

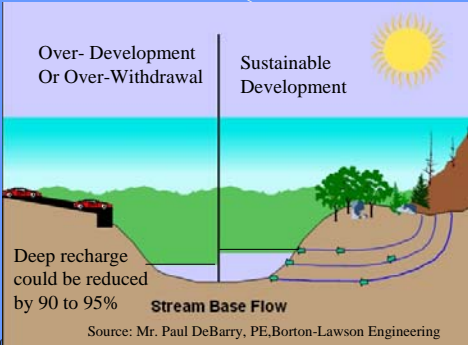
Why Be Concerned about Groundwater Quality / Quantity ?

- In Luzerne County - 18 % of residents serviced by private wells, but Virtually 100 % are supported by groundwater withdrawal.
- Groundwater helps to maintain and sustain recreational areas and habitats, i.e., streams, lakes, wetlands, and most surfacewater features.
- Over withdrawal or groundwater mining can impact existing and future uses, facilitate contamination, decrease stream aquatic habitat, and result in subsidence.
- Improper planning can result in groundwater contamination, which can cause a financial burden on individuals, business, and other entities in the Community.
- Changing land-usage and infiltration capacity can adversely impact both groundwater quality and quantity.

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Because of increased impervious areas, over-pumping of groundwater sources- stream baseflows will decrease.



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Without Linking Water Resource Planning to Land Development – We get more Extremes (More Flooding Larger Events and More Dry Streams)



Uncontrolled Runoff Causes Erosion



Dry Stream Channels

When Rainfall Rate Exceeds Infiltration -Runoff is Generated
When Runoff Occurs Groundwater - Recharge Decreases.

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Groundwater and Surfacewater Withdrawals (Who does what?)

- Depending on the size of a project or proposed use, the use of water for consumption or withdrawal may be regulated and permitted by the local PADEP and River Basin Commissions with feedback from the other state and federal organizations. **Local agencies can not allocate water.**
- PADEP and the River Basin Commission are not a local or county planning agency – they are state/federal permitting agencies.
- PADEP Permits and Regulates – Public Water Systems Sizing and Engineering and River Basin Commission Allocates Water.
- River Basin Commissions are typically involved with consumptive use or withdrawals starting at 20,000 gallons or 100,000 + gpd, but in certain areas the River Basin Commission evaluates consumptive water use at a level of 10,000 gpd.
- PADEP and River Basin Commissions do not contact local planning, but require local planning approval before permits.

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PA Act 220 – Planning Regions



We are Located in the Upper/ Middle Susquehanna Planning Area

Act 220

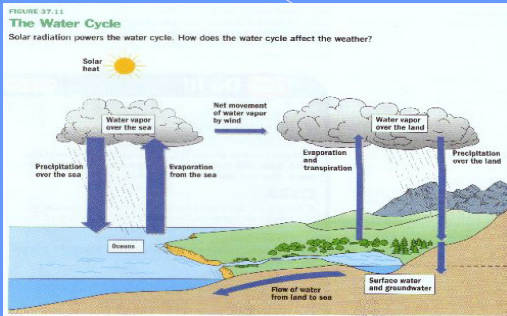
PA Water Resources Planning Act

- Passed into law in 2002.
- Act does not allocate water – just a planning tool.
- Requires registration of all water users exceeding 10,000 gpd – Helping to develop a database of users.
- Regional Committees meet to identify “Critical Areas” within the state.
- Make Recommendations regarding long-term best practices and assessments that are needed for each area and provide other recommendations to manage the resource.

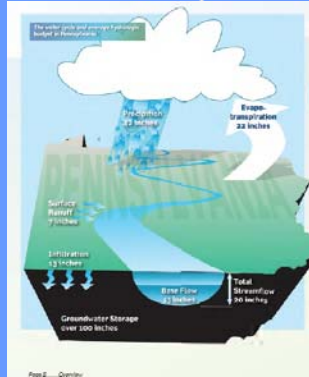
Preliminary Conclusions

- Toby Creek Watershed was identified as a "Potential" Critical Water Planning Area in Act 220.
- General Recommendations
 - Encourage Conservation and Add Metering (not on private wells)
 - Control Water Loss Due to Leakage
 - Develop Groundwater Recharge Systems
 - Implement Stormwater Management Systems
 - Encourage Water Reuse
 - Remediate Contaminated or Impacted Waters, such as Mine Drainage as Industrial Water Source.
 - Develop and Implement Private Well Construction Standards.
 - Encourage Best Management Practices for Developments, Industry, and Agricultural Users
 - Develop Land Use Planning Approaches that Consider Water Resource Issues , such as Development Rights Transfers, Infill, Conservation Subdivisions, and more.

