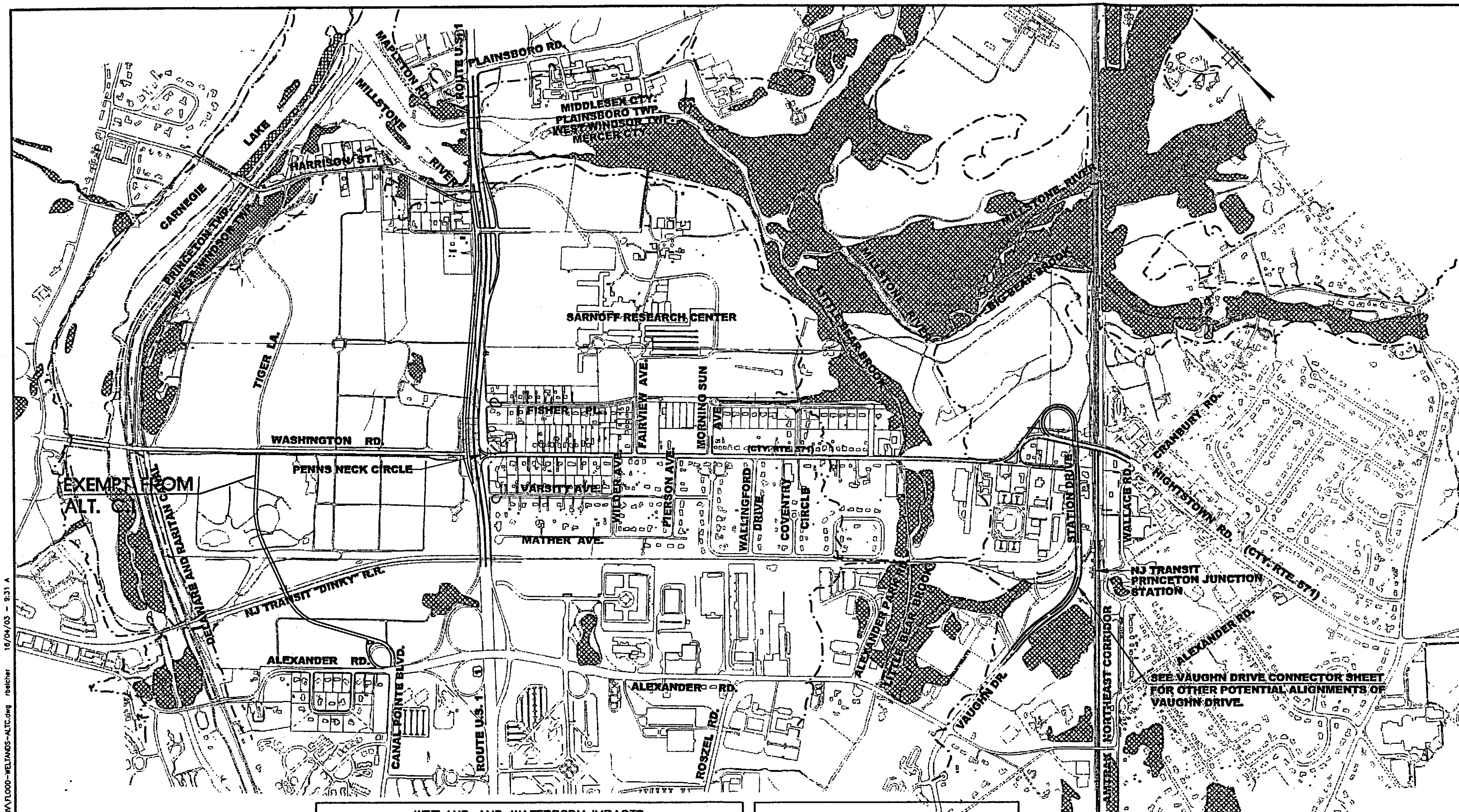
PENNS NECK AREA ENVIRONMENTAL IMPACT STATEMENT

ACTION ALTERNATIVE B, B.1, B.2 WETLANDS, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-38

DMJMHARRIS P:\1366\22\ENV\FLOOD-WETLANDS-ALTB.dwg rbeicher 16/04/03 - 9:31 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLANDS (ACRES) MILLSTONE RIVER	WETLANDS (ACRES) LITTLE BEAR BROOK	WETLANDS (ACRES) TOTAL	WATERBODIES (ACRES) (SHADING) MILLSTONE RIVER	WATERBODIES (ACRES) (SHADING) LITTLE BEAR BROOK	WATERBODIES (ACRES) (SHADING) TOTAL
C	0.06	–0–	0.06	0.08	0.08	0.16
C.1	0.06	–0–	0.06	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE C & C.1 DO NOT INCLUDE THE VAUGHN DRIVE CONNECTOR. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5–2n.

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
C	0.99	–0–	0.99
C.1	0.99	–0–	0.99

