

DRAFT – FOR CONSIDERATION AT JUNE 26, 2008
HIGHLANDS COUNCIL MEETING



JON S. CORZINE
Governor

State of New Jersey
Highlands Water Protection and Planning Council
100 North Road (Route 513)
Chester, New Jersey 07930-2322
(908) 879-6737
(908) 879-4205 (fax)
www.highlands.state.nj.us



JOHN R. WEINGART
Chairman

EILEEN SWAN
Executive Director

PRIME GROUND WATER RECHARGE AREA STANDARDS
Summary and Recommendation

This paper responds to the Highlands Council request at its meeting on May 15, 2008 for further information regarding recommendations for Prime Ground Water Recharge Area protection.

A new analysis of the distribution of Prime Ground Water Recharge Areas by LUCM Zone shows that nearly 98% of the Prime Ground Water Recharge Areas are in the Protection Zone (68 percent) and the two Environmentally-Constrained Sub-zones (30%). Therefore staff recommends:

- That a single policy apply to all Prime Ground Water Recharge Areas, as nearly all are in Zones with low allowable septic system densities.

In researching examples throughout the country, we found very few examples of impervious surface standards for ground water recharge areas (ranging from 10 to 61 percent), with no apparent scientific basis provided. The Center for Watershed Protection advises us that they have no research on this issue and no NJDEP rules address this issue. Most existing impervious surface standards in New Jersey are based on either community character or impacts of stormwater runoff to stream habitats, or both. Therefore staff recommends:

- That standards for Prime Ground Water Recharge Areas be unique to the Highlands Region and based on development types anticipated for the more restrictive Zones and Sub-Zones.

Site development concerns regarding Prime Ground Water Recharge Areas focus on recharge quantity and quality, including the risk that engineered recharge systems may not meet their objectives perpetually. Therefore, Council staff recommends the following approach using the management hierarchy **Avoid>Minimize>Mitigate** (see draft GPOs):

1. Prohibit development in Prime Ground Water Recharge Areas unless the entire site is in such areas, or if necessary to avoid Critical Habitat, Highlands Open Water Buffers and steep slopes (**Policy 2D4a**).
2. Prohibit infrastructure extensions except for clusters and waivers (**Objective 2D4e**).
3. Limit total recharge disruption (i.e., alteration of natural recharge patterns or volumes) to 15 percent of Prime Ground Water Recharge Areas, placed wherever feasible on those parts of the Prime Ground Water Recharge Areas with the lowest relative ground water recharge rates and the least potential for aquifer recharge, based on site analyses (**Objective 2D4d**).
4. Use low impact development techniques to reduce total recharge disruption as much as feasible, within the 15 percent maximum (**Objective 2D4c**).
5. Require mitigation equal to 125% of the pre-construction recharge from the area where disruption of the Prime Ground Water Recharge Areas is permitted (**Objective 2D4b**).

6. Restrict the development of major potential pollutant sources (**Objectives 2D3d, 2D4f**), and manage existing and future potential pollutant sources (**Objective 2D3g**).

PRIME GROUND WATER RECHARGE AREA STANDARDS

Overview

At its meeting on May 15, 2008, the Highlands Council requested that staff prepare information regarding Prime Ground Water Recharge Areas, and specifically the potential basis for RMP policies regarding allowable impervious surfaces by LUCM Zone or regionally. This paper examines the general nature of recharge areas, the distribution of Prime Ground Water Recharge Areas in the Highlands Region by LUCM Zone, management issues for protection of such areas, examples from various municipalities and agencies, and potential approaches for use in the Highlands Region.

In summary, nearly 98% of the Prime Ground Water Recharge Areas are in the Protection Zone (68 percent) and in the Environmentally-Constrained Sub-zones of the Conservation and Existing Community Zones (30%), all of which have relatively low allowable development densities based on septic system yields. Therefore, Prime Ground Water Recharge Areas should be subject to little if any truly dense development. Based on this finding, allowable percentages for impervious surface should reflect the limited development potential of these Zones, and a single threshold should be feasible.

The question then is what thresholds would be appropriate. We have been able to identify through a legal search only a very few municipalities and no regional agencies that regulate impervious surfaces in ground water recharge areas by percentage. Of those that do, no scientific rationale was stated for the selection of their percentages, which appear to respond more to local needs than regional perspectives. Impervious surface limitations identified by the Center for Watershed Protection, the CAFRA rules, the Highlands Act and similar regulations are based on research regarding the impact of storm water runoff on stream stability and habitat quality, not on ground water recharge. We specifically inquired with the Center for Watershed Protection, a national leader in this field, and they informed us that their research does not address the issue of impervious surfaces in ground water recharge areas, nor were they aware of any such studies. We have not been able to identify any existing, defensible models for setting an impervious surface threshold. Therefore, a new approach is needed.

We examine two approaches. One is site-specific and does not result in a predetermined impervious surface threshold. Instead, it relies on site-specific analyses and low impact development approaches to minimize development impacts so as to protect recharge volume and quantity. The other method sets a maximum percentage of a site where Prime Ground Water Recharge Areas are disrupted; that is, the land surface is changed such that natural recharge patterns no longer exist. Storm water may be routed through engineered systems, or recharge is not through infiltration in naturally vegetated areas.

We examined how a threshold could be set, including the case of a septic system cluster on a lot that is entirely within a Prime Ground Water Recharge Area. Staff recommends that the maximum

allowable disruption of the Prime Ground Water Recharge Area would be 15 percent, but with the allowable area placed where the potential for aquifer recharge is most limited and the relative ground water recharge rate is lowest. Identification of these areas would be based on a site-specific approach, which would be detailed in the conformance standards for development review.

