Water Quality Analysis of A4335/S3156
Report on
Impacts of A4335/S3156 to
New Jersey's Waterways

Submitted By:

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Introduction

New Jersey is the most developed state in the nation and will be the first to reach full build out – when all our land area will be either formally preserved or developed. According to Rutgers University Spatial Remote Sensing and Spatial Analysis this is expected to happen within the next forty years, or sooner.

One of the consequences of development is a resulting decline in water quality. Research has established a strong connection between water pollution and the encroachment of development on critical watershed lands that protect water supplies.

Open natural lands are critical to maintaining the quality of both underground water supplies and above ground waterways. Forested lands in particular filter pollutants from water and absorb stormwater runoff.

As New Jersey reaches full build out, we must recognize the contribution of poorly planned development to declining water quality, and craft a definition of "smart growth" that puts clean water at its center. Nature has provided our waterways with their best defense from pollution -- the lands that surround them. True "smart growth" avoids destroying the water quality protecting characteristics of these lands and ensures that they remain intact.

The NJDEP 2008 Water Quality Management Planning (WQMP) Rules were designed to protect water by prohibiting the extension of sewer lines into lands that protect water quality. A primary purpose is to avoid the water degradation impacts of intense development that follows sewers. Despite New Jersey's level of urbanization, there still remain some 300,000 acres of resource rich open lands, in blocks of 25 contiguous acres or more -- forests, farmland, stream corridors and wetlands -- that buffer and protect important waterways and underground aquifers. They are highly vulnerable to development pressure. These lands comprise some of the highest quality, most valuable and environmentally sensitive lands remaining in New Jersey that have not yet been formally protected. The 2008 WQMP rule protected these 300,000 acres from high density development by prohibiting sewer service into them.

Although the 2008 WQMP rule was adopted, its implementation has been greatly delayed. First, counties designated to facilitate local compliance with the new rule requested more time to bring local plans into compliance with new standards. The

NJDEP granted these extensions and continued to do so as deadlines came and went. More recently, development interests have pressed the Legislature to delay the rule for another three years. The bills pending before the New Jersey Legislature (A4335 and S3156) would not only unnecessarily delay the implementation of the 2008 WQMP rule, but would also severely weaken protections for these lands provided by the 2008 rule.

The passage of A4335 and S3156 will weaken the WQMP Rule by allowing sewer service to be extended into these 300,000 acres. The proposed legislation also weakens the WQMP's standard limiting high density development over important drinking water aquifers. The U.S. EPA gave New Jersey counties $1.6 Million to develop new plans under these rules. As noted above, most counties have worked closely over the past 3+ years with municipal governments and have completed (or have nearly completed) the preparation of the plans. S3156/A4335 dismantles and delays compliance with the 2008 WQMP Rules.

Much of the non-point source pollution impacts affecting the State's surface waters, estuaries and coastal waters can be linked to development sprawl. The WQMP rule is intended to address the sprawl and poorly planned development that are largely the root cause of most of the impairments afflicting the State's waterways. It should be noted that:

- More than <u>50%</u> of waterways designated as drinking water sources do not fully support that use, failing to meet one or more water quality standards.
- Only <u>16%</u> of waterways designated for recreational use are safe for swimming.
- Less than <u>1%</u> of the state's waters meet the standards that support fishing as a food source, and fish caught in many of these waters are not safe for consumption.

The WQMP rule was a significant effort to reverse these serious deficiencies. A basic tenet of "smart growth" is to keep growth away from natural resources that are critical to sustainability over the long term. The proposed legislation will roll back the protection of our water resources established in the WQMP rule. Further development of the critical watershed lands protected by the WQMP rule will worsen the already impaired water quality conditions of the State's lakes, ponds, rivers, streams and coastal waterway.

This report computes the increase in water pollution that will result from the whole or partial development of these 300,000 acres of currently undeveloped critical natural lands. Specifically, this report analyzes the pollution loading increases that will occur if the 300,000 acres are converted into high density developed areas, as opposed to being left intact in their present condition. Although beyond the scope of this report, it is worth noting that the cost of not protecting these lands will extend well beyond environmental pollution costs, into areas of food production, protection of biodiversity, recreational opportunity, and carbon sequestration to combat climate change, and have substantial ramifications for public health, long term quality of life, and the economic well being of taxpayers.