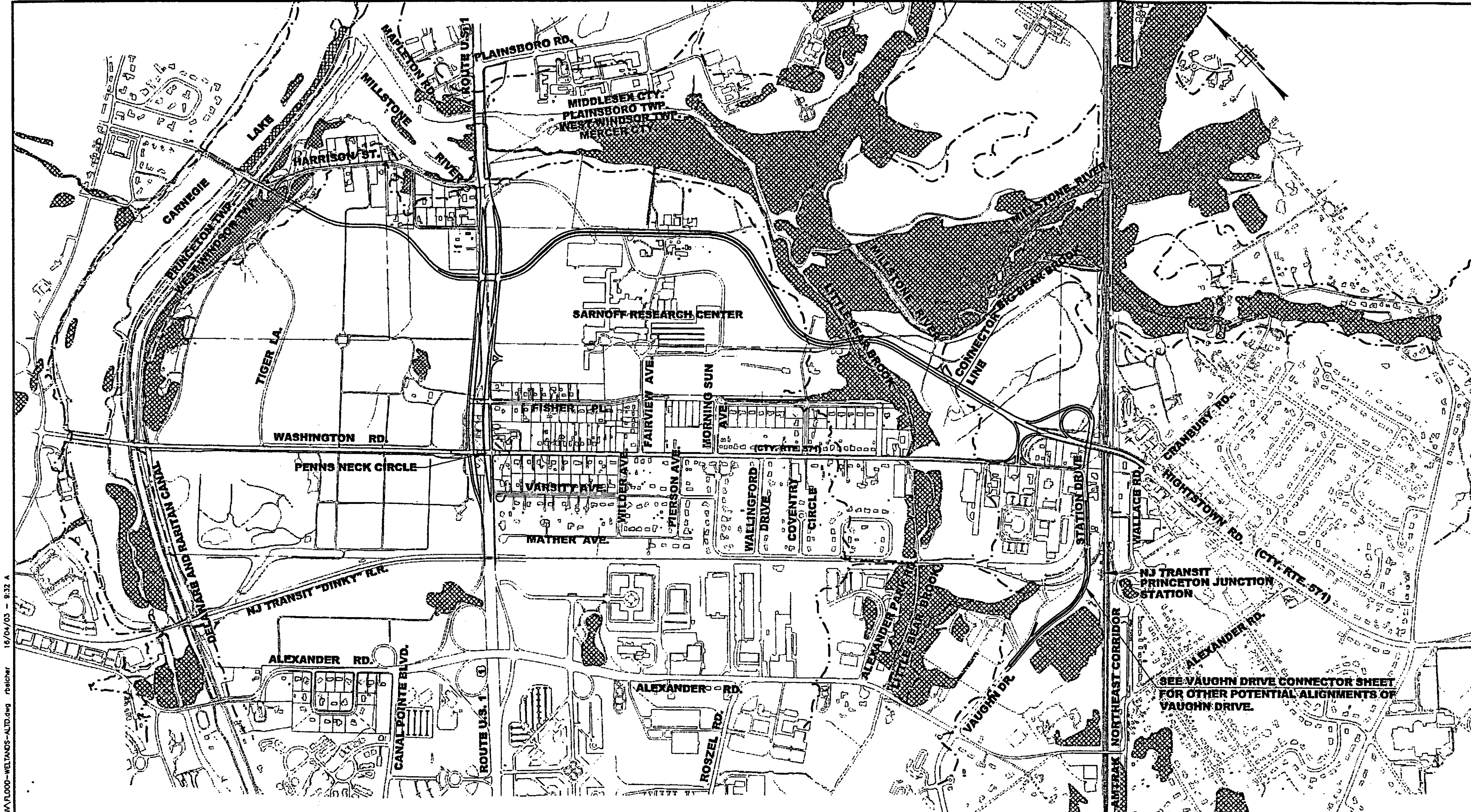
NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT

ACTION ALTERNATIVE C, C.1 WETLANDS, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-39



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLANDS (ACRES) MILLSTONE RIVER	WETLANDS (ACRES) LITTLE BEAR BROOK	WETLANDS (ACRES) TOTAL	WATERBODIES (ACRES) (SHADING) MILLSTONE RIVER	WATERBODIES (ACRES) (SHADING) LITTLE BEAR BROOK	WATERBODIES (ACRES) (SHADING) TOTAL
D	0.18	0.11	0.29	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE D ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
D	1.22	2.38	3.60

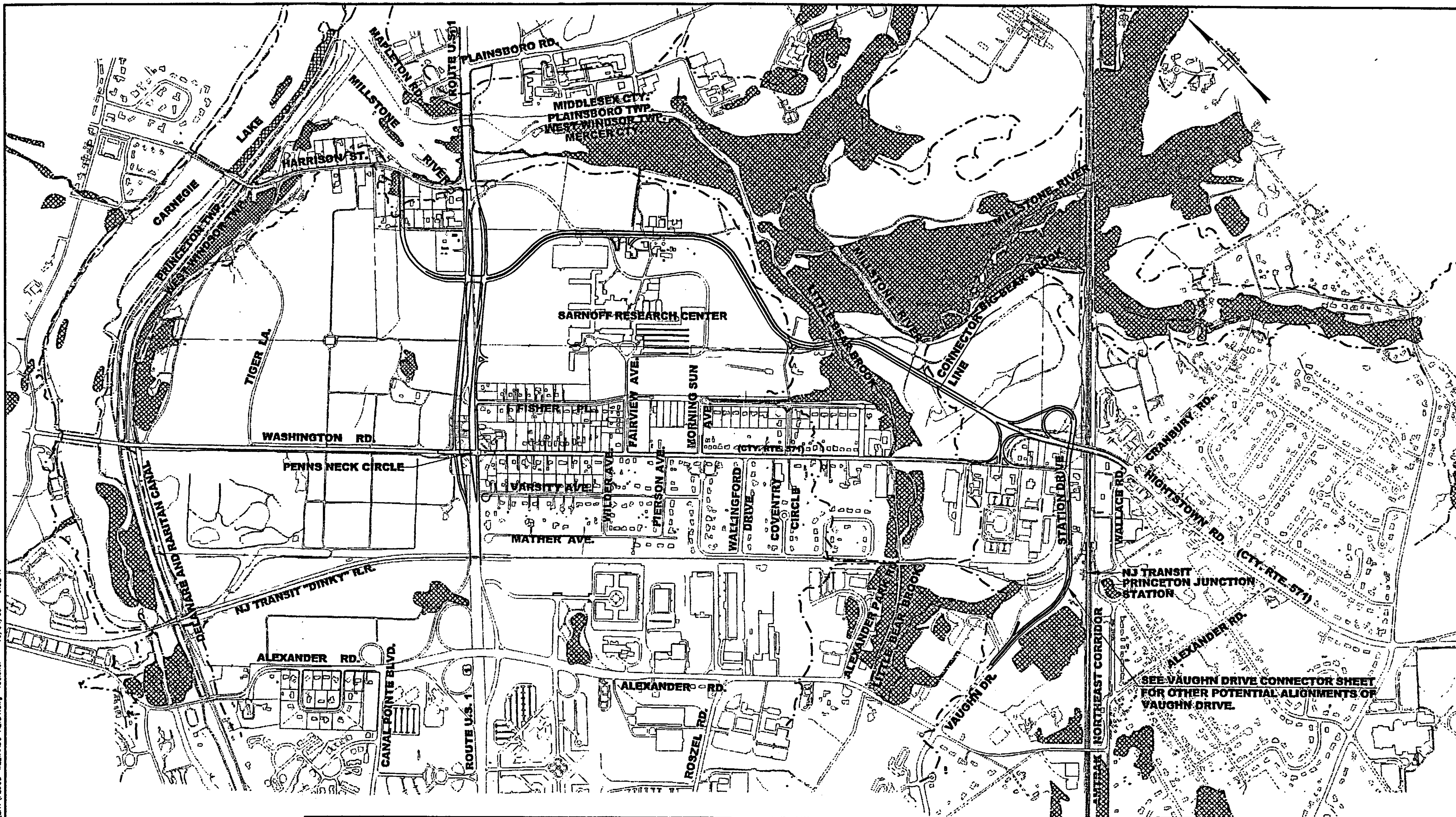
NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT
ACTION ALTERNATIVE D
WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-40

