S U S T A I N A B L E J E R S E Y

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Sustainability Brief: Water Quality and Watershed Integrity

New Jersey depends on water resources for the health of our people, the strength of our economy, and the vitality of our ecosystems. The quality of our water resources and the integrity of our watersheds are fundamental elements of sustainable communities. Many other resources are important to New Jersey – water is irreplaceable. This briefing paper provides an overview of the topic, sustainability issues, options and their implications, and preliminary thoughts on sustainability indicators, targets and municipal actions.[1]

1 Background

The concepts of water quality and watershed integrity are related but not equivalent. Water quality is very important for both people and ecosystems; these issues apply to both fresh and coastal waters. Water quality is inherently at the scale of the water resource in question, whether ground water (including aquifers) or surface water (e.g., watersheds – including their lakes, streams, rivers; estuaries; the ocean). Watershed integrity includes water quality but is far broader. It also includes consideration of watershed hydrologic functions, stream channels, riparian areas, wetlands, etc., all of which affect public welfare and aquatic and terrestrial ecosystem health. Each watershed supports natural resource, environmental and ecological functions, including societal services such as water availability, recreation, flood protection and habitat.

Sustainable communities rely on ground and surface water quality that meets human needs, including protection of ecological functions. Ground water quality is important for potable water supply wells. It also affects the quality of streams, which rely heavily on ground water for their flows, especially during dry periods. Surface water quality is also important for public water supply, as well as recreation, aesthetics and the protection of aquatic life and ecosystems. National standards have been adopted by USEPA for surface water quality under the Clean Water Act (USEPA 2012). These standards protect intended (or "designated") uses such as drinking water, recreation, aquatic ecosystems, industrial use and agriculture, and protect waters from degradation (i.e., antidegradation and nondegradation policies). NJDEP has adopted Surface Water Quality Standards (SWQS) that are as or more stringent, as well as Ground Water Quality Standards (GWQS).

New Jersey has monitored surface water quality for decades, in both fresh and saline waters. The freshwater monitoring system addresses physical/chemical parameters; it also includes indicators of aquatic biological health using macroinvertebrate and fish tissue sampling. Saline water monitoring focuses

[1] Much of the information provided in this report is drawn from the Water Resources Baseline Assessment Report prepared for the Together North Jersey project, funded in part by the U.S. Department of Housing and Urban Development.

on bathing beaches and shellfish areas using indicators of pathogens that would endanger public health directly (recreation) or indirectly (shellfish consumption). Additional water quality monitoring is focused on coastal areas affected by Combined Sewer Overflows, and those in the National Estuary Program (Delaware Bay, Hudson/Raritan Estuary and Barnegat Bay). The New Jersey Integrated Water Quality Monitoring and Assessment Report provides an assessment of aggregate results by subwatershed and for coastal waters (NJDEP 2012).

Ground water quality patterns and trends are much harder to monitor and assess. Three general types of ground water monitoring data exist in New Jersey: (1) a small network of wells to assess natural ground water quality; (2) monitoring wells at contaminated sites, which have a site-specific purpose and are not aggregated; and (3) residential wells tested as required by the Private Well Testing Act. While the last database is not drawn from dedicated monitoring wells of known construction, it is enormous (over 50,000 individual wells from 2002 to 2007) and growing, which enhances the utility of the data (NJDEP 2008). These data can only be used in the aggregate, as location and quality information for specific wells are confidential.

2 Sustainability Issues

2.1 Status of Water Quality and Watershed Integrity

A water resource is of no value if the quality is so degraded (naturally or anthropogenically) that it prevents the desired water uses. Therefore, water quality is an integral aspect of water resources sustainability. The quality of some New Jersey surface waters is far higher than in the 1970's, primarily due to the closing or upgrading of industrial wastewater and public sewage treatment plants.

Unfortunately, many waters in suburban and exurban areas have declined in quality over the same period, primarily due to the development of formerly rural areas. Agricultural pollutant loads in rural watersheds have fluxed over time with changes in dominant products, farming practices, fertilizer costs, available pesticides, and irrigation practices, but are still of concern in some areas. Both types of "nonpoint" pollutant sources will be extremely difficult to control.

