

An Evaluation of Existing Safe-Yield, Aquifer Protection, Replenishment, Recharge Enhancement and Protection Activities Across the United States

Safe-Yield Work Group

Prepared by

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Safe-Yield

- In this presentation other entities may not use or describe the term safe-yield per say in their plans but refer to aspects known as:
 - Aquifer protection
 - Aquifer replenishment
 - Aquifer recharge
 - Water resource management
 - Water balance
 - Balanced usage
 - Natural water balance
 - Availability for future users

Safe-Yield

- The important points of this presentation focus on the strategic planning, the plans, ordinances, authorities, districts, legislation, and the components of how their goals were realized and implemented
- Whether it is surface water, groundwater, or both, these different entities have struggled with what we call safe-yield, sustainable yield, or a balance between usage and supply

Safe-Yield

- An interesting footnote is that some entities believe primarily in replenishment through enhancements, others look primarily at recharge area protection and enhancements, while yet others focus primarily on stormwater capture and recharge
- Many entities look holistically at the approach and have incorporated a number of tools i.e. conservation, reduced usage, enhancements to recharge
- Also, it is noteworthy to report that water quality seemed to be a tandem component if there was a sole-source aquifer issue, or prevent contamination of areas that were identified as primary recharge locations for an aquifer (water quantity and quality are shared here also)

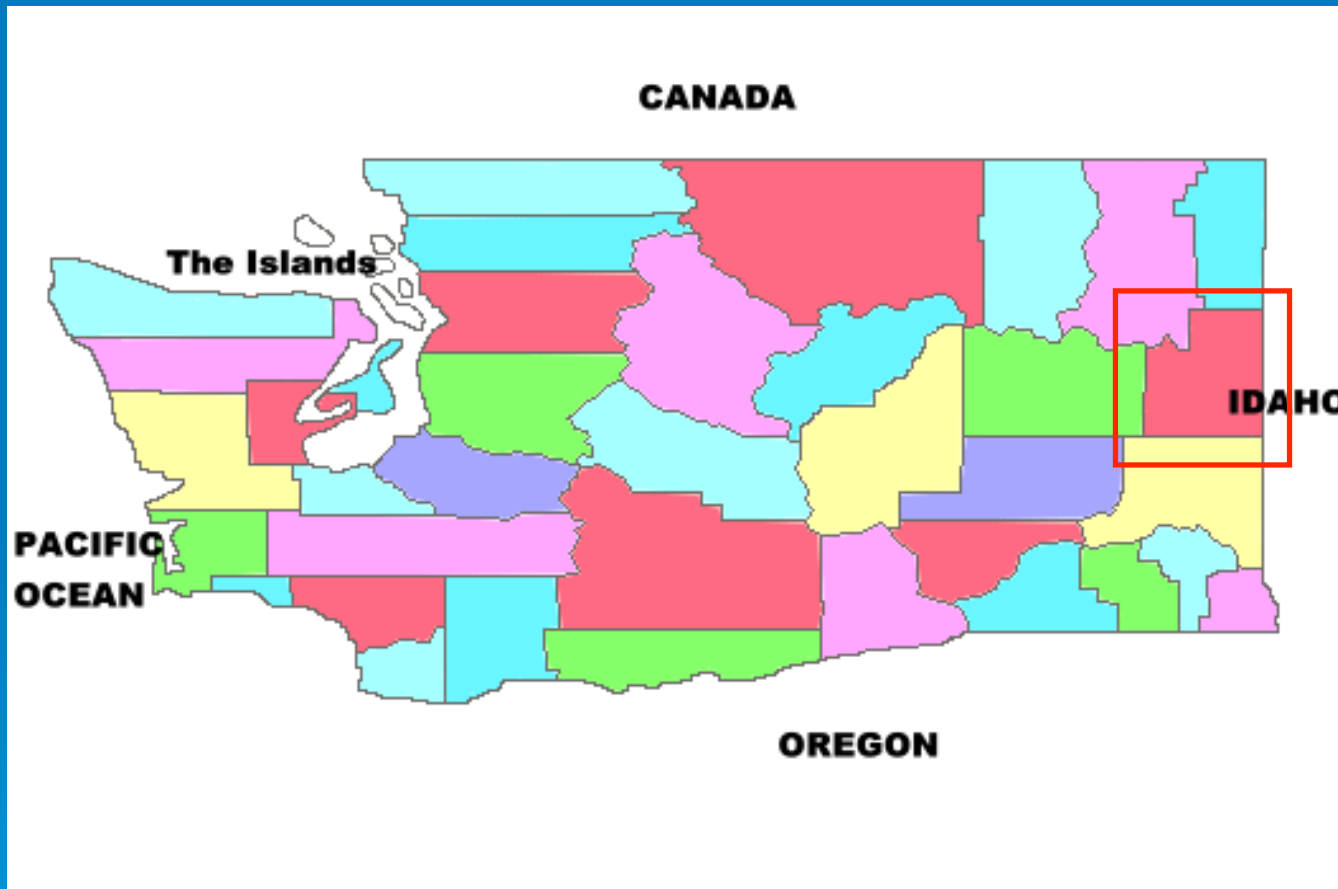
Case Studies

- Spokane County, Washington
- Edward's Aquifer Authority, Texas
- West Holyoke, Massachusetts, Barnes Aquifer Zoning Ordinance,
- State of California Water Plan
- Montgomery County, Pennsylvania, Water Resources Plan
- St. John's River, Florida, Water Management District, Aquifer Protection Program
- Connecticut's Department of Environmental Protection, Aquifer Protection Program

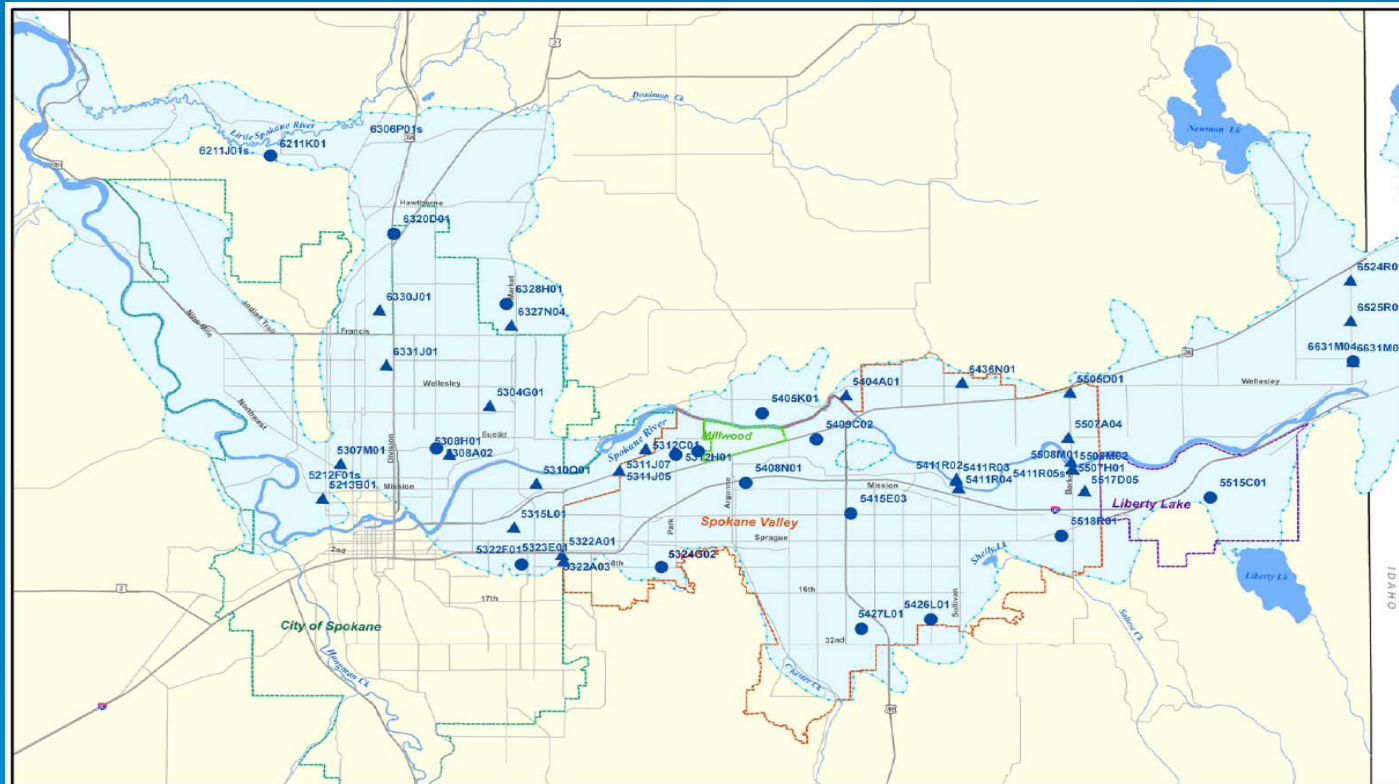
Spokane County, Washington Water Planning



Spokane County Washington



The Spokane Valley Rathdrum Prairie Aquifer (SVRP Aquifer)



Spokane County Water Planning

➤ Title, Purpose, and Intent

- Critical Areas Ordinance for the Protection of Wetlands, Fish and Wildlife Habitats, Geo-hazard Areas and Critical Aquifer Recharge Areas

(A) Prevent degradation of groundwater quality in Spokane County and improve water quality of aquifers that do not meet state standards.