DMJMHARRIS P:\1366\22\ENV\FLOOD-WETLANDS-ALTD.dwg rbelcher 16/04/03 - 9:32 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLANDS (ACRES) MILLSTONE RIVER	WETLANDS (ACRES) LITTLE BEAR BROOK	WETLANDS (ACRES) TOTAL	WATERBODIES (ACRES) (SHADING) MILLSTONE RIVER	WATERBODIES (ACRES) (SHADING) LITTLE BEAR BROOK	WATERBODIES (ACRES) (SHADING) TOTAL
D.1	0.08	0.11	0.19	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE D.1 ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
D.1	1.20	2.38	3.58

NEW JERSEY DEPARTMENT OF TRANSPORTATION

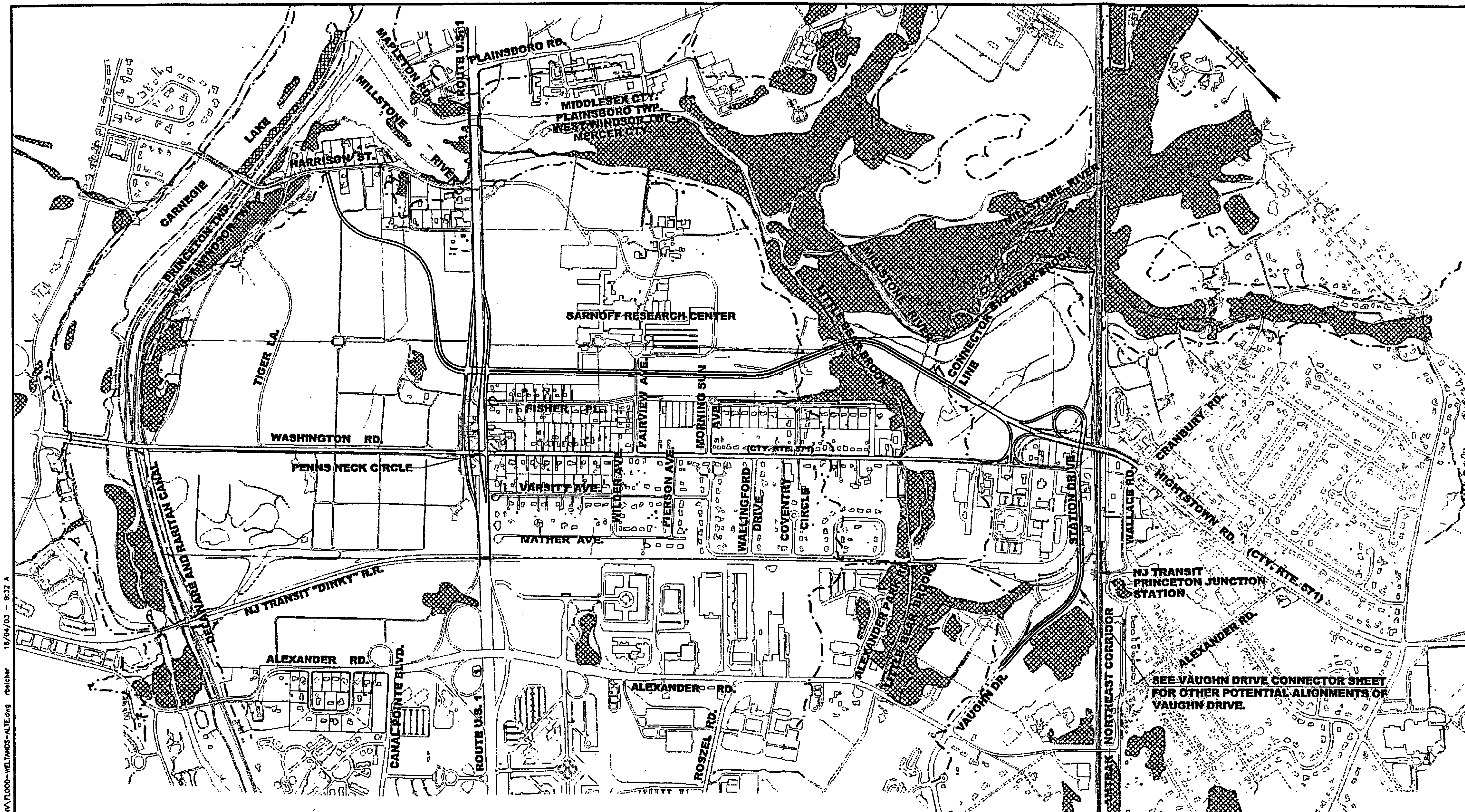
PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT

ACTION ALTERNATIVE D.1
WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-41

DMJM+HARRIS P:\1366\22\ENV\FLOOD-WETLANDS-ALTD1.dwg rbelcher 16/04/03 - 9:32 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLANDS (ACRES)			WATERBODIES (ACRES) (SHADING)		
	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
E	0.10	0.11	0.21	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE E ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
E	0.66	2.38	3.04

NEW JERSEY DEPARTMENT OF TRANSPORTATION

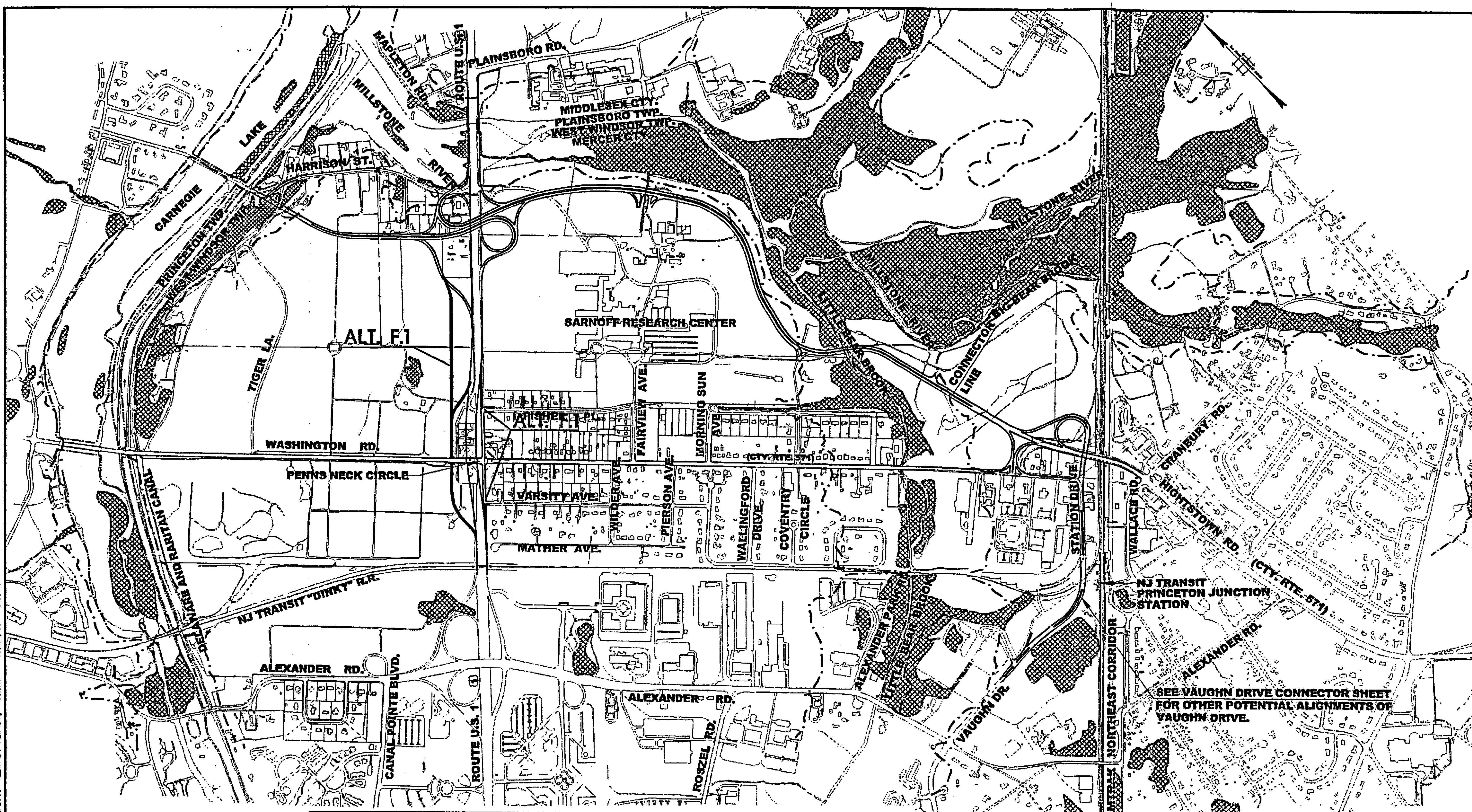
PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT

ACTION ALTERNATIVE E
WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-42

DMJM HARRIS P:\1366\22\ENV\FLOOD-WELTANDS-ALTE.dwg rbelcher 16/04/03 - 9:32 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLANDS (ACRES) MILLSTONE RIVER	WETLANDS (ACRES) LITTLE BEAR BROOK	WETLANDS (ACRES) TOTAL	WATERBODIES (ACRES) (SHADING) MILLSTONE RIVER	WATERBODIES (ACRES) (SHADING) LITTLE BEAR BROOK	WATERBODIES (ACRES) (SHADING) TOTAL
F	0.18	0.11	0.29	0.08	0.08	0.16
F.1	0.18	0.11	0.29	0.08	0.08	0.16

NOTE: IMPACTS FOR ALTERNATIVE F & F.1 ONLY INCLUDE UP TO THE CONNECTOR LINE. IMPACTS ASSOCIATED WITH THE VAUGHN DRIVE CONNECTOR ALIGNMENTS ARE SHOWN SEPARATELY ON FIG. 5-2n.