In older urban areas, the greatest surface water quality concern comes from Combined Sewer Overflows (CSOs), a legacy of 19th century wastewater practices that now represent the largest uncontrolled sewage discharges in New Jersey. New Jersey's CSOs are concentrated in the urban northeast and the Camden area, and therefore the high costs of controlling them to meet federal requirements will fall on cities of this region, including Bayonne, Camden, Elizabeth, Jersey City, Newark, Paterson and Perth Amboy.

The Draft 2012 New Jersey Integrated Water Quality Monitoring and Assessment Report (NJDEP, 2012) provides a good overview of recent surface water quality. As seen in Figure 1, many waters do not support fish consumption (due to PCB, mercury and other pollutants), recreational uses (pathogens) and aquatic life (multiple causes), or lack sufficient data for assessment.

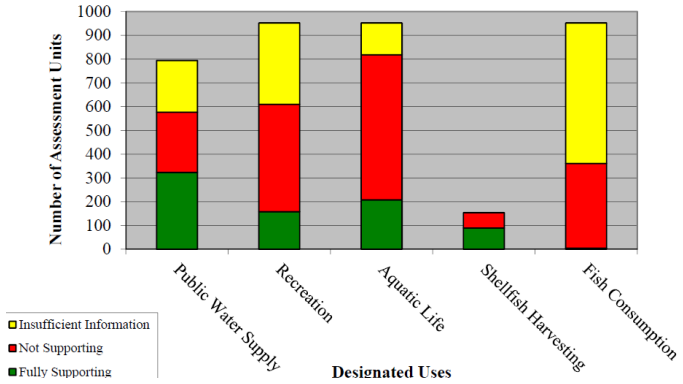

Figure 1 Draft Designated Use Assessment Results for 2012 (NJDEP, 2012)

Ground water is a major source of supply through most rural and exurban and many suburban areas of the state. Contamination by fertilizers, septic systems and our industrial legacy has damaged aquifer quality in many areas (resulting in closure or enhanced treatment of both private and public wells), though most areas still have good quality. Many industrial pollution sites will require decades to restore. Addressing pollution problems associated with suburban development and agriculture will be difficult also.

Watershed integrity has likewise been damaged by many causes, both historic and recent. Development of floodplains and wetlands from historic times through the 1970's and 1980's placed large areas and thousands of properties at risk of frequent flooding along our rivers, especially in the Passaic River Basin and portions of the Raritan and Delaware River Basins. Poor stormwater management up through the 1990's resulted in widespread damage to stream channels from excessive flows and velocities. Destruction and fragmentation of forests, riparian areas and wetlands damaged both habitat integrity and surface water quality. Ground water recharge losses from development reduced flows to streams, harming aquatic ecosystems and other water uses. Correction of these problems, from flood damages to ecosystem health, poses a major challenge and cost, but also a major opportunity to improve sustainability of the region. However, no consensus method exists for assessing overall watershed integrity.

2.2 Sustainability Issues

The issues discussed above have many implications for the sustainability of our communities and state. Poor surface water quality deters development potential and damages ecosystems in most urban areas, despite some improvements. Ground water contamination of industrial sites delays reuse of these areas in many cities and older suburbs, leaving holes in community structure and damaging local economies. Flood plain development in historic urban areas and post-World War II suburbs causes repetitive flood damages with high costs. Finally, the costs of CSO controls will affect some of the least wealthy municipalities in the region, though success in managing CSOs will also benefit the same communities. The net effect on sustainability is high.

3 Sustainability Responses

Generally, sustainability for ground and surface water quality requires meeting established standards to protect designated uses. The national approach for parameter-specific standards and development of restoration plans is used in New Jersey for both ground and surface waters. Watershed integrity and support of aquatic ecosystem vitality are relatively new and complex issues that lack formal standards.