(B) Protect groundwater quality from development impacts.

(C) Secure adequate water quantity for the residents of Spokane County.



Spokane County Water Planning

- Critical Areas Ordinance for the Protection of Wetlands, Fish and Wildlife Habitats, Geo-hazard Areas and Critical Aquifer Recharge Areas

(D) Provide public information programs for land users to demonstrate how to protect critical aquifer recharge areas from degradation.

(E) Consistently enforce regulations, effectively monitor compliance and provide incentives to protect critical aquifer recharge areas.

(F) Regularly update critical aquifer recharge area protection measures so they are effective, enforceable and equitable.



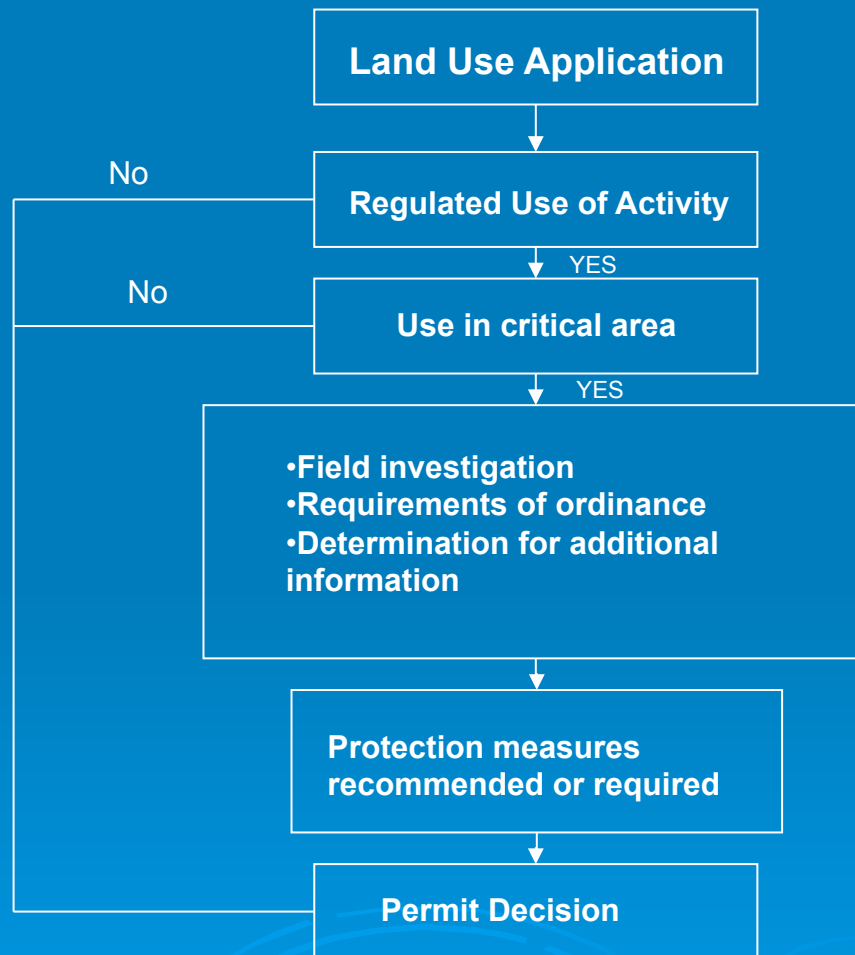
Spokane County Process Outlined

- Authority maintains maps of critical recharge areas
 1. Map in conjunction with site visit may prompt additional requirement for further investigations
 2. Maps updated as more detailed information is compiled
 3. Owner / developer responsible for compliance of provisions

Spokane County Process Outlined

4. Appeal of provisions
5. Permits issued
6. Zoning amendment if required
7. Enforcement / violations
8. Voluntary compliance agreement

Spokane County Process Outlined



Spokane County Critical Aquifer Recharge Areas

- Protecting areas within Spokane County critical to maintaining ground water recharge
 - Critical aquifer recharge areas are those areas with a critical recharging effect on aquifers used for potable water
 - Critical aquifer recharge areas have prevailing geologic conditions associated with infiltration rates that create a high potential contribute significantly to the replenishment of ground water

Spokane County Critical Aquifer Recharge Areas

- Aquifer recharge areas are rated as having a high, moderate, or low based on a scientific analysis of soils, hydraulic conductivity (the ease with which water moves between the surface and aquifers), annual rainfall, the depth to aquifers, the importance of the material between soils and aquifers

Spokane County Critical Aquifer Recharge Areas

- If a parcel lies within two or more rating designations, the higher rating designation shall apply to the whole parcel

Spokane County Incentives

- Property Tax and Income Tax Advantages
- On-Site Density Transfer
- Transfer of Development Rights

Spokane County

Methods of rating critical areas

- Soil Media
- Hydraulic Conductivity
- Annual Recharge
- Depth to Ground Water
- Importance of the Vadose Zone

The Edward's Aquifer Authority, Texas



Edward's Aquifer Authority, Texas



The Edward's Aquifer Authority, Texas

- Strategic planning is one of the most effective approaches to ensuring maximum efficiency and effectiveness in reaching targeted organizational goals
- Strategic planning involves the development of a collective vision, mission, and corresponding strategic themes and goals

The Edward's Aquifer Authority, Texas

- The Authority is an 8 county regulatory agency charged with managing, conserving, preserving, protecting, and increasing the recharge of and preventing waste and pollution
- The Authority was created by the Texas Legislature in 1993 with the passage of the Edwards Aquifer Authority Act to preserve and protect this unique groundwater resource



The Edward's Aquifer Authority Functions

- Sustaining the aquifer as a natural resource;
- Sustaining the diverse economic and social interests dependent on the aquifer for water supply;
- Protecting terrestrial and aquatic life;
- Protecting domestic and municipal water supplies; and
- Providing effective control of the aquifer to protect the operation of existing industries and the economic development of the state.



Edward's Aquifer Authority

Water Quantity

- The region will continue to experience rapid population growth over the next 50 years. This will require an adequate supply of water for population support, maintaining the natural environment and associated habitats and an excellent quality of life for all residents in the region. Three strategic goals are associated with water quantity.



Edward's Aquifer Authority

Strategic Goals

➤ Goal A. Sustain Federally Protected Aquifer Dependent Species

- The Authority will work cooperatively with the United States Fish and Wildlife Service and other agencies and stakeholders to develop a Recovery Implementation Program (RIP).
- The goal of the RIP for the Authority is the long-term protection of federally protected species through the development and approval of a Habitat Conservation Plan. The Recovery Implementation Plan will be developed for the species associated with the aquifer that are listed as threatened or endangered species under federal law.

Edward's Aquifer Authority Strategic Goals

➤ **Goal B. Manage Groundwater Withdrawals**

- The Authority manages groundwater withdrawal amounts from the aquifer for all conditions and levels. It is the challenge of the Authority to develop and implement appropriate management strategies that complement the natural system and optimize use of the aquifer.
- Management strategies include, but are not limited to, mechanisms to provide additional water to the aquifer, implementing a program to regulate and promote a water market, and reduction measures for less-than-average rainfall conditions.

Edward's Aquifer Authority

Strategic Goals

- **Goal C. Develop Recharge Program For Improved Aquifer Management and Environmental Restoration**
 - Several studies on the potential for enhanced recharge have concluded there is potential for increasing recharge to the aquifer through the construction and operation of recharge structures.
 - The purpose of the recharge program is to promote management of waters recharged into the aquifer to: (1) increase the amount of groundwater that may be available for subsequent withdrawal from the aquifer for beneficial uses; and (2) support spring flows at San Marcos and Comal springs.

Edward's Aquifer Authority

Recharge and Recirculation Program

Direction

- Design and implement pilot recharge project.
- Bring aquifer management strategies that could preserve endangered species to recovery implementation program (RIP).
- Create rules for recharge credits for range management.
- Acquire groundwater rights for recharge if recharge and recirculation study shows it is desirable.
- Create simplified application procedure for small recharge structures.
- Analyze additional Type 1 and other new opportunities for recharge structures.