Background

In the hydrologic cycle, when precipitation occurs over the land surface a majority of it will be returned back to the atmosphere through evaporation and some will flow over the surface in a process known as overland flow to lakes and other open water bodies which flow into streams and eventually to the ocean where the cycle begins again. A small percentage of precipitation that reaches the land surface will find its way into the subsurface in a process known as infiltration. Where infiltration reaches the water table, it is considered ground water recharge, and the overlying land areas are classified as ground water recharge areas. Ground water recharge areas can be defined as locations within a drainage basin where meteorological, ecological, geological and hydro geological factors are conducive to allow for the infiltration of water from the surface into the subsurface. The factors that determine recharge potential are:

- **Precipitation:** The primary meteorological factor controlling infiltration. The amount of precipitation and its characteristics such as intensity and duration control the overall volume of water that is available for infiltration.
- **Evapotranspiration:** Is the combined evaporation from streams, open water bodies and land surfaces, and transpiration from plants. Of all the precipitation that falls within a drainage basin, a majority will be returned back to the atmosphere as evapotranspiration. Evapotranspiration rates are controlled by a combination of meteorological factors such as temperature, relative humidity and wind speed, and ecological factors such as type of vegetation, soil type and the size and volume of a water body.
- **Anthropogenic:** Socio-economic factors that include extent of urbanization, suburban areas, industrial zones, the presence of sewer service areas, public and private water supply wells, reservoirs, and septic system densities, cultural and historical and agricultural activities. Anthropogenic factors are the primary non-meteorological factor affecting infiltration.
- **Ecological:** These factors include the types of vegetation, the density of forested areas, wetlands, vernal pools, critical habitat and riparian buffer zones.
- **Geological factors** include soil type and characteristics, depth to bedrock, rock type and its characteristics, rock outcroppings, faulting, and topography.
- **Hydro-geological factors** include depth to ground water, soil permeability, rock type porosity, the presence or absence of fractures and wellhead protection areas.

Once into the subsurface, the infiltrated water under the pull of gravity will move down through the soil root zone to zones of saturation to become ground water. A portion of this ground water will become ground water runoff or ground water base flow which is ground water that migrates horizontally along zones of lower permeability soil or along the soil-bedrock interface and exits the drainage basin as stream flow. Some ground water will move further downward to enter an aquifer system where it can be used as a water-supply resource, or will eventually migrate to surface waters and again exit the drainage basin as stream flow.

Prime Ground Water Recharge Areas in the Highlands Region

Ground water recharge zones are designated within the Highlands Region as Prime Ground Water Recharge Areas account for 232,854 acres (126,636 acres of the Preservation Area and 106,221 acres of the Planning Area), or 27 percent of the Highlands Region.

Prime Ground Water Recharge Areas were one factor used in defining the Protection Zone. The Land Use Capability Zone Map divides the Prime Ground Water Recharge Areas among the Protection Zone, the Conservation Zone (CZ), the Existing Communities Zone (ECZ) and the Environmentally Constrained Sub-zones of the Existing Community Zone and Conservation Zone as shown in Table 1.

Table 1. Distribution Of Prime Ground Water Recharge Areas By Land Use Capability Zone				
Zone and Sub-zone	Total Acres	PGWRA Acreage	Percentage of Zone in PGWRAs	Percentage of Total PGWRA in Zone
Protection Zone	469,462	158,392	33.74	68.13
Conservation Zone (not environmentally constrained)	70,474	4,357	6.18	1.87
CZ Environmentally Constrained Sub-zone	120,485	38,611	32.04	16.58
Existing Community Zone (not environmentally constrained)	146,011	737	0.50	0.32
ECZ Environmentally Constrained Sub-zone	32,231	30,757	95.42	13.21

*Excludes Lake Community Overlay Zone

As shown above, Prime Ground Water Recharge Areas are predominantly in the Protection Zone (68 percent) and in the CZ Environmentally Constrained Sub-zone (17 percent) and ECZ Environmentally Constrained Sub-zone (13 percent), all of which have lower allowable development densities based on septic system yields. With 98 percent of Prime Ground Water Recharge Areas within these areas, dense development will not be proposed in these areas. This distribution is particularly striking in the ECZ Environmentally Constrained Sub-zone which is 95 percent Prime Ground Water Recharge Areas. In sharp contrast, Prime Ground Water Recharge Areas comprise only 1.87 percent of the Conservation and only 0.37 percent of the Existing Communities Zones. In both cases, these areas are likely on existing developed parcels. The very small percentage of Prime Ground Water Recharge Areas in these Zones means that the RMP threshold should have little to no impact on development there, and is no bar to using a single regional standard.

Although Prime Ground Water Recharge Areas do make up a significant portion of the Protection Zone and Environmentally Constrained Sub-zones, they are not stand alone features, but instead are totally interrelated to local anthropogenic, ecological, geological and hydro-geological conditions which function as constraints that control the degree of infiltration and hence the volume of water that is recharged to ground water base flow and aquifer systems.

Management Issues and Examples for Prime Ground Water Recharge Areas

Changes in anthropogenic factors greatly affect the degree of infiltration and water quality within a ground water recharge area by changing the ecological, geological and hydrogeological constraining factors. Because anthropogenic changes are influenced largely by socio-economic forces they can be controlled through the regulatory process and through the use of engineering techniques or a combination of both, as discussed below.