Loading Methodology

The changes in pollutant loading computed in this analysis involved the application of a simple unit areal loading (UAL) algorithm. This essentially entailed multiplying the area of the affected land (in hectares) by a loading coefficient (kg/ha/yr). The pollutants of concern that are the subject of this analysis are total nitrogen (TN), total phosphorus (TP) and total suspended solids (TSS). Limiting the analysis to these three pollutants of concern is consistent with the NJDEP's efforts to protect and restore the surface waters of the State as reflected in the Department's Watershed Protection Plans (WPP) and Total Maximum Daily Loads (TMDL). Additionally, these same pollutants are consistent with the NJDEP's management of stormwater quality as reflected in the State's surface water quality standards and stormwater rules (respectively, N.J.A.C. 7:7B and N.J.A.C. 7:8) and NJDEP's New Jersey Stormwater Best Management Practices Manual (NJDEP 2010). Finally, TN, TP and TSS are recognized as the primary pollutants responsible for the majority of the eutrophication and use impairments impacting the State's rivers, streams, lakes and reservoirs. The impacts caused by these pollutants are detailed further below. The need to reduce the introduction of these pollutants into the water's of the State is exemplified in the NJDEP's efforts to restore Barnegat Bay and the State's restoration projects of Lake Hopatcong, Spruce Run Reservoir, Round Valley Reservoir, Greenwood Lake, Swarstwood Lake and a multitude of other recreational lakes and drinking water reservoirs.

The environmental impacts attributable to nitrogen, phosphorus and sediment are well documented in the scientific literature. Phosphorus and nitrogen are the two nutrients most critical to plant and algal growth and as such, increases in these nutrients generally lead to increased productivity, which essentially translates to increased eutrophication. The negative effects of eutrophication can be observed with respect to changes in ecological services and functions, alteration of food webs and species composition, decline in water quality and aesthetics and losses in recreational use and degraded drinking water. In freshwater ecosystems phosphorus is the limiting nutrient, that is, the nutrient that is least available in relation to biological demand. As such, small increases in phosphorus loading typically translate to disproportional increases in algal and weed growth. In estuarine and coastal ecosystems, nitrogen is the limiting nutrient. Again, as documented by extensive studies of Barnegat Bay, Chesapeake Bay and estuarine ecosystems, increased nitrogen loading results in major alterations to the overall ecological state of such systems.

Total suspended solids is a measurement of the total amount of inorganic and organic particles present in the water column. TSS is a prime determinant of water clarity. While a decrease in clarity is an obvious impact of increased TSS loading, adsorbed or adhered to the sediment particles are a variety of pollutants including nutrients, heavy metals, pesticides, and petroleum hydrocarbons. Thus the impacts of increased TSS loading are far more significant than just the obvious increase in turbidity and loss of water clarity. In creased TSS loading is typically the result of the transport during rain events of accumulated material from paved surfaces, the erosion of upland soils or the erosion and down cutting of river and stream banks. Increases in TSS loading are inherently linked to increases in impervious coverage. The more impervious cover, the more stormwater runoff and hence an increase in stormwater runoff velocities and volumes, both of which serves to increase erosional process and sediment transport.

For this analysis, land use coverage data was obtained from the most current NJDEP GIS land use and land cover database. The minimum parcel size used in the analysis was 25 acres. A composite map of the affected lands is provided as Figure 1. Four land use land cover categories were modeled; these being agricultural, forest, barren land and urban. The coefficients applied to each category are provided below (Table 1).

Table 1 – Loading Coefficients By Land Use / Land Cover Category			
Land Use Descriptor	Loading Coefficients (kg/ha/yr)		
	TN	TP	TSS
Urban (High Density, Mixed Use Residential)	7.50	1.20	3000
Agricultural	5.00	1.00	2500
Mixed Forest (>50% Crown Closure)	2.50	0.20	250
Barren	5.00	0.80	1000

For the forested category, the basic assumption was that these areas represent relatively stable and intact woodlands with good canopy cover (> 50%). For the agricultural land category, the loading coefficient that was utilized is representative of a cover crop. Barren land was defined as disturbed areas with nominal tree and vegetative cover. Such areas include abandoned previously developed sites, early successional fields, historical sand/quarry sites, and cleared but undeveloped lands with erratic vegetative cover. The urban land use coefficient used in the analysis is representative of a high density, mixed use residential setting. Such a land use condition is consistent with that occurring in sewer service areas. The percent impervious cover is likely in the range of 25% or greater.