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
F	1.56	2.38	3.94
F.1	1.56	2.38	3.94

NEW JERSEY DEPARTMENT OF TRANSPORTATION

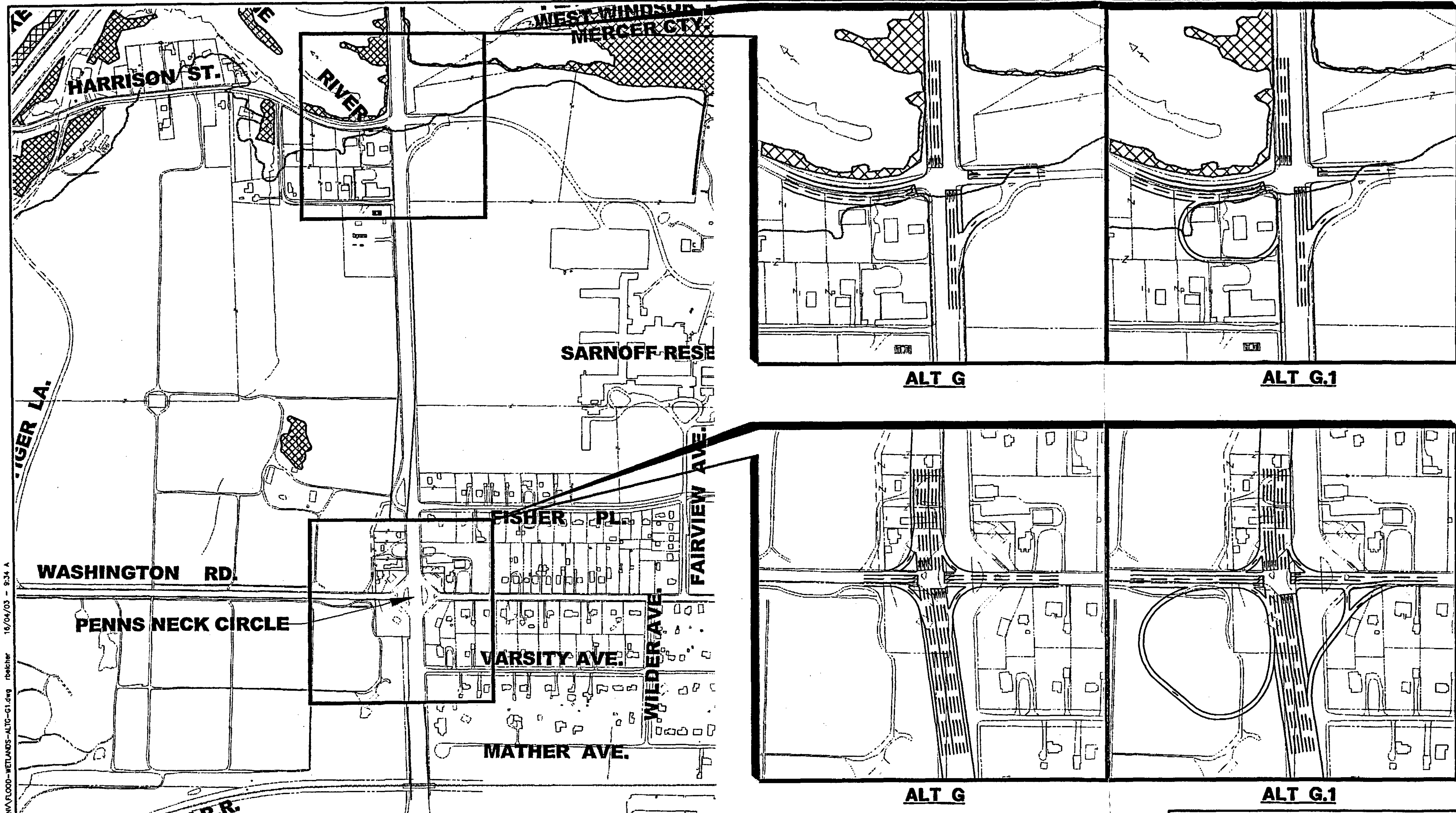
PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT

ACTION ALTERNATIVE F, F.1
WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-43

DMJMHARRIS P:\1366\22\ENV\FLOOD-WELTANDS-ALTF.dwg rbelcher 16/04/03 - 9:33 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLANDS (ACRES): MILLSTONE RIVER	WETLANDS (ACRES): LITTLE BEAR BROOK	WETLANDS (ACRES): TOTAL	WATERBODIES (ACRES) (SHADING): MILLSTONE RIVER	WATERBODIES (ACRES) (SHADING): LITTLE BEAR BROOK	WATERBODIES (ACRES) (SHADING): TOTAL
G	0.10	–0–	0.10	–0–	–0–	–0–
G.1	0.10	–0–	0.10	–0–	–0–	–0–

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
G	0.98	–0–	0.98
G.1	1.02	–0–	1.02