Water quality can be regulated through the establishment of water quality standards which set specific concentration limits on potential contaminants to prevent water quality degradation. By establishing water quality standards, regulators can limit the type of land use activity and its density within ground water recharge areas to those that do not violate these standards. One of the more widely used water quality standard is for nitrate concentrations in ground water (e.g., the RMP standards for septic system densities). Another approach to water quality protection is to regulate specific types of pollutant sources, as is done in the RMP wellhead protection requirements.

Land use can be controlled through adoption of rules and ordinances to regulate or prohibit certain land use activities, establish development densities, require scientific studies to evaluate a development’s potential impact, and provide the necessary and appropriate measures to protect and enhance infiltration and water quality. Listed in Table 2 are examples of county level and local regulations designed to manage Prime Ground Water Recharge Areas, as identified through a search of legal databases available to the Highlands Council.

County/Municipality	Regulation
Augusta, GA	Restricts or prohibits certain land use activities and regulates septic system densities nitrate using ground water quality standards and sets stormwater performance standards
Borough of Ringwood, NJ	Standard wellhead protection ordinance
The Cape Cod Commission, MA	Model Aquifer Protection Bylaw: Establishes an Aquifer Protection Overlay District which prohibits certain land use activities, requires permitting for certain land use activities and for any construction that renders 10,000 square feet impervious, establishes Nitrogen based ground water quality standards, and sets stormwater performance standards
Fauquier County, VA	Establishes an Aquifer Protection Overlay District which prohibits certain land use activities, requires permitting for certain land use activities and for any construction that renders 10,000 square feet impervious, establishes Nitrogen based ground water quality standards, and sets stormwater performance standards
Middlesex County, NJ	Recommends “Site Specific Recharge Analysis” and that municipalities adopt an Aquifer Protection Overlay District to be managed through wellhead protection regulations. Evaluates aquifers based on quality.
Montville, NJ	Modification of Land Use ordinance to include wellhead protection regulations prohibiting certain land use activities and requires a site specific hydrogeologic study
Mountain Lakes, NJ	Prohibits certain land use activities and requires a “Ground Water

Table 2. Summary of County and Municipal Ground Water Recharge Regulations	
	Management Plan” detailing site hydrogeology and other factors.
Readington Township, NJ	Standard wellhead protection and stormwater regulations.

The most common method to manage Prime Ground Water Recharge Areas is through the use of zoning regulations that restrict or prohibit specific land use activities that are considered potential contaminant sources based upon their Standard Industrial Classification (SIC) Code. These zoning regulations are most commonly applied in an Aquifer Protection Overlay District or Zone established through a Wellhead Protection Ordinance. To manage infiltration within a Prime Ground Water Recharge Area, all of the counties and municipalities listed above require conformance with stormwater performance standards. Nitrogen based water quality standards are employed by Augusta, GA, The Cape Cod Commission, MA and Fauquier County, VA to regulate septic system densities. Site specific hydrogeologic or recharge analysis studies were only recommended or required by Middlesex County, NJ, Montville, NJ and Mountain Lakes, NJ. Thus, as summarized above, it very common for county and local regulators use a combination of zoning, wellhead protection and storm water regulations and nitrogen based water quality standards to manage Prime Ground Water Recharge Areas.

However, a few counties and municipalities have adopted aquifer recharge ordinances or have included within their wellhead protection ordinances language that specifies the maximum percentage of impervious coverage allowed within a ground water recharge area. The primary goal of impervious coverage limits is to allow for controlled development within prime ground water recharge areas while protecting natural infiltration. This goal is supplemented by an embedded requirement in the regulations to implement Best Management Practices to maximize water infiltration and to maintain and possibly enhance water quality. Table 3 represents a sampling of county and municipal impervious coverage limits:

Table 3. County/Municipal Regulation of Impervious Coverage In Aquifer Protection Zones	
County/Municipality	Allowable Percentage of Impervious Coverage
Boonton, NJ	15 percent
Fremont, NH	10 percent
Hillsdale, NJ	20 percent to 38 percent
Montville, NJ	50 percent Restricted Aquifer Zone, 40 percent Prime Aquifer Zone
Princeton, NJ	A sliding scale from 14 percent to 61 percent
Rye, NH	35 percent
Stratham, NH	20 percent

The designation of impervious coverage limits within Prime Ground Water Recharge Areas attempts to balance the pressures of development with that of the protection of ground water resources. However, the examples include many inconsistencies. As shown in Table 3, the maximum percentage of impervious cover varies widely from municipality to municipality and from state to state. Impervious coverage limitations range from a low of 10 percent in Fremont, New Hampshire to a high of 61 percent in Princeton, New Jersey. The lack of uniformity with respect to impervious coverage standards suggests that these standards are derived at the local level in response to local factors and are not established by any regional regulatory authority or regional analysis. Further, a review of these ordinances reveals that the rationale used to establish impervious coverage standards

is either not stated or is based upon a patchwork of local zoning regulations and stormwater-derived engineering methods and procedures. This finding indicates that there are no established, overarching, scientifically-based methods and procedures to determine the appropriate extent of impervious coverage. Additionally, the lack of a clear regionally accepted standard suggests that impervious coverage standards are based more upon local socio-economic and community conditions than purely environmental concerns.