Example sources of the pollutant loading coefficients used in this analysis include those published by Brezonik and Stademann (2001), Frick (1991), Driver, et. al. (1985), Reckhow (1980), Line, et. al. (2002), Smullen, et. al. (1999), and Uttormark et. al. (1974). These coefficients are routinely used nation-wide to compute pollutant loading under different land development scenarios. The coefficients used in this analysis have been accepted in the past by NJDEP as part of NJDEP approved Watershed Protection Plans and TMDLs developed state-wide. They are also consistent with the pollutant loading computations conducted by NJDEP, USGS and Kennish and others in recent studies of the eutrophication of Barnegat Bay.

Results

Pollutant loads were computed under existing and projected land use conditions. The existing land use conditions reflect the current land use practices and land covers that currently exist in the areas targeted for sewer expansion (see Figure 1). Specifically the Existing Load values presented in Table 2 represent the pollutant loads attributable to that collectively generated by the existing urban, agricultural, barren and forested loads. Again referring to Table 2, under the projected land use scenario the Projected Load is the sum of the existing urban load plus the load that will occur as a result of the conversion of the existing agricultural, forested and/or barren land into the urban (high density, mixed use residential) condition. The computed increase in loading presented in Table 2 represents the difference between the Existing Load and the Projected Post-Development Load. This difference accounts for the TN, TP and TSS generated under existing conditions by the subject farmlands, forested areas and barren lands. It therefore represents a true, net increase in loading.

It should be noted that the loading data presented in Table 2 is that resulting solely from stormwater runoff from the converted lands. It does not include any additional loading that would result from the increased wastewater generated by any new development or the stormwater runoff from new roads or expended roadways constructed specifically to service the newly developed or redeveloped areas. Additionally, the analysis does not account for any additional pollutant inputs that would occur as a result of the infilling or alteration of wetlands or the loss of the natural soil stabilization and pollutant filtering services provided by any wetlands, wetland transition areas or riparian buffers compromised by the added development. Also, although the stormwater regulations require the management of TSS, the rules do not mandate nutrient management.

Table 3 provides a summary of the changes in pollutant loading that will result with the planned expansion of the sewer service areas. The projected increases in pollutant loading are exceptionally high for Atlantic, Cumberland, Monmouth, Ocean and Somerset Counties (Table 3). **For example, in Ocean County the annual nitrogen load increases by 128275.356 pounds (58,306.98 kg) as a result of the conversion of the subject agricultural, forested and barren lands to urban land.** Given that most of these areas drain to Barnegat Bay; this represents a significant amount of added nitrogen loading to an ecosystem that is already eutrophic. Adding this much nitrogen to the already highly eutrophic Bay will only further stimulate algae related problems. This added loading also counters the present efforts being exerted by the communities, watershed organizations and the State itself in curtailing pollutant loading to the Bay. The success of these multi-million dollar programs and projects are directly jeopardized by the added loading attributable to the projected development.

Figure 1

Summary

Surface water, wetland and groundwater resources are all hydrologically linked. Thus the proper management of these resources requires a concerted, integrated approach. Improper planning and sprawl type land development are not consistent with such an integrated approach. As previously stated, it is such development practices that are largely responsible for much of the water quality impairments affecting the State's waterways. Sensitively to the interlinked nature of surface water, wetland and groundwater resources in part is based on:

- Proper characterization of water, wetland and groundwater resources,
- Minimization of potential environmental impact through the use of conservation and preservation measures,
- Implementation of environmentally sound development practices, and
- Protection of surface water, wetland and groundwater resources through the design, construction, and maintenance of sustainable development practices.