The Water Cycle Powered by the Sun- Solar Power



Water Budget for PA



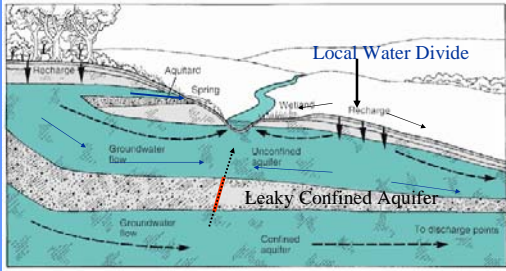
- In
- Precipitation – 42 inches
- Out
- Evapotranspiration – 22"
 - Total Streamflow – 20"
 - Baseflow – 13"
 - Surface Runoff – 7"

Other

- Storage in Groundwater Aquifers over 100 inches*

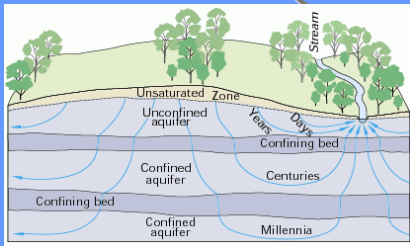
* This is our "Water" Cushion.

Surface Water & Groundwater They Are Related and Connected !



Groundwater Discharge – Supports Stream Baseflow
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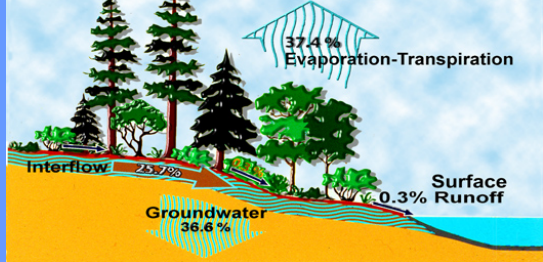
Groundwater Moves Slowly- feet per year



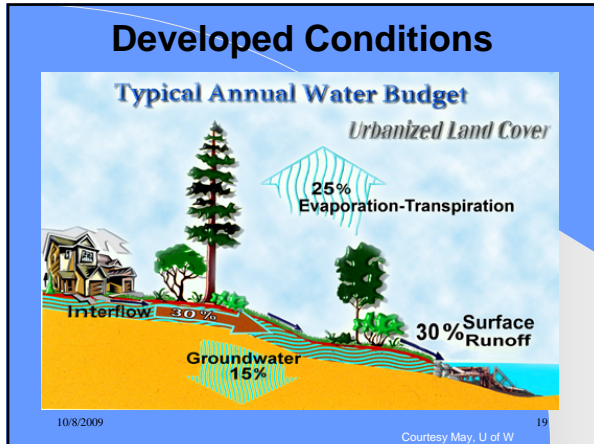
Yes We Have a Lot of Groundwater in Storage, but
it have taken centuries or longer to fill up the system.
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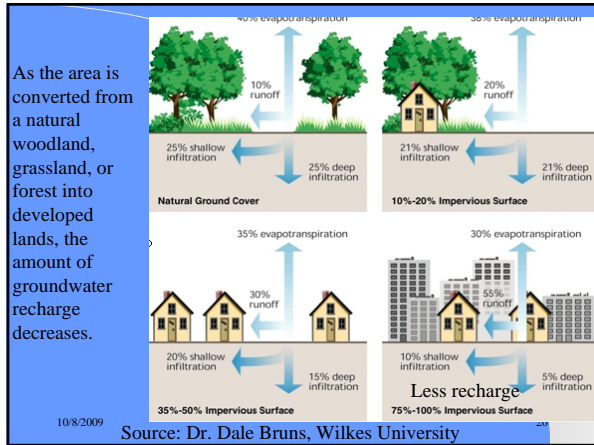
Hydrology Under Natural Conditions

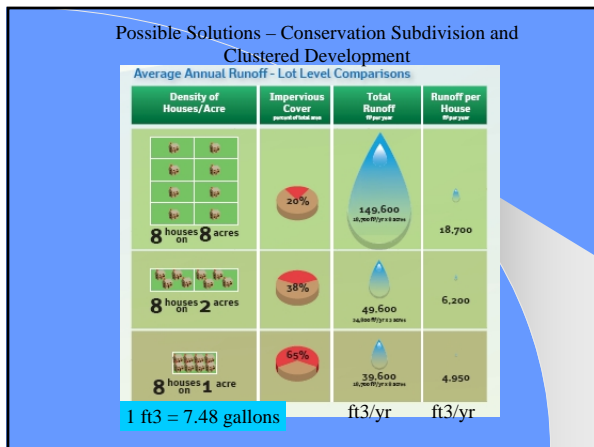
Typical Annual Water Budget Forested Land Cover



Courtesy May, U of W.