Edward's Aquifer Authority

Recharge and Recirculation Program

Direction

- Start building trust and formal agreements with others to build recharge dams.
- Acquire surface water rights for recharge if study shows this is desirable for aquifer management.
- Be prepared to receive applications for recharge recovery rights.
- Develop partnership with the Federal government.
- Solicit input and recommendations from RIP Science Subcommittee and Recharge Subcommittee.
- Consider statutory limitations on Authority ownership or financing of a facility to recirculate water at Comal or San Marcos springs.

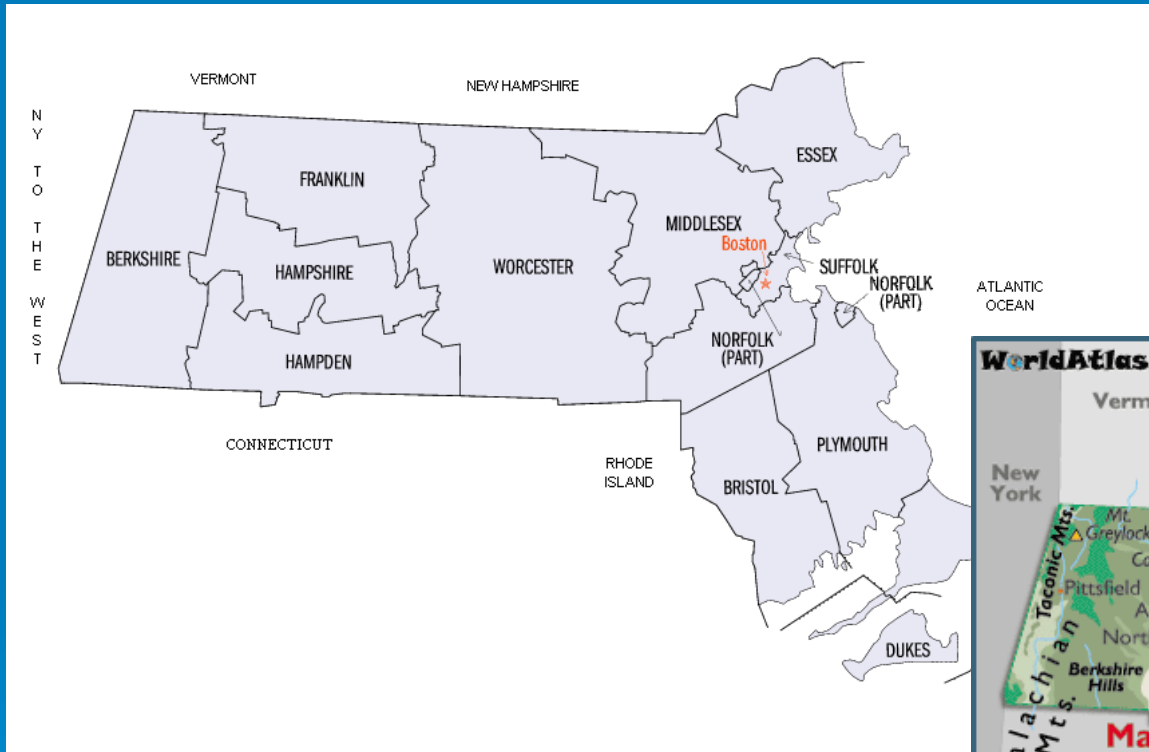


West Holyoke, MA

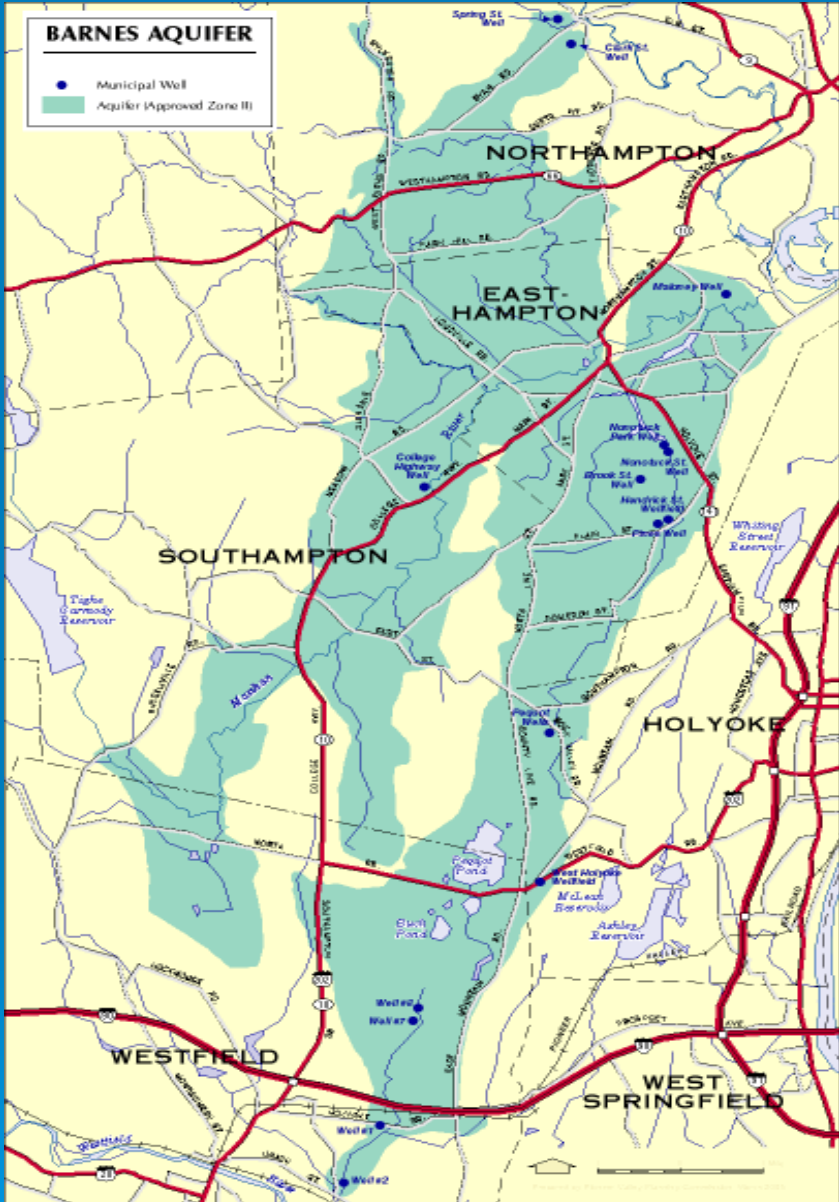
Water Protection & Aquifer Recharge Areas Barnes Aquifer



West Holyoke, MA Hampden County



West Holyoke, MA Barnes Aquifer



West Holyoke

Zoning Ordinance Water Protection & Aquifer Recharge Areas

➤ Aquifer Recharge Area

- There is established an aquifer recharge area which is delineated on the zoning map and which overlies the classes of districts which are part of this ordinance
- Any uses otherwise permitted in the districts so overlaid or in any portion of the districts so overlaid shall be allowed in accordance with the limitations and provisions

West Holyoke

Zoning Ordinance Water Protection & Aquifer Recharge Areas Barnes Aquifer

➤ Aquifer Recharge Area

- Where the bounds delineated are in doubt or in dispute, the burden of proof shall be upon the owner (s) of the land in question to show where they should properly be located

West Holyoke

Basic Requirements

- **Within the aquifer recharge area, maximum land coverage calculations shall include impervious surfaces with area over one hundred (100) square feet and shall be no greater than twenty (20) percent of the lot**

West Holyoke Basic Requirements

- Lot size requirements
 - Cluster development provisions
 - Provisions if served by a water and sewer service area

West Holyoke

Special Permit Requirements

- Increase in impermeable surfaces to greater than 15% of lot area or 2500 square feet, whichever is greater
- Enlargement in the building footprint greater than 25% of the existing footprint

West Holyoke

Artificial Recharge Requirements

- The rendering impervious of either 15% of the area or 2,500 square feet whichever is greater, provided that a system for artificial recharge of precipitation is developed. The management of stormwater and any artificial recharge systems developed shall be designed so as not to result in the degradation of groundwater

West Holyoke

Artificial Recharge Requirements

- For commercial uses, a stormwater management plan shall be developed which provides for the artificial recharge of precipitation to groundwater, where feasible.

Recharge shall be attained through site design that incorporates natural drainage patterns and vegetation, and through use of stormwater infiltration basins, infiltration basins, infiltration trenches, porous pavement or similar systems.