In essence the WQMP rules are intended to integrate and implement the above practices. Fundamental to the WQMP rules is pollutant source reduction, resource conservation, resource preservation and proper land use planning; all of which when correctly implemented are highly effective methods of minimizing both short and long-term development related water quality impacts. These measures reduce or eliminate environmental impacts before they occur. Limiting the entry of pollutants into the environment or avoiding the disturbance of sensitive habitats are ultimately preferable to implementing clean up, mitigation or restoration activities. By reducing the opportunity for pollutants to enter the environment in the first place, the level of protection provided the environment is that much greater than that attained through mitigation and restoration activities.

This analysis clearly shows how development of the subject 300,000 acres of currently protected lands will negatively affect water quality by significantly increasing the amount of TN, TP and TSS entering the waterways to which these lands drain. While it can be argued that measures could be put into place to reduce the added pollutant loading, the fact of the matter is that no matter how effective the best management practice there will still be an increase in loading. Protection of these lands offers a far better and more effective, sustainable means of avoiding the added pollutant loading that will be realized with the development of these lands.

Table 2 - Changes In Loading (Kg/Yr)			
Atlantic County			
	TN	TP	TSS
Existing	25,260.48	2,919.80	5,644,288.77
Predicted	54,177.90	8,668.46	21,671,161.51
Increase	28,917.42	5,748.67	16,026,872.74
Bergen County			
	TN	TP	TSS
Existing	14,234.32	2,144.94	5,170,743.99
Predicted	17,684.49	2,829.52	7,073,796.00
Increase	3,450.17	684.58	1,903,052.02
Burlington County			
	TN	TP	TSS
Existing	13,580.05	1,709.74	3,429,650.05
Predicted	29,004.79	4,640.77	1,1601,914.61
Increase	15,424.74	2,931.02	8,172,264.55
Camden County			
	TN	TP	TSS
Existing	12,686.64	1,668.01	3,504,984.94
Predicted	22,395.93	3,583.35	8,958,372.49
Increase	9,709.29	1,915.34	5,453,387.54
Cape May			
	TN	TP	TSS
Existing	4,674.73	620.85	1,311,997.81
Predicted	8,382.21	3,583.15	3,352,884.46
Increase	3,707.48	720.31	2,040,886.64
Cumberland			
	TN	TP	TSS
Existing	54,975.87	6,285.79	11,681,802.00
Predicted	134,459.82	21,513.57	53,783,929.95
Increase	79,483.95	15,227.79	42,102,127.95
Essex			
	TN	TP	TSS
Existing	3,996.65	603.07	1,447,797.63
Predicted	4,972.79	795.65	1,989,117.30
Increase	976.15	192.57	541,319.66
Gloucester			
	TN	TP	TSS
Existing	8,898.17	1,350.76	2,989,307.53
Predicted	1,5825.29	2,532.05	6,330,116.96
Increase	6,927.12	1,181.29	3,340,809.43

Table 2 Continued- Changes In Loading (Kg/Yr)			
Hudson			
	TN	TP	TSS
Existing	3,944.03	624.69	155,1094.86
Predicted	4,109.70	657.55	1,643,878.04
Increase	165.67	32.87	92,783.18
Hunterdon			
	TN	TP	TSS
Existing	96,16.90	1,439.37	3,293,470.06
Predicted	17,047.17	2,727.55	6,818,868.44
Increase	7,430.27	1,288.18	3,525,398.38
Mercer			
	TN	TP	TSS
Existing	9,020.64	1,257.89	2,776,763.51
Predicted	16,512.14	2,641.94	6,604,854.30
Increase	7,491.49	1,384.05	3,828,090.79
Middlesex			
	TN	TP	TSS
Existing	7,278.13	1,002.95	2,177,736.46
Predicted	13,072.14	2,091.54	5,228,855.03
Increase	5,794.01	1,088.59	3,051,118.57
Monmouth			
	TN	TP	TSS
Existing	24,626.37	3,124.31	6,424,683.62
Predicted	49,016.46	7,842.63	19,606,582.04
Increase	24,390.08	4,718.32	13,181,898.42
Morris			
	TN	TP	TSS
Existing	13,353.41	1,892.88	4,385,948.75
Predicted	19,854.11	3,176.66	7,941,642.73
Increase	6,500.69	1,283.78	3,555,693.98
Ocean			
	TN	TP	TSS
Existing	51,758.97	6,020.33	11,693,950.92
Predicted	110,065.95	17,610.55	44,026,380.16
Increase	58,306.98	11,590.22	32,332,429.24
Passaic			
	TN	TP	TSS
Existing	956.21	143.03	341,222.89
Predicted	1,290.56	206.49	516,224.21
Increase	334.35	63.46	175,001.32