We reviewed available information from the Center for Watershed Protection, a nationally-recognized leader in the field of watershed management that has extensive research on the impacts of storm water runoff from developed lands on stream stability and habitat quality. In discussions with the Research Director of the Center, they do not have nor are they aware of any studies regarding impervious surface limitations on ground water recharge areas. The Center's primary focus is on the destructive impacts of high flow periods rather than on low flow periods, though they do emphasize the need to maintain the volume and quality of recharge. RMP requirements address these issues regarding maintenance of recharge volume, mitigation at 125% for disturbance of Prime Ground Water Recharge Areas, and control of potential pollutant sources in the same manner as for wellhead protection areas. We reviewed the CAFRA regulations, which address percent impervious surface in certain areas, and find that these regulations, similar to the Center for Watershed Protection recommendations, are based on impacts of runoff on surface waters, rather than on recharge impacts. There are no NJDEP regulations that address impervious surface limitations in ground water recharge areas.

Management of Prime Ground Water Recharge Areas needs to be implemented in two ways – through municipal planning that maximizes protection by proper zoning, and on a site-specific basis to address variations in local anthropogenic, ecological, geological and hydrogeological conditions. To do this, regulators must provide clear, scientifically sound standards or method and procedures that can be applied to site-specific conditions. Ordinances for wellhead protection and stormwater, and standards such as impervious coverage limits based upon community character or surface water impacts are not appropriate to manage Prime Ground Water Recharge Areas. This is because these ordinances and standards lack the necessary guidance or appropriate scientific methods that can be applied to site-specific conditions associated with ground water recharge.

Recommended Approach for the Highlands Region

Council staff recommends the following method for addressing the protection of Prime Ground Water Recharge Areas beyond the volume and quality provisions already in the RMP. The method is based on a limit on disruption of natural recharge patterns and volumes, with the use of site-specific analyses to address parts of the requirements. As with most other resource policies in the RMP, the management hierarchy is **Avoid>Minimize>Mitigate**. The references to policies and objectives are based on the draft GPOs, provided separately.

1. Prohibit development in Prime Ground Water Recharge Areas unless the entire site is in such areas, or if necessary to avoid Critical Habitat, Highlands Open Water Buffers and steep slopes (**Policy 2D4a**).

The first priority is to avoid development of Prime Ground Water Recharge Areas wherever feasible. Where the entire site is Prime Ground Water Recharge Area, then the policy must

recognize that these areas cannot be entirely avoided. At the same time, policies must be seen in context of the full RMP. This policy recognizes that not all critical areas have the same functions, the same potential for mitigation, and the same goals under the Highlands Act. The disruption of Critical Habitat, Highlands Open Water Buffers and Moderately and Severely Constrained Steep Slopes are given very high priority under the RMP. Under this policy, protection of these three critical areas would be given priority over the protection of Prime Ground Water Recharge Areas, but only where avoidance of all four critical areas is not feasible.

2. Prohibit infrastructure extensions except for clusters and waivers (**Objective 2D4e**).

Clusters are mandatory within the Agricultural Resource Area, and within the Planning Area only may include creation or extension of water supply and wastewater infrastructure. The potential for waivers is a general policy within the RMP. Both need to be provided for. However, in all other cases (given that Prime Ground Water Recharge Areas are nearly all in the Protection Zone and Environmentally-Constrained Sub-zones), there is no reason to allow infrastructure in Prime Ground Water Recharge Areas other than for clusters and waivers, and even then only to the extent that compliance with Policy 2D4a requires it.

3. Limit total recharge disruption (i.e., alteration of natural recharge patterns or volumes) to 15 percent of Prime Ground Water Recharge Areas, placed wherever feasible on those parts of the Prime Ground Water Recharge Areas with the lowest relative ground water recharge rates and the least potential for aquifer recharge, based on site analyses (**Objective 2D4d**).

The term “recharge disruption” is used in this policy to reflect the key issues for protection of ground water recharge. The use of impervious surface as a standard would be insufficient, as a development can disrupt natural recharge in a much larger area. The re-routing of storm water flow also disrupts natural recharge potential. The use of total site disturbance would often be excessive, as low impact development techniques could result in site disturbance (e.g., on previously developed or agricultural lands) that actually restore or enhance the potential for recharge through naturalized vegetation. Therefore, a better measure of the site development impacts on Prime Ground Water Recharge Areas is the amount of area that will not, upon construction, recharge directly downward from the point of precipitation, through natural vegetation, naturalized vegetation or other undeveloped soils without any storm water routing. The area of recharge disruption within the Prime Ground Water Recharge Area will include all impervious surfaces, all areas where stormwater is routed to another location through engineered systems such as storm sewers and basins, etc, and all areas where the nature of the land surface does not allow for unimpeded recharge through natural vegetated areas.

It is important to specify that the 15% limit is not equivalent to a 15% limit on impervious surfaces, because impervious surfaces are only one part of the total recharge disruption. While the percentage of impervious surface will differ based on site design and land use, given the nature of land development and stormwater management it will always be less than 15%. Further, it is not scientifically appropriate to compare the total area of recharge disruption to impervious surface thresholds, such as those advocated by the Center for Watershed Protection, that are based on research involving the impacts of stormwater runoff on streams. Where there is a concern regarding stormwater runoff volumes, that issue should be addressed separately.