All infiltration practices shall be preceded by oil, grease, and sediment traps or other best management practices to facilitate removal of contamination

West Holyoke

Artificial Recharge Requirements

- For residential uses, recharge shall be attained through site design that incorporates natural drainage patterns and vegetation.

To the extent possible, stormwater run-off from rooftops, driveways, roadways and other impervious surfaces shall be routed through areas of natural vegetation and/or devices such as infiltration basins, infiltration trenches or similar systems

West Holyoke

Artificial Recharge Requirements

- Infiltration practices shall be utilized to reduce run-off volume increases to the extent possible as determined in accordance with infiltration standards and specifications established by the Soil Conservation Service
- A combination of successive practices may be used to achieve the desired control requirements. Justification shall be provided by the person developing land for rejecting each practice based on site conditions. Any and all recharge areas shall be permanently maintained in full working order by the owner. Provisions for maintenance shall be described in the stormwater management plan

California Groundwater Plans

Volume 2 – Resource Management Strategies

Chapter 15 - Recharge Area Protection



California Coastal and Basin aquifers



Figure 102. The California Coastal Basin aquifers occupy a number of basins in coastal areas of California. These basins are in structural depressions filled with marine and alluvial sediments. Nearly all of the large population centers in California are located in the coastal basins and the available ground water is used primarily for municipal supplies.

California

Recharge Area Protection

- Recharge areas protection includes keeping groundwater recharge areas from being paved over or otherwise developed and guarding the recharge areas so they do not become contaminated
- Protection of recharge areas, whether natural or man-made, is necessary if the quantity and quality of groundwater in the aquifer are to be maintained
- Zoning can play a major role in recharge areas protection by amending land-use practices so that existing recharge sites are retained as recharge areas

California

Recharge Area Protection Areas Chosen

- First, the sediment is coarse enough to allow surface water to infiltrate at a higher rate than through finer sediments
- Second, there is hydraulic continuity between the recharge area, the aquifer in which the groundwater is stored and transported, and the discharge area where wells are built to extract the groundwater
- Third, a local agency had access to the land on which these first two conditions existed

California

Recharge Area Protection Grassroot Efforts

- TreePeople, a citizens' organization, has been working with local government to retrofit playgrounds, school grounds, parking lots, and other parcels of land, to collect, treat, and funnel storm water to “dry” wells or other small scale infiltration facilities

California

Recharge Area Protection

Grassroot Efforts

- To avoid contamination of the aquifer, certain best management practices are recommended. Those best management practices include low-flow basins for runoff from industrial areas and other areas that could increase in the amount of groundwater in storage that can later be extracted for local use or for export, and in some cases, use of the aquifer itself as the conveyance system from the recharge area to the point of extraction and use

California

Recharge Area Protection

Identified Benefits

- The primary benefit of protecting recharge areas is to make storage available as part of a sustainable and reliable water supply of good quality
- The availability of a sustainable and reliable water supply may lessen the need to purchase alternative water supplies at greater expense
- Protection of recharge areas does not make a water supply available; a supply of water to recharge the aquifer depends on coordination of regional and local governments and agencies

California

Recharge Area Protection Identified Costs

- Purchase or lease price of the land that is to be used for a recharge area.
- Design and construction of facilities
- Land that is reserved for recharge areas cannot be used for other purposes that might provide a significant income for the landowner and tax revenues for the government
- If a local government agency owns the land, there is no tax income for the county

California

Recharge Area Protection

Major Issues

- There is a lack of standardized guidelines for pre-treatment of the recharge water, including recycled
- Local governments often lack a clear understanding of recharge areas and how to protect those areas from development or contamination
- Standing water in recharge ponds or spreading basins is an attraction for mosquitoes, dragonflies, and other insects whose egg, larval, and pupal stages mature underwater
- Protection of recharge areas can remove land from availability for other uses

California

Recharge Area Protection

Recommendations

- Increase State funding for proposals to identify and protect recharge areas including incentives for the location
- Expand research into surface spreading as a means of groundwater recharge and the fate of chemicals and microbes contained in the recharge water
- Develop a statewide program to identify potential recharge areas throughout the state and provide that information to city and county governments
- Amend State law to prohibit local decision-makers from developing land for other purposes until it is known if that land is needed for recharge
- Engage the public in an active dialogue using a value based decision-making model in planning land use decisions that involve recharge areas
- Establish a “Water” element in the General Plan process that specifically requires a discussion by local government of the cost and values of protecting recharge areas versus the cost of non-protection

California

Recharge Area Protection

Recommendations

- Require local governments to provide protection of recharge areas for aquifers that have been identified as “sole source aquifers”
- Develop educational programs for public works officials and other officials of local agencies and governments
- Require that source water protection plans include an element that addresses recharge areas if groundwater is a part of the supply
- Encourage an integrated academic program on one or more campuses for protection of groundwater quantity and quality and why recharge areas are critical components
- Develop a uniform method for analyzing the economic benefits and cost of recharge areas and provide guidance and assistance for economic feasibility analyses
- Develop a signage program, modeled on such programs in other states, to notify people that they are entering an area of critical recharge for the groundwater