Table 2 Continued- Changes In Loading (Kg/Yr)			
Salem			
	TN	TP	TSS
Existing	1,803.07	286.49	656,593.27
Predicted	3,324.83	531.97	1,329,933.25
Increase	1,521.77	245.48	673,339.98
Somerset			
	TN	TP	TSS
Existing	11,981.29	1,645.37	3,505,685.69
Predicted	23,671.07	3,787.37	9,468,428.56
Increase	11,689.78	2,142.00	5,962,742.87
Sussex			
	TN	TP	TSS
Existing	8,617.13	1,105.55	2,312,303.80
Predicted	18,050.22	2,888.04	7,220,087.53
Increase	9,433.09	1,782.48	4,907,783.72
Union			
	TN	TP	TSS
Existing	2,876.59	436.19	1,058,901.22
Predicted	3,487.84	558.05	1,395,134.58
Increase	611.25	121.86	336,233.36
Warren			
	TN	TP	TSS
Existing	7,485.06	1,100.66	2,522,366.93
Predicted	12,948.07	2,071.69	5,179,226.97
Increase	5,463.01	971.03	2,656,860.04
Sum of All Counties			
	TN	TP	TSS
Kg/Yr	287,728.76	55,313.89	153,860,094.39
Lbs/Yr	633,003.27	121,690.558	338,492,207.658

Table 3 Summary of Load Increases By County			
County	Pollutant Loading (Kg/Yr)		
	TN	TP	TSS
Atlantic	28,917.42	5,748.67	16,026,872.74
Bergen	3,450.17	684.58	1,903,052.02
Burlington	15,424.74	2,931.02	8,172,264.55
Camden	9,709.29	1,915.34	5,453,387.54
Cape May	3,707.48	720.31	2,040,886.64
Cumberland	79,483.95	15,227.79	42,102,127.95
Essex	976.15	192.57	541,319.66
Gloucester	6,927.12	1,181.29	3,340,809.43
Hudson	165.67	32.87	92,783.18
Hunterdon	7,430.27	1,288.18	3,525,398.38
Mercer	7,491.49	1,384.05	3,828,090.79
Middlesex	5,794.01	1,088.59	3,051,118.57
Monmouth	24,390.08	4,718.32	13,181,898.42
Morris	6,500.69	1,283.78	3,555,693.98
Ocean	58,306.98	11,590.22	32,332,429.24
Passaic	334.35	63.46	175,001.32
Salem	1,521.77	245.48	673,339.98
Somerset	11,689.78	2,142.00	5,962,742.87
Sussex	9,433.09	1,782.48	4,907,783.72
Union	611.25	121.86	336,233.36
Warren	5,463.01	971.03	2,656,860.04
Annual Total in Kg	287,728.76	55,313.88	153,860,094.39
Annual Total in Lbs	633,003.27	121,690.53	338,492,207.65

Table 4 - Percent Increase In Pollutant Loading By County			
County	**Total Nitrogen**	**Total Phosphorus**	**Total Suspended Solids**
Atlantic	114.5	196.9	283.9
Bergen	24.2	31.9	36.8
Burlington	113.6	171.4	238.3
Camden	76.5	114.8	155.6
Cape May	79.3	116.0	155.6
Cumberland	144.6	242.3	360.4
Essex	24.4	31.9	37.4
Gloucester	77.8	87.5	111.8
Hudson	4.2	5.3	6.0
Hunterdon	77.3	89.5	107.0
Mercer	83.0	110.0	137.9
Middlesex	79.6	108.5	140.1
Monmouth	99.0	151.0	205.2
Morris	48.7	67.8	81.1
Ocean	112.7	192.5	276.5
Passaic	35.0	44.4	51.3
Salem	84.4	85.7	102.6
Somerset	97.6	130.2	170.1
Sussex	109.5	161.2	212.2
Union	21.2	27.9	31.8
Warren	73.0	88.2	105.3
Total	98.7	148.0	197.6