Protect Your Water Source Things Local Agency Can Do

- Zoning and Planning Process that includes a Groundwater Availability Analysis, Encourages Groundwater Recharge, and Water Reuse.
- Developing a Well Water Ordinance and Linking the Well Water Ordinance to Act 537 Planning (possible assistance with operating cost through Act 537 funding)
- Developing Well Construction Standards and Encouraging Groundwater Recharge (Low Impact Development and Stormwater Recharge Systems for New and Existing Developments)
- Start or Support a Community Based Groundwater Education Program (Carbon County Groundwater Guardians, County Conservation District, and other partners)
- Encourage on-site septic and private well systems over developments with central water and sewer.

Problem – this really targets future development !

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What About the Existing Development ? How do we turn back the clock?

1. The runoff from one acre of paved parking generates the same amount of annual runoff as:
 - a) 36 acres of forest
 - b) 20 acres of grassland
 - c) 14 acre subdivision – 2 acre lots
 - d) 10 acre subdivision – 0.5 acre lots

All of the above – Does this mean we are missing a possible effective means of “turning” back the stormwater clock. Maybe we need to consider – “greening” some of the existing impervious areas. Maybe the plan needs to include a combination of updated land Development ordinances and “Greening” Strategies.

What Next ? What Action a Community Can Take ?



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Preliminary Groundwater Studies

- Preliminary Tool that can be used in the planning process.
- Based on a combination of published, historical, and site-specific data.



Why Conduct a Groundwater Availability Analysis ?

- A preliminary desktop assessment could help to identify potential impacts on existing uses or other regulated facilities during the planning process and existing problems within the community.
- Desktop assessments can be used to develop site-specific criteria for well construction for unregulated projects and long-term sustainability.
- For larger projects, a preliminary analysis may compile enough information to show that a more comprehensive site-specific analysis would provide sufficient data to show if the withdrawal is sustainable.
- Helps to provide a proactive means of managing groundwater and water resources and helps to ensure the long-term reliability, quality, and sustainability of the system.
- The groundwater system helps to sustain the water cycle during droughts.

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When Should a Groundwater or Water Availability Analysis

- As part of planning and local approvals for new subdivisions or expansion of unregulated water systems, the applicant would conduct a groundwater availability analysis.
- For the Luzerne County area, the analysis should be requested when the proposed density is greater than 1 edu per acre or when the project is proposing the use of a central wastewater disposal system with a stream discharge and not a land-based wastewater disposal system.
- Groundwater availability analysis and hydrological description should be conducted by a licensed professional geologist.
- Where the desktop evaluation indicates the potential for over-pumping of the aquifer, insufficient yield, poor water quality, or withdrawal of over 60 % of baseflow, the local regulations could require a more comprehensive hydrological analysis that could include the installation of test wells and conducting a short-term pumping test (24 to 72 hours).

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Desktop Analysis

- Desktop Analysis should include the following:
 - Review of available baseflow and geological data,
 - Nature of the development (i.e., percent impervious, wastewater disposal options, and landscape changes)
 - Existing Water Withdrawals within recharge area and existing users.

Project Site- Current Conditions

- 100 acre Forest Area- Parcel Area
- Annual Rainfall – 45 inches
- Evapotranspiration – 24 inches
- Mean Annual Recharge – 12 ac-inches/year
- Drought Year Recharge – 7 ac-inches/year
- Impervious Area – 0 %

Project Site- Proposed

- 100 acre Tract – Proposed 85 Single-Family (Low Impact)
 - Residential (Low Impact Development)
 - Proposed Lawn/House/Driveway Area- 85*0.1 acres = 8.5 acres
 - Undisturbed Forest- 78.5 acres
 - Impervious – 5 % or 13 acres
- Annual Rainfall – 45 inches
- Evapotranspiration – 24 inches
- Mean Annual Recharge – 12 ac-inches/year (published)
- Drought Year Recharge – 7 ac-inches/year (published)

Example Desktop Analysis Post-Development- 85 Unit (Low Impact Development Concept)

Normal Year Recharge Rate
 (100-13- 8.5) acres * 12 ac-in/yr * 27154 gal/ac-in= **25,579,068** gallons per year or
 70,079 gallons/day or 700 gpd/acre

Drought Year Recharge Rate
 (100-13-8.5) acres * 7 ac-in/yr * 27154 gal/ac-in= **14,921,123** gallons per year or
 40,879 gallons/day or 408 gpd/acre

Assuming an 85-unit single family residence with an average daily usage of 275 gpd
 or (85* 275 = 23,375 gpd), the estimated water usage is 57 % of baseflow.