The other critical issue in this policy is recognition that Prime Ground Water Recharge Areas have internal differences in their recharge rates. Further, some parts of the Prime Ground Water Recharge Areas will be more likely to recharge aquifers, ground water units than can support human water uses through wells. Site-specific analyses can determine what part of the development site has the lowest potential for aquifer recharge, and the Highlands Council mapping indicates areas that have lower relative recharge rates. To the extent that recharge disruption is allowed and necessary, it should be located on those areas with the least aquifer recharge potential and the lowest recharge rates, to minimize development impacts. Site evaluation techniques will be included in the conformance standards guidance, and may include such steps as:

- Evaluation of the type and characteristics of all soils on-site and delineation of the vertical and horizontal extent of soils conducive to maximum water infiltration. Identification of the relative recharge rates of soils within the Prime Ground Water Recharge Areas;
 - Evaluation of the relative potential for aquifer recharge within the Prime Ground Water Recharge Areas;
 - Evaluation of the site's hydrogeological conditions and overall water quality;
 - An evaluation of the relationship between all relevant ecological factors and their relationship to the Prime Ground Water Recharge Areas;
 - The potential effects of proposed development on Prime Ground Water Recharge Areas;
 - A description of all appropriate and necessary best management practices to provide for the maximum amount of natural infiltration and total infiltration, and protection of water quality, including low impact development techniques.
4. Use low impact development techniques to reduce total recharge disruption as much as feasible, within the 15 percent maximum (**Objective 2D4c**).

Even though the 15% limitation applies by site, that does not mean that 15% recharge disruption will be needed or should be allowed on each site. The use of low impact development techniques will minimize the total recharge disruption to the lowest percentage possible, and will emphasize site designs that maximize protection or restoration of natural vegetation and the recharge associated with those areas.

5. Require mitigation equal to 125% of the pre-construction recharge from the area where disruption of the Prime Ground Water Recharge Areas is permitted (**Objective 2D4b**).

This policy is clarified from the Final Draft RMP, so that the recharge target for the site will be enhanced from natural levels. This objective should be technically feasible because the disturbed portions of the Prime Ground Water Recharge Area should still be able to support engineered recharge techniques using clean runoff from the affected area (e.g., rooftop runoff) in excess of natural recharge rates. Staff have examined hypothetical Protection and Conservation Zone examples and determined that meeting the 125% mitigation requirement should be feasible, but may require significant limitations on the loss of forest cover (an objective of Low Impact Development techniques) to meet the requirement.

6. Prohibit the development of major potential pollutant sources (**Objectives 2D3d, 2D4f**), and manage existing and future potential pollutant sources (**Objective 2D3g**).

These objectives address the concern that, even with protections in place, there are some land uses that have too high a risk or potential for significant discharges of pollutants through spills or leaks. These land uses should be prohibited from Prime Ground Water Recharge Areas regardless of the standards for total recharge disruption and low impact development. The risks are too high. For other potential pollutant sources, ongoing management measures should be required and followed. These objectives mimic the wellhead protection policies for WHPA Tiers 2 and 3.

Goals, Policies and Objectives for Prime Ground Water Recharge Areas

(Highlighted text indicates changes from prior versions)

Subpart b. Protection of Water Resources Quantity

The Highlands Regional Master Plan focuses on a variety of measures to protect the replenishment of water resources in the Highlands Region through ground water recharge and other means, to ensure the maintenance of aquatic ecosystems and human water uses. Science agenda items include improvements to the methods for estimating Net Water Availability, safe yields and passing flow requirements, better watershed delineations, and improved tracking of water and wastewater flows across watershed boundaries. The protection of Prime Ground Water Recharge Areas is emphasized, as these areas provide the most productive recharge of waters that are critical for stream flow and water supply wells. Protection is provided for both the quantity and quality of recharge.

GOAL 2C	REFINEMENT OF WATER AVAILABILITY METHODS AND ESTIMATES.
Policy 2C1	To improve estimates of Net Water Availability over time, including testing, development and adoption of ecologically-based assessment techniques to evaluate the high and low flow needs of streams necessary to maintain the health of aquatic ecosystems, and the relationship between ground water recharge, ecological flow needs, consumptive water uses and estimates of water availability for both ground and surface water resources.
Policy 2C2	To evaluate potable water supply reservoir safe yield and passing flow requirements and examine the effects of upstream consumptive and depletive water uses on safe yields and of passing flows on Highlands Open Waters and recommend regulatory changes to NJDEP as appropriate.
Policy 2C3	To develop a more refined Hydrologic Unit Map using Light Detection and Ranging (LiDAR) technology and high resolution digital elevation modeling to support more detailed geographic estimates of water availability.
Policy 2C4	To develop more refined estimates of the effects on Net Water Availability regarding the exportation and importation of water and wastewater.

GOAL 2D	MAINTENANCE OF HYDROLOGIC INTEGRITY THROUGH THE PROTECTION OF GROUND WATER RECHARGE.
Policy 2D1	To map and maintain an inventory of ground water recharge potential for the Highlands Region.
Policy 2D2	To delineate Prime Ground Water Recharge Areas as those lands within a HUC14 subwatershed that have the highest recharge volumes as of the most recent land use/land cover data available, relative to other land areas, and in the aggregate provide 40 percent of total ground water recharge during drought conditions.