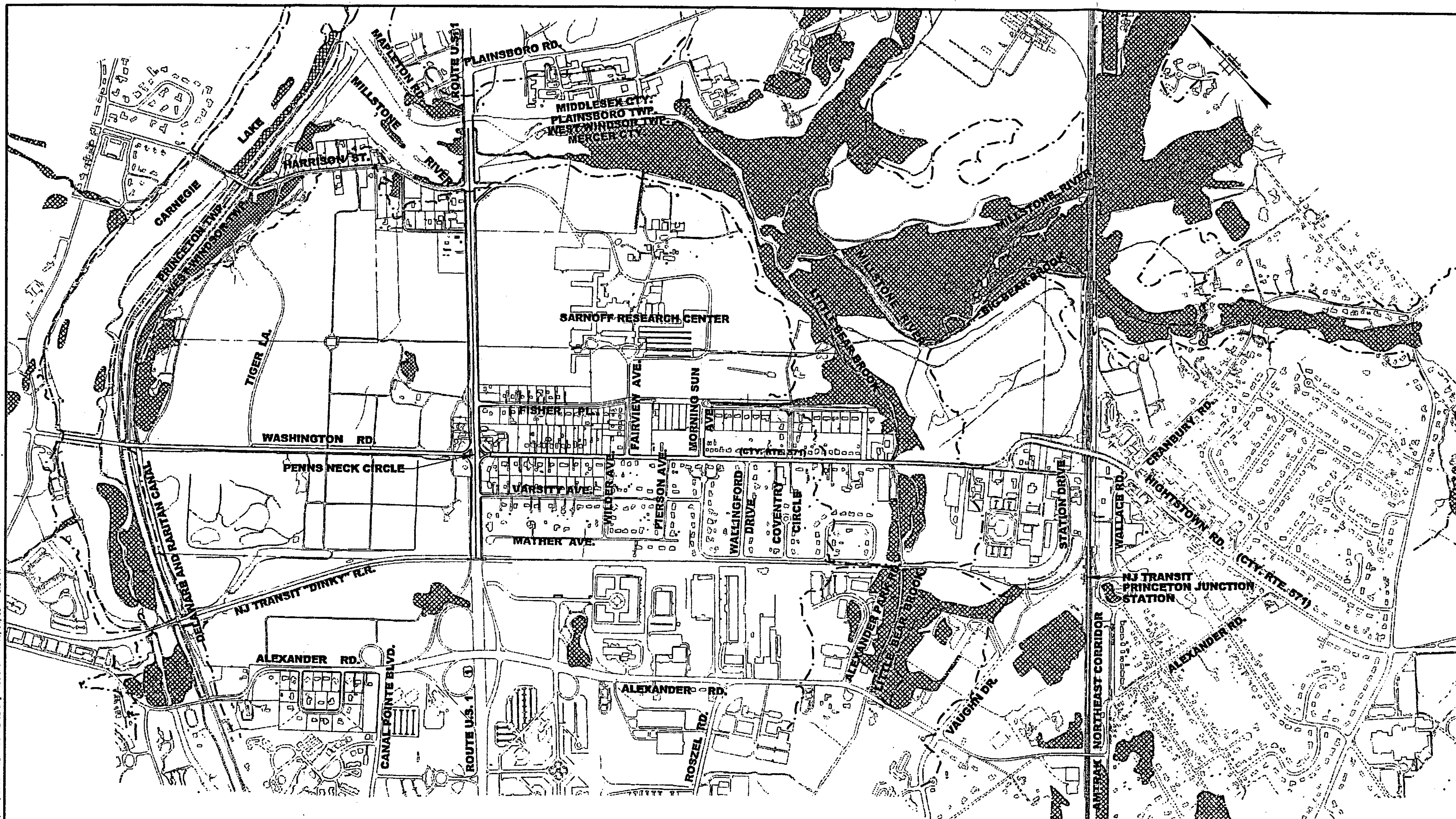
NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT
ACTION ALTERNATIVE G, G.1
WETLAND, WATERBODIES
& FLOODPLAINS

DATE: NOV. 2002
SCALE: 1"=500'

FIGURE 4-44

DMJM HARRIS P:\1366\22\ENV\FLOOD-WETLANDS-ALTG-G1.dwg rbelcher 16/04/03 - 9:34 A



LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- WETLANDS
- NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD LINE

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE	WETLANDS (ACRES) MILLSTONE RIVER	WETLANDS (ACRES) LITTLE BEAR BROOK	WETLANDS (ACRES) TOTAL	WATERBODIES (ACRES) (SHADING) MILLSTONE RIVER	WATERBODIES (ACRES) (SHADING) LITTLE BEAR BROOK	WATERBODIES (ACRES) (SHADING) TOTAL
G.2	0.10	–0–	0.10	–0–	–0–	–0–

FLOODPLAIN IMPACTS

ALTERNATIVE	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
G.2	0.63	–0–	0.63

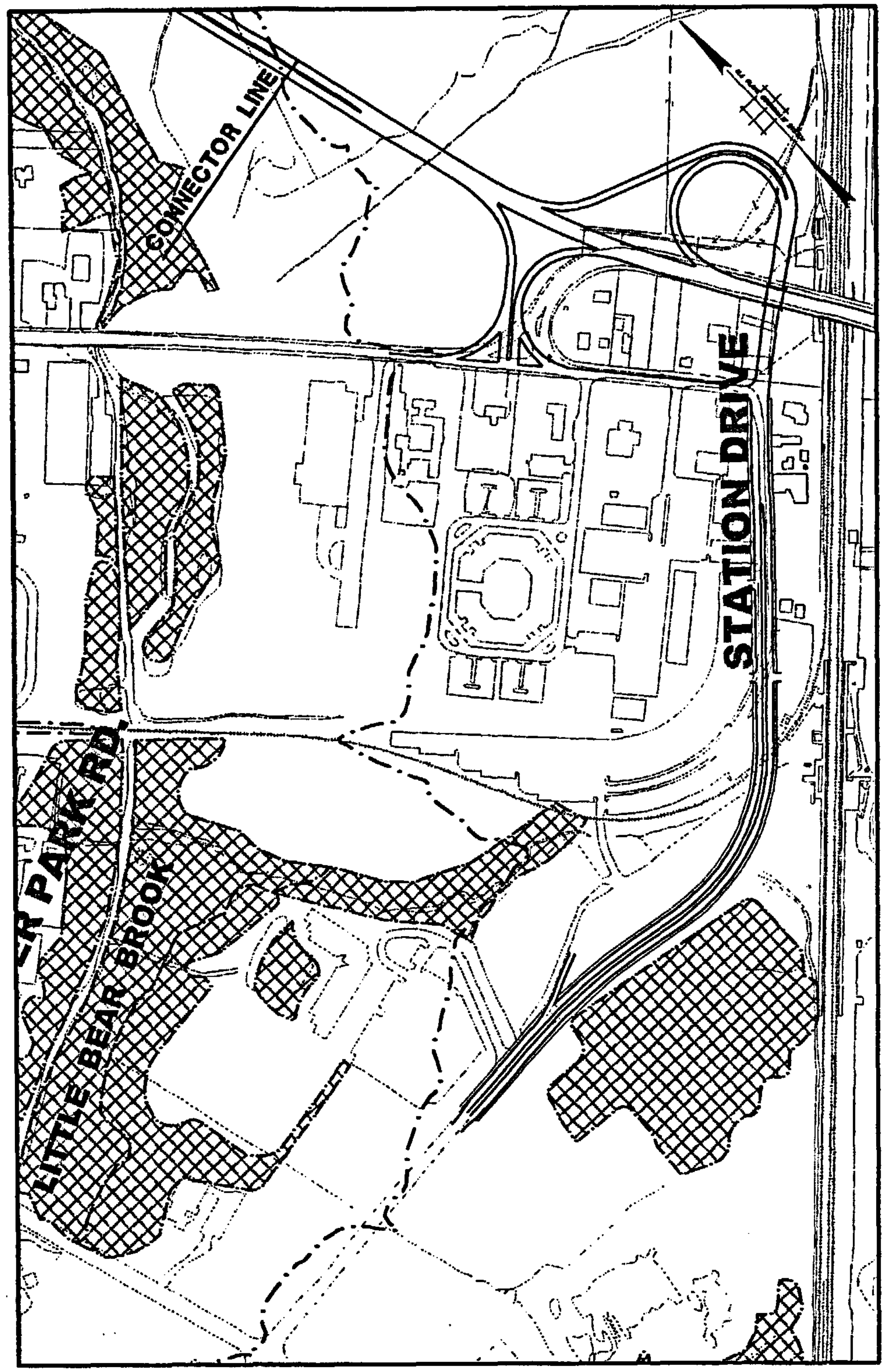
NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT
ACTION ALTERNATIVE G.2
WETLAND, WATERBODIES & FLOODPLAINS