If the project was proposing the use of on-lot septic systems and the use of individual
 on-site stormwater management systems, it is likely that this development would have
 a sustainable water resource.

It is likely that no additional assessments are needed.

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Project Site- Proposed

- 100 acre Tract – Proposed 85 Single-Family (Standard)
 - Residential
 - Proposed Lawn/House/Driveway Area- 85*0.25 acres =21.25 acres
 - Modified Forest- 25 acres
 - Impervious – 15 % or 15 acres
 - Undisturbed Forest – 38.75 acres
- Annual Rainfall – 45 inches
- Evapotranspiration – 24 inches
- Mean Annual Recharge – 12 ac-inches/year (published)
- Drought Year Recharge – 7 ac-inches/year (published)

Example Desktop Analysis Post-Development- 85 Unit (Central Water / Central Sewage)

Normal Year Recharge Rate
 38.75 acres * 12 ac-in/yr * 27154 gal/ac-in * (1/365) = 34,393 gpd
 (100 – 21.25 – 15- 38.75) * 0.5* 12 * 27154 * (1/365 d) = 11,159 gpd
 Total – 45,752 gpd

Drought Year Recharge Rate
 38.75 acres * 6 ac-in/yr * 27154 gal/ac-in * (1/365) = 17,296 gpd
 (100 – 21.25 – 15- 38.75) * 0.5* 7 * 27154 * (1/365 d) = 6,509 gpd
 Total – 23,805 gpd

Assuming an 85-unit single family residence with an average daily usage of 275 gpd
 or (85* 275 = 23,375 gpd), the estimated water usage is 98 % of baseflow.

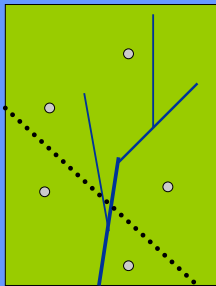
The proposed project could adversely impact groundwater system and a more
 detailed analysis and site-specific data would be needed. In addition, it would be
 advisable to consider the use on land-based disposal for wastewater and possibly
 stormwater.

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Additional Evaluations

- May require a modification to design.
- A more detailed site-specific and watershed based hydrological evaluation.
- A more detailed evaluation that includes the installation of on-site water wells.

Additional On-site Evaluation Individual Well Approach

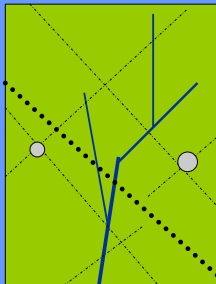


1. Develop a Well Construction Standard for the Project.
2. Identify Geological Boundaries.
3. Install a number of test wells to confirm aquifer yield and quality. For example, a project with 85 units it may be advisable to install 4 to 5 test wells.
4. Document yield of each well and water quality.
5. Document direction of groundwater flow.
6. Conduct a short pumping test on one or more of the wells to simulate average daily withdrawal.
7. Monitor off-site wells.

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Test Well Analysis Community Approach



Delineate Geological Boundary, Conduct a Fracture Trace Analysis and prepare a Predrilling Plan for Submission to PADEP for Review.

85 units * 275 gpd = 23,375 gpd (avg demand)
23,375 * 2 = 46,750 gpd (peak daily demand)
46,750 gpd * (1/12 hour/pc) (1hr/60 min) =
64.9 gpm (peak demand)

If formation typically has yields of 30 gpm, the system will require at least two production wells.
Predrilling Plan for Submission to PADEP for Review.

Drill wells to PADEP Standards and Conduct a Preliminary Pumping Test to Confirm Yield and Monitor a Number of Private Wells.

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Test Well Analysis Modeling/ Watershed Approach



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1. Develop a Well Construction Standard for the Project.
2. Identify Geological Boundaries.
3. Use a Groundwater Model to simulate the installation of 85 wells with a withdrawal equivalent to peak daily demand.
4. Can be used to more directly evaluate existing wells and surfacewater features

Protect Your Water Source Things Local Agency Can Do

- Zoning and Planning Process that includes a Groundwater Availability Analysis, Encourages Groundwater Recharge, and Water Reuse.
- Developing a Well Water Ordinance and Linking the Well Water Ordinance to Act 537 Planning (possible assistance with updating cost through Act 537 funding)
- Developing Well Construction Standards and Encouraging Groundwater Recharge (Low Impact Development and Stormwater Recharge Systems for New and Existing Developments)
- Start or Support a Community Based Groundwater Education Program (Carbon County Groundwater Guardians, County Conservation District, and other partners)

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Additional Options for Local Agency

- Developing Water Well Ordinance that provides construction standards and an initial water quality and yield analysis.
- Developing Well Construction and Placement standards – beyond a minimum isolation distance from land-based wastewater systems, what about hazardous chemicals, manure storage, stormwater facilities, floodplains, etc.