Policy 2D3	To protect, enhance and restore the quantity and quality of Prime Ground Water Recharge Areas.
Objective 2D3a (Formerly 2D3a, 2D6a, 2D8b, 2D9)	Establish low impact development and other best management practices, technical guidelines and procedures to protect, restore and enhance Prime Ground Water Recharge Areas, to maximize the protection of natural ground water recharge and to minimize the need for engineered recharge methods for the purpose of complying with N.J.A.C. 7:8 (Stormwater Management Rules).
Objective 2D3b (Formerly 2D11)	Establish model municipal development regulations and master plan elements for the protection of Prime Ground Water Recharge Areas, through mechanisms that both complement and supplement the provisions of N.J.A.C. 7:8 (Stormwater Management Rules).
Objective 2D3c	Implement master plans and development review ordinances through Plan Conformance that protect Prime Ground Water Recharge Areas and minimize the potential for disruption of recharge in such areas by development. This requirement shall apply to all portions of the Prime Ground Water Recharge Area where the recharge is disrupted through impervious surfaces, routing of stormwater runoff and recharge from natural flow paths, and other similar changes.
Objective 2D3d (Formerly 2D8a, 2D10)	Establish minimum site design guidelines and permissible uses within a Prime Ground Water Recharge Area, including identification of land use categories or other activities posing sufficient risk of contamination that are not allowed within Prime Ground Water Recharge Areas.
Objective 2D3e (Formerly 2D8c)	Identify and implement opportunities for the restoration or enhancement of recharge in Prime Ground Water Recharge Areas and other lands through the retrofit or rehabilitation of stormwater recharge facilities, land management improvements, reforestation, etc.
Objective 2D3f (Formerly 2D8d)	Implement programs for Prime Ground Water Recharge Areas which encourage redevelopment of previously developed areas and allow for other compatible uses that improve recharge area productivity or water quality.
Objective 2D3g (Formerly 2H2c)	Require through Plan Conformance and local health ordinances, that existing land uses that have a significant potential to result in major discharges of pollutants to ground water or to the land surface (including but not limited to non-sanitary wastewater effluent and any major sources of potential discharges such as spills and leaks), such that they may degrade ground water quality within a Prime Ground Water Recharge Area, shall incorporate ongoing management of toxic chemical sources and prohibition of unregulated discharges, so that the potential for ground water contamination is minimized and the opportunity for discharge discovery and control is maximized.
Policy 2D4 (Formerly 2D3b, 2D4, 2D5, 2D6, 2D7, 2D8)	To apply standards through Plan Conformance, local development review and Highlands Project Review to protect, restore and enhance the functionality and the water resource value of Prime Ground Water Recharge Areas by restricting development and uses of land within a Prime Ground Water Recharge Area that reduce natural ground water recharge volumes or may directly or indirectly contribute to or result in water quality degradation.
Objective 2D4a	Development shall not occur in Prime Ground Water Recharge Areas unless the

	entire site is in such areas, or if necessary to prevent disturbance of Critical Habitat, Highlands Open Water Buffers and Moderately and Severely Constrained Steep Slopes.
Objective 2D4b	Any development activity approved to occur in a Prime Ground Water Recharge Area shall provide an equivalent of 125% of pre-construction recharge volumes for the disrupted portion of the Prime Ground Water Recharge Area of the site as defined in Objective 2D3c, within the following areas, in order of priority: (1) the same development site where feasible; (2) the same HUC14 subwatershed, or (3) an interrelated HUC14 subwatershed as approved by the Highlands Council where no feasible option exists in the same HUC14 subwatershed.
Objective 2D4c (Formerly 2D3a)	Require through Plan Conformance, local development review and Highlands Project Review that the disruption of Prime Ground Water Recharge Area shall be minimized through the implementation of low impact development best management practices meeting the requirements of Objective 2D3a .
Objective 2D4d	Require through Plan Conformance, local development review and Highlands Project Review that the disruption of Prime Ground Water Recharge Area, after conformance with Objectives 2D4a, 2D4b and 2D4c is achieved, shall be limited to no greater than 15% of the Prime Ground Water Recharge Area on the site and shall be preferentially be sited on that portion of the Prime Ground Water Recharge Area that has the lowest ground water recharge rates and the lowest potential for aquifer recharge.
Objective 2D4e (Formerly 2D5a, 2D5b, 2D6a, 2D6b)	Prohibit through Plan Conformance, local development review and Highlands Project Review the expansion or creation of public water supply systems or public wastewater collection and treatment systems or community-based on-site wastewater facilities into a Prime Ground Water Recharge Area within the Protection or Conservation Zone within the Planning Area except as provided for in Policy 2J4 with Objectives 2J4a through 2J4d, and Policy 2K3 with Objectives 2K3a through 2K3e , and within the Preservation Area except as provided for in Policy 2I1 and Objectives 2I1a and 2I1b . (see attachment for these objectives from the Water Utilities GPOs)
Objective 2D4f (Formerly 2H2b)	Prohibit through Plan Conformance, local development review and Highlands Project Review new land uses, including those identified through Objective 2D3d, that have a significant potential to result in the discharge of persistent organic chemicals sources (including but not limited to existing discharges of industrial or other non-sanitary wastewater effluent) to ground water or to the land surface within a Prime Ground Water Recharge Area, such that they may degrade or contribute to the degradation of ground water quality.
Objective 2D4g (Formerly 2D8e)	Require conformance with applicable components of regional stormwater management plans, where applicable, as a mandatory requirement for any site plan application.
Objective 2D4h (Formerly 2D7a)	Achieve a net improvement in ground water recharge volume and maintenance of water quality as required through compliance with and implementation of any related provisions of an adopted regional stormwater plan.
Objective 2D4i	Achieve a net improvement in ground water volume and maintenance of water quality through redevelopment, enhanced infiltration, pretreatment or other means

(Formerly 2D7b) where feasible.

GOAL 2E IMPROVEMENT OF GROUND WATER RECHARGE THROUGH REGIONAL MANAGEMENT EFFORTS.