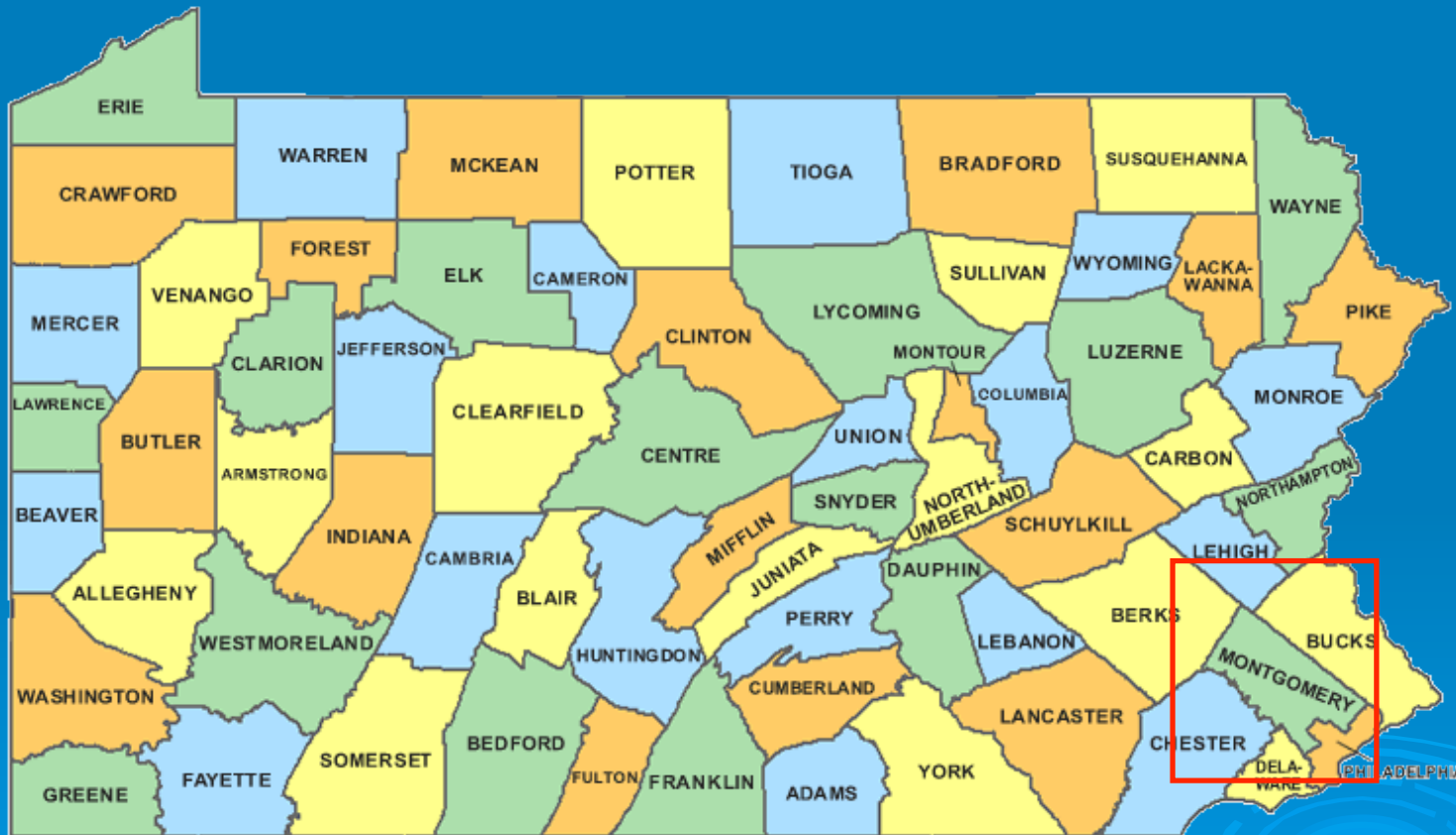


Montgomery County, Pa Planning Commission

Water Resources Plan



Montgomery County, Pa

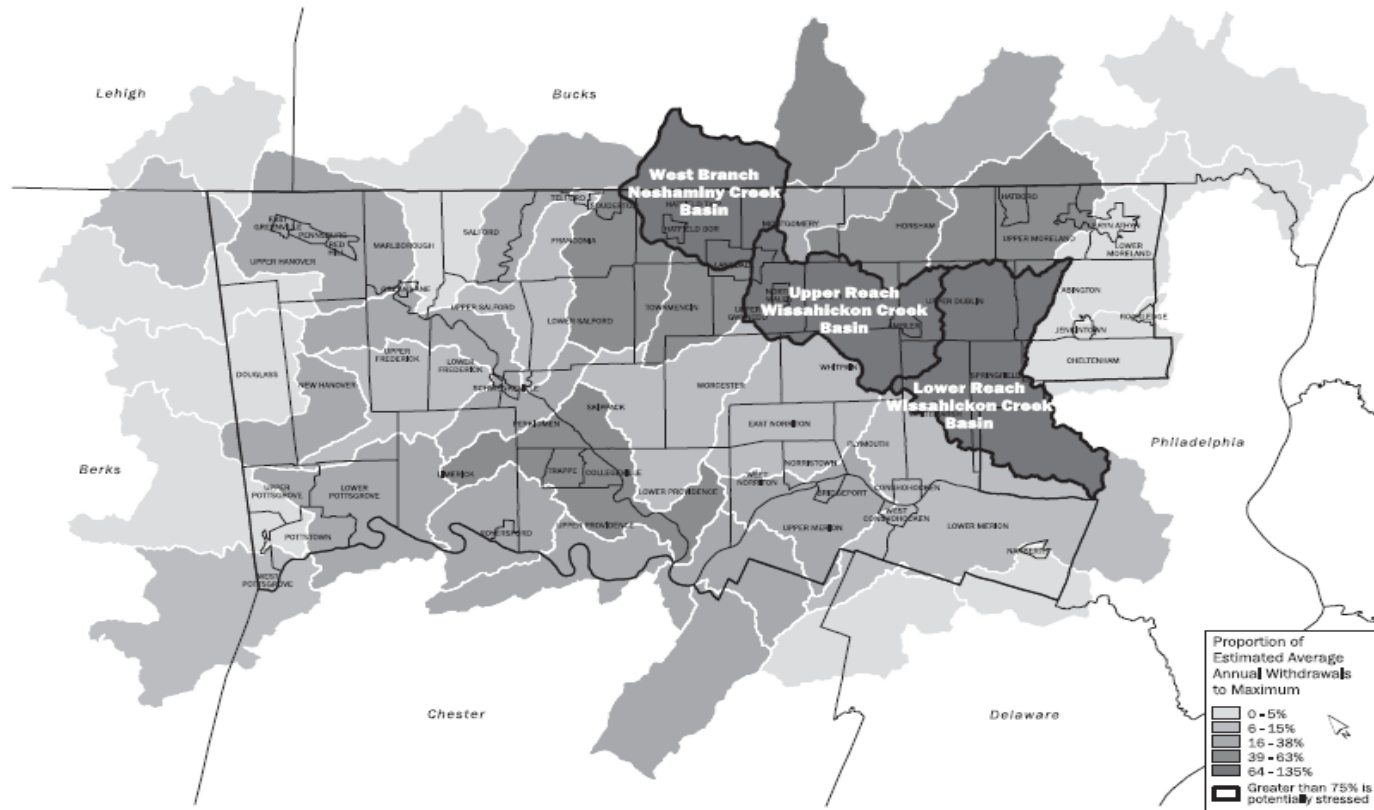


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Montgomery County, Pa

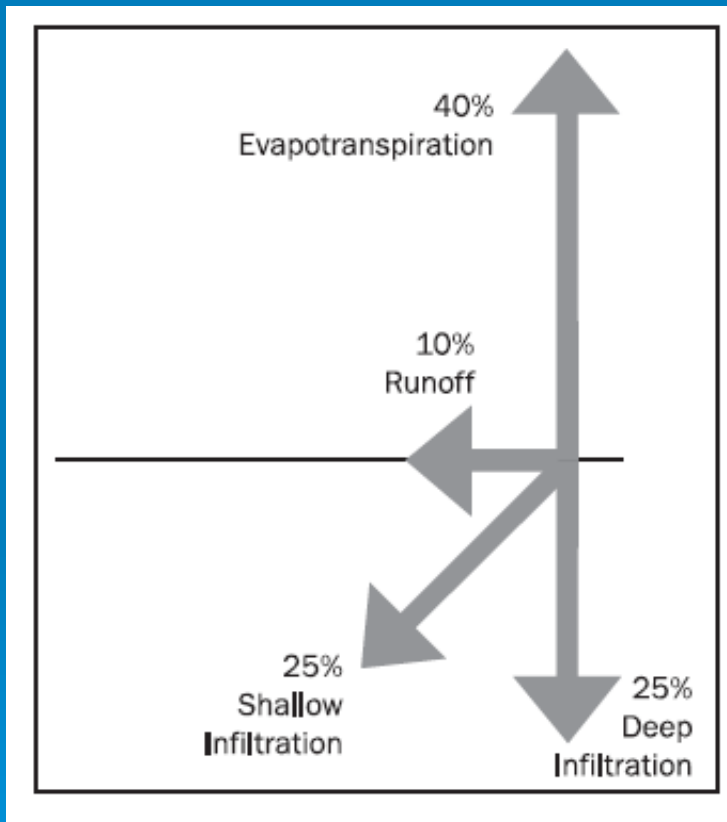
Figure 6
MONTGOMERY COUNTY SUB-BASINS



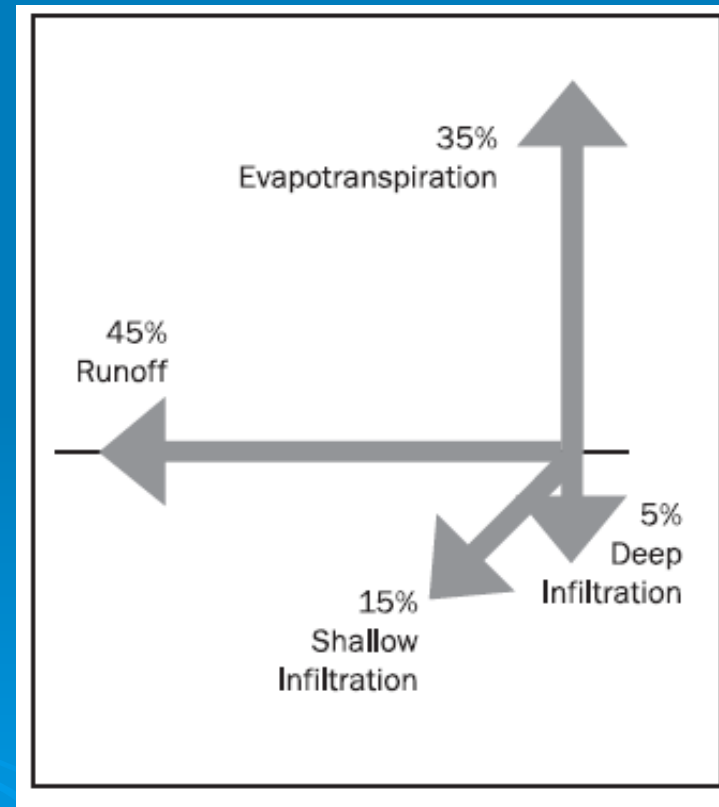
Source: U.S. Geological Survey and the Delaware River Basin Commission.

Montgomery County

➤ *SITE HYDROLOGY BEFORE DEVELOPMENT*



SITE HYDROLOGY AFTER DEVELOPMENT



Montgomery County Goals

- Provide an adequate supply of water,
- Improve water quality and reduce water pollution,
- Limit the impact of flooding, and
- Promote better stormwater management practices.

Montgomery County

Provide an Adequate Supply of Water for Both
Consumption and Natural Habitats

- Encouraging water systems to use a variety of water sources, including wells and surface water.
- Encouraging conservation of water.
- Using community water systems instead of individual wells where development is dense enough to support these systems.
- Providing safe water service alternatives to areas with contaminated groundwater while simultaneously cleaning up any contamination.
- Interconnecting water supply systems to create a consistent and safe supply for both daily use and emergency situations.
- Increasing the amount of stormwater that recharges as groundwater.
- Educating consumers about water conservation.