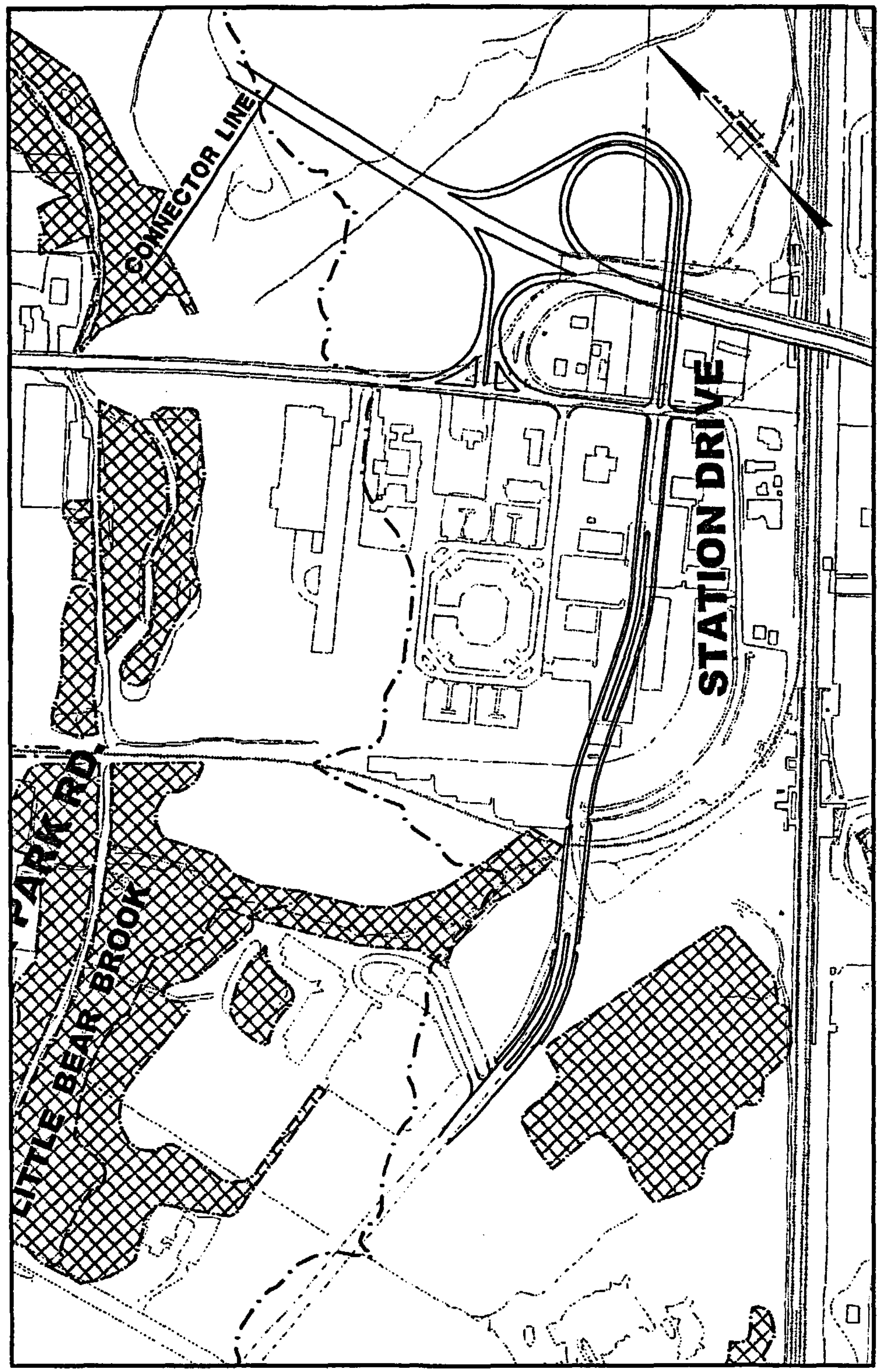
DATE: NOV. 2002
SCALE: 1"=1000'