Policy 2E1 To develop regional stormwater plans to promote regional protection, restoration and enhancement of ground water recharge volume and quality where specific watersheds are at risk in the absence of regional analysis and enhanced standards (see N.J.A.C. 7:8, Stormwater Management Rules).

Policy 2E2 To coordinate programs, funding and activities among public and private entities to encourage regional ground water recharge protection, restoration and enhancement activities consistent with the Plan.

References for Objective 2D4c

Policy 2I1 and Objectives 2I1a and 2I1b

Policy 2J4 with Objectives 2J4a through 2J4d

Policy 2K3 with Objectives 2K3a through 2K3e

Policy 2I1. To prohibit the expansion or creation of public water supply systems, public wastewater collection and treatment systems and community on-site treatment facilities in the Preservation Area unless approved through a Highlands Applicability Determination or a Highlands Preservation Area Approval with waiver pursuant to N.J.A.C. 7:38 and Policy 7G1.

Objective 2I1a. Designated sewer service areas in the Preservation Area shall be restricted to the Existing Area Served as of August 10, 2004, except to serve development that is approved through a Highlands Applicability Determination or a Highlands Preservation Area Approval with waiver pursuant to N.J.A.C. 7:38 and Policy 7G1.

Objective 2I1b. The expansion or creation of public water supply systems, public wastewater collection and treatment systems and community on-site treatment facilities in the Preservation Area as approved through a Highlands Preservation Area Approval with waiver pursuant to N.J.A.C. 7:38 and Policy 7G1 shall maximize the protection of sensitive environmental resources including avoidance of Open Water buffer areas, Riparian Areas, the forested portion of the Forest Resource Area, agricultural lands of Agricultural Resource Areas, Steep Slopes, Prime Ground Water Recharge Areas, and Critical Habitat Areas.

Policy 2J4. To minimize, through Plan Conformance, local development review and Highlands Project Review, the creation or extension of public water supply systems within the Protection Zone, the Conservation Zone and the Environmentally-Constrained Sub-zones of the Planning Area, and to allow for the creation or extension of public water supply systems where appropriate within the Existing Community Zone.

Objective 2J4a. Prohibit new, expanded or extended public water systems within the Protection Zone, the Conservation Zone and the Environmentally-Constrained Sub-zones of the Planning Area unless they are shown to be necessary for and are approved by the Highlands Council for one or more of the purposes listed below. For approvals regarding parts 1, 2 and 4, the project must maximize the protection of sensitive environmental resources such as Open Water buffer areas, Riparian Areas, the forested portion of the Forest Resource Area, agricultural lands of Agricultural Resource Areas, Steep Slopes, Prime Ground Water Recharge Areas and Critical Habitat Areas. For approvals regarding part 3, the project must avoid disturbance of Open Water buffer areas, Riparian Areas, Steep Slopes and Critical Habitat Areas, and must minimize disturbance of the forested portion of the Forest Resource Area, agricultural lands of Agricultural Resource Areas, and Prime Ground Water Recharge Areas. The extension or creation of systems shall follow the requirements in Objective 2J4b (parts 2 and 3). The applicable purposes are:

1. to address through a waiver under Policy 7G1 or 7G2 a documented existing or imminent threat to public health and safety from contaminated domestic and other on-site water supplies that is of sufficient scale to justify a public water supply and where no alternative is feasible that would sufficiently assure long-term protection of public health and safety. Such needs shall have highest priority for allocation of existing system capacity;
2. to address development permitted through a Highlands Redevelopment Area or takings waiver under Policy 7G1 or 7G2; or
3. to serve a cluster development that meets all requirements of Objective 2J4b.

Objective 2J4b. Clustered development served by public water supply within the Protection Zone, the Conservation Zone and the Environmentally-Constrained Sub-zones of the Planning Area shall be approved only if the following conditions are met:

1. The development impacts are otherwise consistent with the requirements of the RMP, including provisions for mandatory clustering in Agricultural Resource Areas pursuant to Policy 3A5;
2. Extension of an existing public water system will occur only where the cluster development is within or immediately adjacent to an Existing Area Served with available capacity;
3. Creation of a new public water system will occur only where such development is not within or immediately adjacent to an Existing Area Served with available capacity;
4. The clustered development preserves at least 80 percent of the cluster project area in perpetuity for environmental protection or agricultural purposes. To the maximum extent feasible the developed portion (i.e., not including wetlands, open water buffers, and recreational lands) occupies no more than 10 percent of the cluster project area if served by a public or community on-site wastewater system;
5. Where the preserved land in the cluster project area is dedicated to agricultural purposes, the cluster development ordinance and an Agriculture Retention/Farmland Preservation Plan supports continued agricultural viability of the agricultural land and requires the implementation of best management practices, including development and implementation of a Farm Conservation Plan that addresses the protection of water and soil resources prepared by the USDA Natural Resources Conservation Service (NRCS), Technical Service Provider (TSP), appropriate agent or NJDA staff, and approved by the local Soil Conservation District (SCD).

Objective 2J4c. Allow the expansion or creation of public water systems within the Existing Community Zone of the Planning Area, other than the Environmentally-Constrained Sub-zone, to serve lands which are appropriate for designated TDR Receiving Zones, infill or redevelopment, to meet needs and protection requirements equivalent to Objective 2J4a within the Existing Community Zone, or to serve new areas for development that meet all other requirements of the RMP. TDR Receiving Zones, affordable housing projects (where the affordable units exceed 10% of the total units), infill and redevelopment shall have higher priority for capacity than expansion of public water service areas within this Zone.