Montgomery County

Protect Water Quality

- Improving the quality of water discharged from stormwater facilities by requiring the use of best management practices.
- Restoring and protecting stream-banks to limit erosion.
- Encouraging as much groundwater recharge and infiltration as possible through the use of pervious paving, seepage beds, bio-retention areas, swales, and other best management practices.
- Supporting efforts to develop and enforce more stringent maximum stream discharge limits.
- Adopting ordinances and programs to protect stream corridors and enhance existing and new riparian woodlands.
- Adopting ordinances to protect wetlands, steep slopes, and woodlands.
- Maintaining the existing natural drainage and water cycle on a site during and after the development process.
- Adopting water-supply well protection ordinances.
- Enforcing conservation plans for farms and erosion and sediment control plans for developments



Montgomery County

Create Attractive Stormwater Facilities that
Control Flooding, Recharge Groundwater, and
Improve Water Quality

- Retaining stormwater on-site for a longer period to allow for groundwater recharge and sedimentation of pollutants.
- Improving the appearance and function of stormwater basins by creating naturalized basins, requiring curvilinear basins, minimizing side slopes, planting basins with water-tolerant trees, shrubs, and perennials, and eliminating low flow concrete channels.
- Reducing the amount of impervious surfaces in new development through a variety of techniques, such as minimizing road widths, using common driveways, and reducing the amount of parking.
- Maintaining the natural drainage and water cycle on a site during and after the development process.



Montgomery County

Water Policies

- Encouraging water systems to use a variety of water sources, including wells and surface water,
- Educating consumers and suppliers about water conservation,
- Providing safe water service alternatives in areas with contaminated groundwater while simultaneously cleaning up any contamination,
- Interconnecting water supply systems to create a consistent and safe supply for both daily use and emergency situations,
- Increasing the amount of stormwater that recharges as groundwater, and
- Amending zoning ordinances to both accommodate development appropriate to the water resource capacity of an area and safeguard wellhead protection zones, wetlands, and riparian habitats.



Montgomery County

Conservation Measures

- Requiring new development to maintain existing groundwater infiltration levels on their sites
- Adjusting pricing to manage demand
- Educating the public about various conservation practices they can use at home and work
- Changing use habits of customers
- Requiring conservation measures for all new developments
- Retrofitting old fixtures with new, low flow fixtures
- Encouraging efficient landscaping and lawn maintenance practices
- Improving loss detection on water lines and fixing leaks
- Reuse of water from various sources

Montgomery County

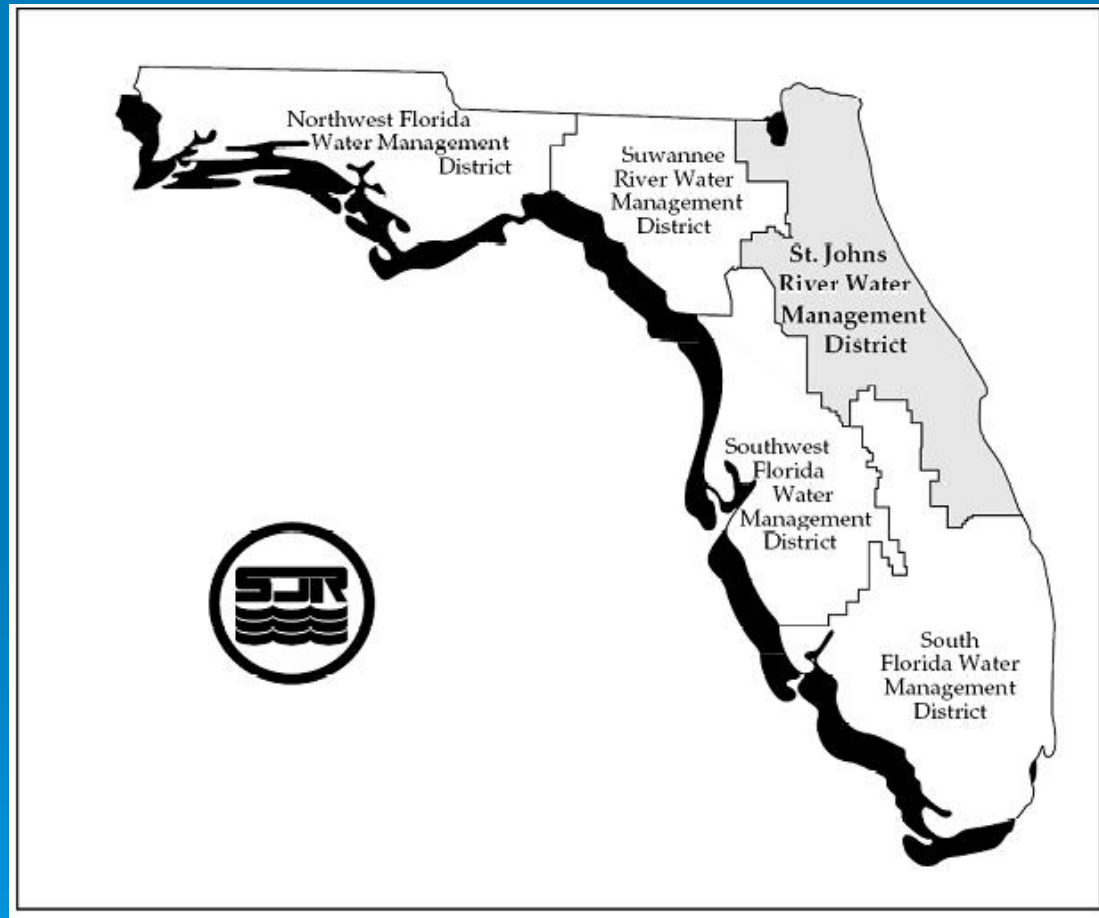
Recommendations

- Continue regional regulation
- Eliminate water regulation exemptions
- Focus water improvements in designated growth areas
- Restrict extension of public water into rural resource areas
- Withhold funding to projects that intrude into rural resource areas
- Provide concurrence between public water and sewer facilities
- Expand opportunities by developing new sources
- Develop more conjunctive use of water resources
- Protect water quality via source water protection plans, including wellhead protection
- Encourage developments in rural resource areas of greater than 15 units and more than a half mile from existing public water facilities to install community water systems
- Encourage owners of individual water supply systems to use an on-lot septic system for wastewater disposal
- Amend the County Health Department Code
- Improve and maintain the county's well monitoring network
- Revise applicable municipal zoning codes¹⁷

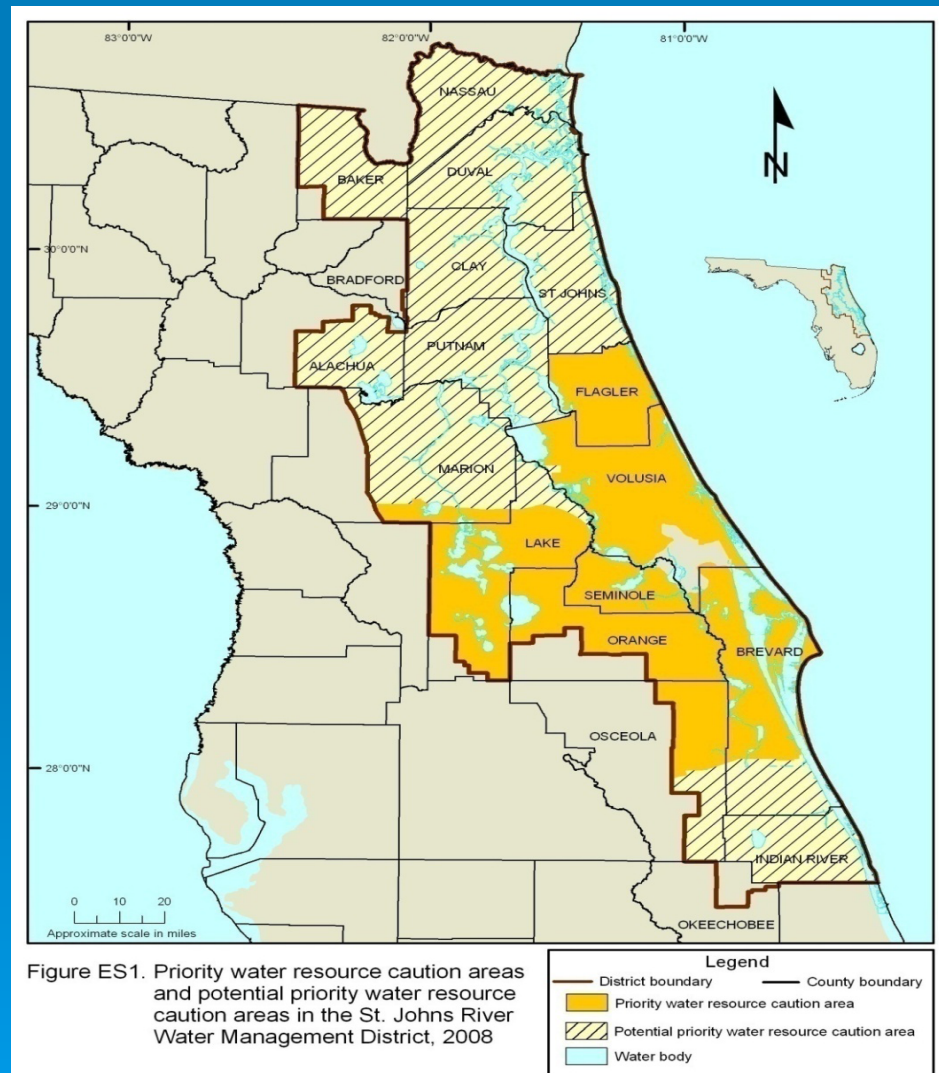
St. Johns River, Florida, Water Management District Aquifer protection program