USEPA has developed a new Healthy Watersheds Initiative as an enhancement to the existing "pollution focused" approach. USEPA defines a healthy watershed as "one in which natural land cover supports dynamic hydrologic and geomorphic processes within their natural range of variation; habitat of sufficient size and connectivity supports native aquatic and riparian species; and water quality supports healthy biological communities…" (USEPA 2012) The Initiative therefore provides a framework for watershed management, but does not identify specific thresholds for sustainable watershed integrity; these must be determined for each watershed. The Initiative incorporates a well-defined and holistic approach that serves as the national approach for watershed integrity, and is directly applicable in New Jersey.

4 Implications

These broad objectives have several major implications and underlying assumptions:

- Maintenance of higher quality waters is a fundamental aspect of water quality standards.
- Restoration of water quality for urban areas is important for optimizing societal health and function.
- Pollutant discharge is not a right, but a privilege that carries with it responsibilities.
- Where pollutant loads exceed natural attenuation capacity, action is needed to mitigate pollution effects.
- Natural land cover is a fundamental component of each watershed, to support hydrologic processes such as recharge, stream base flow, flood attenuation and ecosystem support.
- Natural land cover also is critical to support interconnected aquatic and riparian habitats and species.
- Ecosystems, unlike human uses, are associated with specific environmental conditions, including watersheds. Therefore, maintaining ecological integrity is necessary in each major watershed.
- Restoration of ecosystem vitality is coequal in importance to maintenance of areas with higher ecosystem integrity where degradation is minimal or nonexistent.
- Species cannot be replaced. Sustainable communities maintain long-term viability of all natural species, though not necessarily in all parts of their natural range.
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5 Defining & Tracking Sustainability

Based on the above concepts, the following objectives provide proposed sustainable conditions:

- **Ground and Surface Water Quality** – Ground and surface water quality support and protect reasonable human needs (e.g., public health and sanitation, agriculture, commerce and industry, recreation, aesthetic, spiritual) and natural ecosystem functions, in a manner that optimizes societal health and function.
- **Watershed Integrity** – Watersheds are maintained or restored to a level of integrity in which: natural land cover supports dynamic hydrologic and geomorphic processes within their natural

range of variation; habitat of sufficient size and connectivity supports native aquatic and riparian ecosystems and species; and water quality supports healthy biological communities.

- **Ecosystem Vitality and Biodiversity** – Water resources remain in natural water bodies in sufficient quantity and quality to support overall ecosystem vitality and biodiversity, such that aquatic ecosystems of each major watershed have or are restored to a level of integrity that supports a full complement of organisms, including rare, threatened and endangered species, aquatic species, and species reliant on aquatic ecosystems for a critical portion of their lifecycle.

Table 1 provides potential indicators for water quality and watershed integrity. The surface water quality, watershed integrity and most ecosystem vitality and biodiversity indicators can be used by municipalities on a subwatershed scale. Ground water quality and the ecosystem vitality and biodiversity targets for "terrestrial rare, threatened or endangered plant or animal species" can be used at the municipal scale. The GWQS and SWQS (including nondegradation and antidegradation policies) serve as sufficient targets for water quality. The remaining indicators and targets will require development of appropriate targets. These targets may include targets by category such as physiographic province and development category; an appropriate target for rural Sussex County in the Valley & Ridge Province, for example, may not be appropriate for highly developed parts of Atlantic County in the Coastal Plain Province.

6 Conclusions

Water quality protection in New Jersey has focused on industrial and municipal wastewater discharges, a relatively small number of facilities that clearly have significant effects on water quality, and more recently on stormwater from new development. Far less attention has been paid to the myriad other existing causes of water pollution and impaired watershed integrity, such as habitat loss, stormwater discharges, application of pesticides and fertilizers, etc. Low density "sprawl" development exacerbates these impacts through the development of much larger areas than would have been affected by higher density "smart growth" growth patterns. New Jersey therefore has a large number of impaired watersheds, which cannot be restored in the absence of an intensive and extensive program to correct the nonpoint source pollution and habitat destruction. Protection of intact watersheds will require improved land and pollutant management efforts as well.