FIGURE 4-45

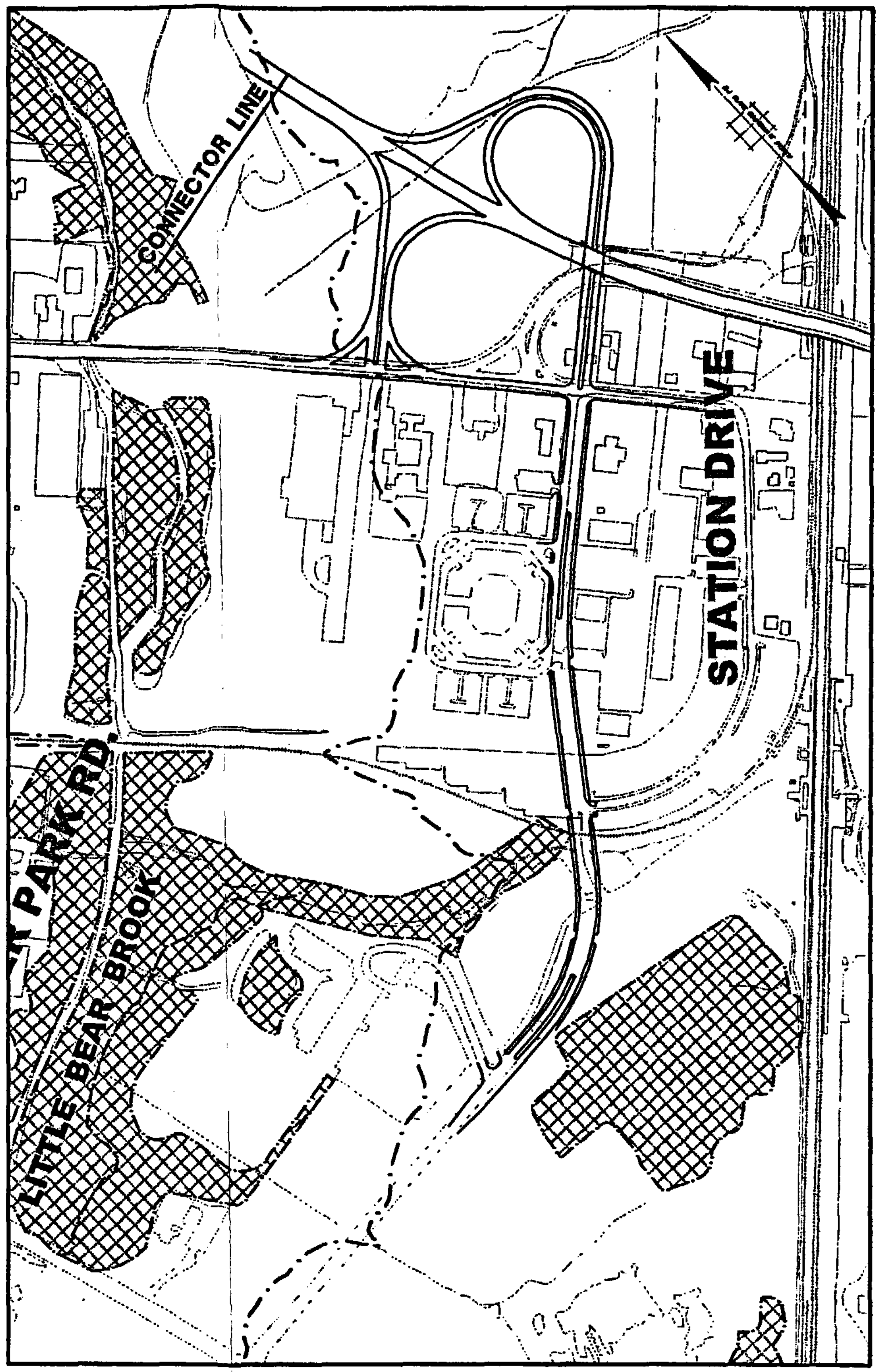
DMJM HARRIS P:\1366\22\ENV\FLOOD-WETLANDS-ALTG2.dwg rbelcher 18/04/03 - 9:34 A



ALIGNMENT 1



ALIGNMENT 2



ALIGNMENT 3

LEGEND:

- PROPOSED IMPROVEMENTS
- EXISTING CONDITIONS
- 100 YEAR FLOOD LIMITS
- WETLANDS

WETLAND AND WATERBODY IMPACTS

ALTERNATIVE		WETLANDS (ACRES)			WATERBODIES (ACRES) (SHADING)		
		MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL	MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
VDC 1	ESC & EB RAMPS VDC ROAD & WB RAMPS	-0-	-0-	-0-	-0-	-0-	-0-
VDC 2	ESC & EB RAMPS VDC ROAD & WB RAMPS	-0-	-0-	-0-	-0-	-0-	-0-
VDC 3	ESC & EB RAMPS VDC ROAD & WB RAMPS	-0-	-0-	-0-	-0-	-0-	-0-

FLOODPLAIN IMPACTS

ALTERNATIVE		MILLSTONE RIVER	LITTLE BEAR BROOK	TOTAL
VDC 1	ESC & EB RAMPS VDC ROAD & WB RAMPS	-0-	-0-	-0-
VDC 2	ESC & EB RAMPS VDC ROAD & WB RAMPS	-0-	-0-	-0-
VDC 3	ESC & EB RAMPS VDC ROAD & WB RAMPS	-0-	-0-	-0-

NEW JERSEY DEPARTMENT OF TRANSPORTATION

PENNS NECK AREA
ENVIRONMENTAL IMPACT STATEMENT
VAUGHN DRIVE CONNECTORS
ACTION ALIGNMENTS 1, 2, 3
WETLAND, WATERBODIES & FLOODPLAINS

DATE: NOV.2002
SCALE: 1"=1000'

FIGURE 4-46