St. Johns River, Florida, Water Management District



St. Johns River, Florida, Water Management District



St. Johns River Water Management District

Existing Problems

- Currently, more than 95 percent of northeast and east-central Florida's public water supply comes from aquifers
- Aquifers are refilled, or recharged, by rainfall
- However, less and less area is available to allow rainfall to refill the aquifers because paved roads, parking lots, and housing developments and other buildings cover up lands that have soils best suited to allow water to seep into aquifers
- In addition to reduced recharge areas, aquifer water quality is threatened by various pollutants that run off developed areas and seep into the ground

St. Johns River Water Management District

Aquifer Protection Plan Goals

- To ensure the availability of an adequate and affordable supply of water for all reasonable-beneficial uses while protecting the water and related natural resources
- To minimize flood damage and to maintain natural floodplain features and functions, giving preference to use of non-structural surface water management approaches
- To protect existing surface water and groundwater quality from degradation and to improve and restore water quality where degraded
- To maintain native biological diversity and productivity by protecting ecosystems and restoring altered systems to a naturally functioning condition



St. Johns River Water Management District

Water Supply Planning

- Seek to avoid competition for water supplies through regional planning
- Through the water supply planning process, identify sustainable water supply sources and projects that, if implemented, would contribute to avoiding damage to water resources from future water withdrawals
- Evaluate and consider water conservation measures as a way to meet water supply needs
- Evaluate and consider water conservation measures as a way to meet water supply needs
- Include as a priority the acquisition of areas needed for implementation of water resource development projects
- Assist with cost-share funding as an incentive for timely implementation of strategic alternative water supply projects
- Provide technical assistance and facilitate interagency coordination to eliminate institutional and regulatory barriers to the use of aquifer storage and recovery



St. Johns River Water Management District

Flood Protection and Floodplain Management

- Focus flood protection efforts on regional flood issues and on regulatory compliance for systems
- Through technical assistance and planning reviews, encourage land uses in the 100- year floodplain that are compatible with maintenance of natural floodplain functions, including water storage and conveyance, erosion control, surface water and groundwater quality protection, groundwater recharge, and habitat for aquatic and wetland-dependent species
- Support a watershed approach to stormwater management in urban areas where retrofitting is needed
- Promote long-term solutions to regional flood problems that will avoid recurring flood losses and will improve water resource quality



St. Johns River Water Management District

Water Supply Management

➤ Districtwide Water Supply Assessment

- a. *Existing legal uses, reasonably anticipated future needs, and existing and reasonably anticipated sources of water and conservation efforts; and*
- b. *Whether existing and reasonably anticipated sources of water and conservation efforts are adequate to supply water for all existing legal uses and reasonably anticipated future needs and to sustain water resources and related natural systems*
- c. Defining the limits of water resource impacts beyond which an unacceptable water resource-related condition could occur (water resource constraints)
- d. Projecting the water resource impacts that could occur in the planning horizon as a result of projected changes in water use
- e. Identifying priority water resource caution areas



St. Johns River Water Management District

Water Supply Management

➤ Regional Water Supply Plans

- A water supply development component
- A water resource development component
- A minimum flows and levels component

St. Johns River Water Management District

Water Supply Management

➤ Water Conservation

- 40C-2.301(e) *All available water conservation measures must be implemented unless the applicant demonstrates that implementation is not economically, environmentally or technically feasible.*
- water conservation

St. Johns River Water Management District

Water Supply Management

➤ Conservation Rate Structures

- *Permitting of Consumptive Uses of Water. The applicant must submit a written proposal and implement a water conservation promoting rate structure, unless the applicant demonstrates that the cost of implementing such a rate structure is not justified because it will have little or no effect on reducing water use.*
- *In the event that the applicant has a water conservation promoting rate structure in effect, the applicant must submit a written assessment of whether the existing rate structure would be more effective in promoting water conservation if it were modified, and if so, describe and implement the needed changes.*

St. Johns River Water Management District

Water Supply Management

➤ Use of Reclaimed Water

- *When reclaimed water is readily available it must be used in place of higher quality water sources unless the applicant demonstrates that it is not economically, environmentally, or technically feasible.*
- *The lowest acceptable quality water source, including reclaimed water which is addressed in paragraph 40C-2.301(4)(f) above, must be utilized for each consumptive use. To use a higher quality water source an applicant must demonstrate that the use of all lower quality water sources will not be economically, environmentally, or technically feasible.*



St. Johns River Water Management District

Water Supply Management

➤ **Water Shortage Planning**

- The purposes of the plan are to protect the water resources from serious harm;
- To assure equitable distribution of available water resources among all water users during times of shortage, consistent with the goals of minimizing adverse economic, social, and health-related impacts; to provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage; and to promote greater security for water use.



St. Johns River Water Management District

Water Supply Management

➤ **Cost-Effectiveness of Water Supply Alternatives**

- A major conclusion of this work is that the blending of surface water and groundwater in east-central Florida will likely increase the price of water service but not to a level that would be considered excessive or unaffordable based on the U.S. Environmental Protection Agency (EPA) affordability guidelines

St. Johns River Water Management District

Source Protection

➤ Aquifer Recharge Areas

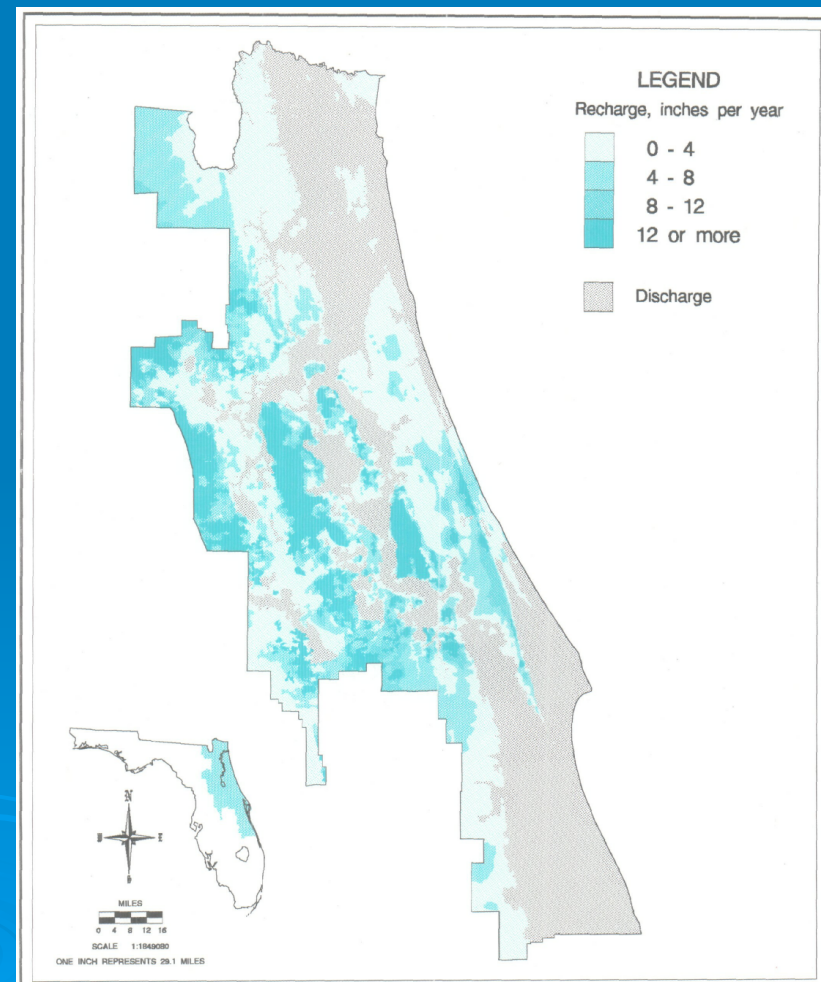
- Maps of recharge areas are useful planning tools for groundwater resource management
- Groundwater recharge to the aquifer from the overlying surficial aquifer or more directly from rainfall in areas where the surficial aquifer is thin or absent and the limestones of the Floridan aquifer are at or near land surface
- The amount of water available as recharge after losses to runoff and evapotranspiration, which infiltrates through the soil zone to the water table and continues to move downward to underlying aquifer systems
- Where the water table elevation is higher than the Upper Floridan aquifer potentiometric elevation, creating downward hydraulic pressure
- The areas of upward leakage define the discharge areas of the Floridan aquifer
- Based on an analysis of the hydraulic pressure differences between the surficial aquifer water table and the Floridan aquifer potentiometric surface
- Recharge also occurs directly from infiltrating rainfall where the limestones of the Floridan aquifer are at or near land surface