Table 1: Preliminary Sustainability Indicators and Targets for Water Resources

Category	Definition	Preliminary Indicator	Preliminary Target	Scale of Analysis	Availability and Period of Data
Ground and Surface Water Quality	*Ground and surface water quality support and protect reasonable human needs (e.g., public health and sanitation, agriculture, commerce and industry, recreation, aesthetic, spiritual) and natural ecosystem functions, in a manner that optimizes societal health and function.*	•Surface water quality and trends •Ground Water Classification Exception Areas (CEAs) •Nitrate Trends from the Private Well Testing Act data	•SWQS violations (current or projected) •GWQS violations (current)	• Statewide network, not all subwatersheds have monitoring data •Statewide by contaminated sites •Statewide point data	•Biennial assessment of data from routine monitoring network •Updated as new CEAs identified •Data from 2002 to current, as residential property transfers occur
Watershed Integrity	*Watersheds are maintained or restored to a level of integrity in which: natural land cover supports dynamic hydrologic and geomorphic processes within their natural range of variation; habitat of sufficient size and connectivity supports native aquatic and riparian species; and water quality supports healthy biological communities.*	•Forest land cover •Wetlands land cover •Riparian area, natural and developed •% impervious surface •Developed floodplain areas	•Forest area trends and fragmentation by watershed (habitat integrity) •Wetlands acreage trends and fragmentation by watershed (habitat integrity) •Riparian area trends and fragmentation by watershed (habitat integrity) •% impervious surface and trends within riparian areas by watershed (habitat integrity and stormwater) •% impervious surface and trends by watershed (stormwater) •% of floodplain with structures (flood damage potential)	•Any scale from neighborhood to regional (all data types)	<u>Statewide</u>: •1986, 1995, 2002, 2007 Land Use/Land Cover based on aerial photo interpretation for all data types except flood plain delineations; •satellite remote sensory data for land cover; •NFIP Flood Insurance Rate Map delineations; •NJDEP flood prone area delineations

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Ecosystem Vitality and Biodiversity	*Water resources remain in natural water bodies in sufficient quantity and quality to support overall ecosystem vitality and biodiversity, such that aquatic ecosystems of each major watershed have or are restored to a level of integrity that supports a full complement of organisms, including rare, threatened and endangered species, aquatic species, and species reliant on aquatic ecosystems for a critical portion of their lifecycle.*	•Presence of rare, threatened or endangered plant or animal species	•# rare, threatened or endangered plant or animal species by watershed (normalized by watershed size) & trends (biodiversity)	•Statewide by watershed	•Ongoing data acquisition, formalized starting in 1980's
		•Surface water quality for aquatic life criteria	•Surface water violations for aquatic life criteria (water quality)	• See Ground and Surface Water Quality	• See Ground and Surface Water Quality
		•Stream daily flows	•Low flow (7Q10 and 7Q30) trends (aquatic ecosystem support)	• Statewide network, not all subwatersheds have monitoring data	•Varies by gaging station, many have decades of data
			•Net Water Availability deficits (aquatic ecosystem support)	•See Water Availability	• See Water Availability
		•Riparian area trends and fragmentation	•Riparian area trends and fragmentation (habitat integrity)	•See Watershed Integrity	•See Watershed Integrity
		•Ambient Biological Monitoring Network (AMNET) and Fish Index of Biological Integrity (IBI) scores	•Aquatic Life Support (SWQS)	•See Ground and Surface Water Quality	•See Ground and Surface Water Quality

7 References

NJ Department of Environmental Protection (NJDEP). Surface Water Quality Standards, NJAC 7:9B

NJDEP. Ground Water Quality Standards, NJAC 7:9C

NJDEP. 2008. Private Well Testing Act Program: Well Test Results for September 2002 – April 2007

NJDEP. 2012. Draft 2012 Integrated Water Quality Monitoring and Assessment Overview

USEPA. 2012. Identifying and Protecting Healthy Watersheds: Concepts, Assessments, and Management Approaches. EPA 841-B-11-002, Washington, DC.

Van Abs, D. 2013 (in draft). Water Resources Baseline Assessment Report: Prepared in Support of the Regional Plan for Sustainable Development. New Jersey Future, Trenton, NJ.

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