Objective 2J4d. All development within the Highlands Region, in areas that are not served by public water systems, shall be at a density that can be supported by on-site wells. Where cluster development in the Protection Zone, the Conservation Zone and the Environmentally-Constrained Sub-zones of the Planning Area will be served by on-site wells, and the undeveloped land is preserved for agricultural purposes in perpetuity, the cluster development in combination with the Agriculture Retention/Farmland Preservation Plan required by Objective 2J4b shall provide for best management practices that protect the on-site wells from contamination resulting from agricultural practices and shall include provisions to minimize or reduce net pollutant loadings from the total cluster project area including the preserved agricultural lands.

Policy 2K3. To provide adequate, appropriate, efficient and cost-effective wastewater management to all development in the Highlands Region, through Plan Conformance, local development review and Highlands Project Review.

Objective 2K3a. Areawide Water Quality Management Plans, including Wastewater Management Plans and project-specific amendments, shall be consistent with requirements of this Plan.

Objective 2K3b. Existing wastewater collection and treatments systems which are non-compliant with state water quality standards for wastewater treatment and effluent discharge shall be prohibited from collecting and treating additional wastewater until the treatment systems are fully compliant with State permit requirements.

Objective 2K3c. Prohibit new, expanded or extended public wastewater collection and treatment systems and community on-site treatment facilities within the Protection Zone, the Conservation Zone and the Environmentally-Constrained Sub-zones of the Planning Area unless they are shown to be necessary for and are approved by the Highlands Council for one or more of the purposes listed below. For approvals

regarding parts 1, 2 and 4, the project must maximize the protection of sensitive environmental resources such as Open Water buffer areas, Riparian Areas, the forested portion of the Forest Resource Area, agricultural lands of Agricultural Resource Areas, Steep Slopes, Prime Ground Water Recharge Areas and Critical Habitat Areas. For approvals regarding part 3, the project must avoid disturbance of Open Water buffer areas, Riparian Areas, Steep Slopes and Critical Habitat Areas, and must minimize disturbance of the forested portion of the Forest Resource Area, agricultural lands of Agricultural Resource Areas, and Prime Ground Water Recharge Areas. The choice of extension or creation of systems shall follow the requirements in Objective 2K3d (2 and 3). The applicable purposes are:

1. to address through a waiver under Policy 7G1 or 7G2 a documented existing or imminent threat to public health and safety from a pattern of failing septic systems (where the failing systems cannot reasonably be addressed through rehabilitation or replacement) or highly concentrated septic systems, where the threat is of sufficient scale to justify a public wastewater collection and treatment system or community on-site treatment facility and where no alternative is feasible that would sufficiently assure long-term protection of public health and safety. To address other issues of public health and safety, such needs shall have highest priority for allocation of existing system capacity;
2. to address development permitted through a Highlands Redevelopment Area or takings waiver under Policy 7G1 or 7G2; or
3. to serve a cluster development that meets all requirements of Objective 2K3d.

Objective 2K3d. Clustered development served by a public wastewater collection and treatment system or community on-site treatment facility within the Protection Zone, the Conservation Zone and the Environmentally-Constrained Sub-zones of the Planning Area shall be approved only if the following conditions are met:

1. The development impacts are otherwise consistent with the requirements of the RMP, including provisions for mandatory clustering in Agricultural Resource Areas pursuant to Policy 3A5;
2. Extension of an existing public wastewater collection and treatment system will occur only where the cluster development is within or immediately adjacent to an Existing Area Served with available capacity;
3. Creation of a community on-site treatment facility will occur only where such development is not within or immediately adjacent to an Existing Area Served with available capacity, where the proposed system is designed, permitted and constructed at a capacity limited to the needs of the clustered development, and where the system does not create the potential for future expansion into areas that are not the subject of cluster developments immediately adjacent to the initial cluster served;
4. The cluster development preserves at least 80 percent of the cluster project area in perpetuity for environmental protection or agriculture purposes. To the maximum extent feasible the developed portion of the project area (i.e. not including wetlands, open water buffers, and recreational lands) occupies no more than 10 percent of the cluster project area if served by a public or community on-site wastewater system.
5. Where the preserved land in the cluster project area is dedicated to agricultural purposes, the cluster development ordinance and an Agriculture Retention/Farmland Preservation Plan supports continued agricultural viability of the agricultural land and requires the implementation of best management practices, including development and implementation of a Farm Conservation Plan that addresses the protection of water and soil resources prepared by the USDA Natural Resources Conservation Service (NRCS), Technical Service Provider (TSP), appropriate agent or NJDA staff, and approved by the local Soil Conservation District (SCD).

Objective 2K3e. Allow the expansion or creation of wastewater collection systems within the Existing Community Zone of the Planning Area, other than the Environmentally-Constrained Sub-zone, to serve

lands which are appropriate for designated TDR Receiving Zones, infill or redevelopment, to meet needs and protection requirements equivalent to those provided at Objective 2K3c within the Existing Community Zone, or to serve new areas for development that meet all other requirements of the RMP. The highest priority for allocation of excess or additional wastewater treatment capacity is to areas where there are clusters of failed septic systems that are located within or adjacent to Existing Areas Served. TDR Receiving Areas, where designated, affordable housing projects (where the affordable units exceed 10% of the total units), infill and redevelopment shall have higher priority for capacity than other developments requiring expansion of sewer service areas.