St. Johns River Water Management District

Source Protection

The map, which is intended to be used as a regional planning aid for groundwater resource management, and is not intended for site-specific assessments



St. Johns River Water Management District

Source Protection

- Concern for appropriate management of groundwater recharge as a means of assuring reasonable groundwater availability resulted in the inclusion of the Aquifer Protection Program as a water resource development project



St. Johns River Water Management District

Source Protection

➤ **Priority Water Resource Caution Areas**

Objective

- To increase available water supplies and maximize overall water use efficiency to meet identified existing and future needs

St. Johns River Water Management District

Source Protection

➤ Strategies

- Water supply planning
 - Update the Water Supply Assessment
 - Prepare annual updates
 - Develop and maintain an integrated program management structure, including a reporting schedule



St. Johns River Water Management District

Source Protection

➤ Strategies

- Water use data management
 - Provide electronically accessible data
 - Continue data collection for all water use categories
 - Maintain the reuse end-users and service area boundaries data sets
 - Provide water use data on the Internet and Interweb
 - Continue to collect agricultural actual water use data and other related data through the Benchmark Farms Program
 - Continue to compile actual golf course water use data and maintain the database



St. Johns River Water Management District

Source Protection

➤ **Strategies**

- Local government assistance
- Integrated management and planning system
- Land acquisition
- Water resource development projects
- Water supply development assistance
- Consumptive use permitting
- Environmental resource permitting
- Outreach
- **Performance Measures**



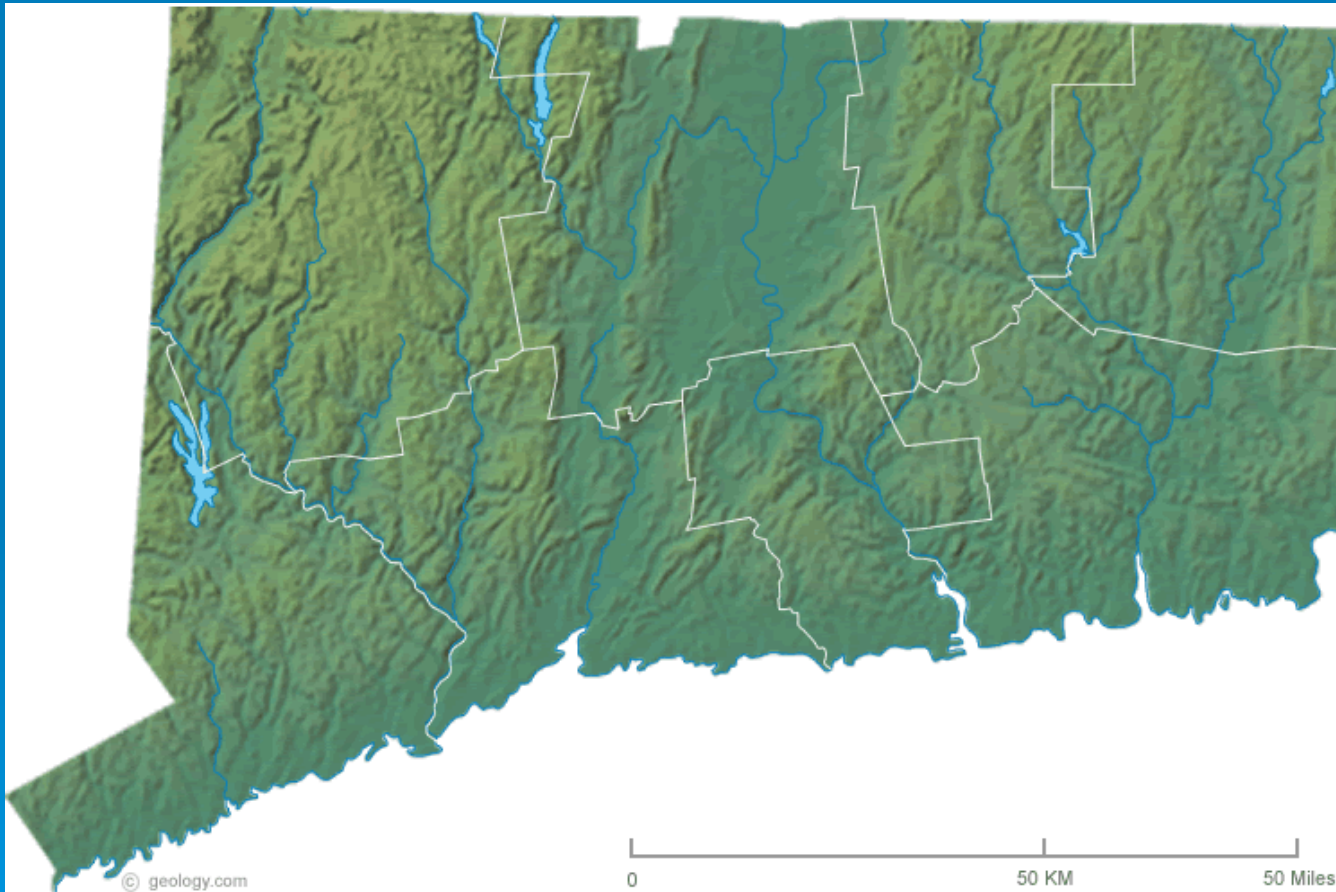
Connecticut's Department of Environmental Protection Aquifer Protection Program



Connecticut's Department of Environmental Protection



Connecticut's Department of Environmental Protection



Connecticut's Aquifer Protection Program

- Mapping of aquifer protection areas
 - Water providers with 1000 or more connections to maps critical portions of aquifer providing water
- Appoint an aquifer protection board
 - Each municipality must appoint an existing board as the aquifer protection agent
 - Most municipalities assign their P & Z board

Connecticut's Aquifer Protection Program

- Aquifer protection agent must hold a public hearing to publish the mapping delineations
- Aquifer protection agency must adopt land use regulations governing the area
- These regulation must be consistent with the State's land use regulations

Connecticut's Aquifer Protection Program

- Once the regulations are adopted, no land use activity may occur within an aquifer protection area without authorization from the aquifer protection agent
- There is a right of appeal
- There is an enforcement component

Connecticut's Aquifer Protection Program

- Regulated activities
 - Activities regarding hazardous materials or water quality contamination potentials
 - Existing activities are registered and grandfathered
 - Managing stormwater

Connecticut's Aquifer Protection Program

- Stormwater Management
 - Site planning and design
 - Source control and practices
 - Stormwater treatment practices
 - Hydrologic sizing criteria
 - Pollution reduction
 - Groundwater recharge
 - Runoff volume reduction
 - Peak flow controls



Connecticut's Aquifer Protection Program

- Stormwater Management Cont.
 - Site stormwater management plan
 - Stormwater retrofits for existing sites

Overall Summary

- Land use activity was ultimately associated with stormwater collection, recharge protection, replenishment activities, and ordinances
- Water authorities produced critical area, recharge, and aquifer protection maps both in a general mapping nature and more detailed upon further investigations and enhanced data
- Maps were produced based on various criteria and methodologies for the specific areas
- Strategic plans were essential that identified a collective vision, mission, and strategic goals
- Cooperation and collaboration between multi-level governing organizations and passage of new legislation on a local and state level
- Aquatic and terrestrial life and habitats were considered as was the protection of economic development
- The implementation of stormwater recharge, stormwater aquifer replenishment, and natural recharge enhancements, increased pervious services and decreased impervious surfaces as the primary tools
- Not only was water quantity addressed but equally water quality addressed as part of the previously mentioned tools
- Public Outreach, education, and modifying social behavior was also a critical component

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