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Why a Well Siting/ Construction Ordinance?

Primary reasons for the ordinances included:

- Improper Well Construction
- Incidents of Well Contamination
 - Improper Siting
 - Interconnection with Contaminated Site
 - Induce Contamination – Lack of Grouting
 - No Testing Requirements to ensure potability
- Overuse of the Groundwater Aquifer.



Online Directory of Model Ordinances
<http://www.epa.gov/owow/nps/ordinance/osm7.htm>

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Well Construction Specs Jackson Township, Monroe County, PA

- Casing must be 18 inch above grade
- Must use a sanitary well seal
- 19# casing must be at least 40 feet in length and 10 feet into bedrock (does not say the bedrock should be firm)
- All casing must be threaded and coupled or if welded, a certified welder must weld it.
- Annulus must be grouted with neat cement grout, Promix cement grout, or concrete grout to within approximately 5 feet of the top of the casing.
- Well must be disinfected – this does not mean long-term disinfection treatment, but shock disinfected.

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Well Construction Specs Paradise Township, Monroe County, PA

- Casing must be 24 inch above grade or the 100-year flood level of record
- Must use a sanitary well seal
- 19# casing must be at least 50 feet in length and 10 feet into bedrock (does not say the bedrock should be firm)
- Annulus must be grouted with bentonite grout.
- Well must be disinfected – this does not mean long-term disinfection treatment, but shock disinfected.

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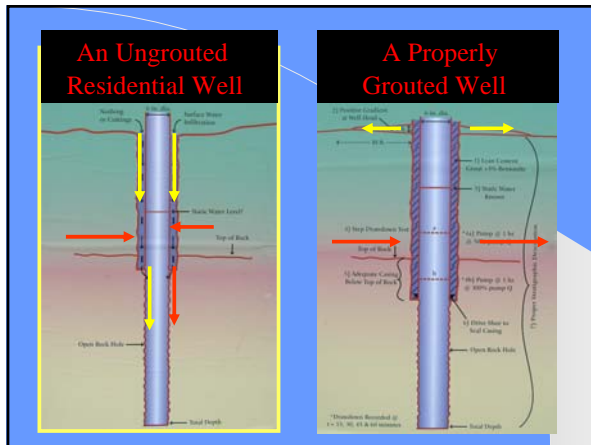
42

Well Construction Specs Ryan Township, Schuylkill County, PA

- Casing must be 12 inch above grade
- Casing wall thickness must be at least 0.1875 inch (13#)
- Must use a sanitary well seal
- Casing must be at least 40 feet in length and 10 feet into bedrock (does not say the bedrock should be firm)
- Annulus must be grouted within 24 hours with bentonite grout or Neat cement grout (No disturbance – 2 hours bentonite and 48-hours cement).
- Well must be disinfected – this does not mean long-term disinfection treatment, but shock disinfected.

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Well Construction Options for Private Wells

Standard Well Cap



Allows entry for insects and small animals

Sanitary Well Cap



Sealed to prevent contamination

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Why Care About Well Construction ?

- Poor construction can affect drinking water quality for well user and regional well users
- Poor construction can contribute, promote, and facilitate pollution and contamination of the groundwater aquifer
- Proper construction can prolong the life and yield of the well

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A Properly Constructed (Sanitary) Residential Water Well Has:

- casing that extends at least 15 feet into firm bedrock or 40 feet below ground, whichever is greater
- casing of adequate wall thickness (meet PADEP Requirements Community Water Supplies- recommend 19#)
- a driveshoe on the bottom of the casing
- annular space should be grouted and casing should have a sanitary well cap.
- casing at least 12 inches above grade and 3 feet above flood elevation.

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Well Isolation Distances

MONTGOMERY COUNTY HEALTH DEPARTMENT INDIVIDUAL WATER SUPPLY WELL CONSTRUCTION SPECIFICATIONS (partial listing)

- Delineated wetlands or floodplains (25 feet)
- Surface waters (25 feet) Storm water Systems (25 feet)
- Spray Irrigation/ Septage Disposal (100 feet)
- Farm silos / manure storage (200 feet) Septic Systems (100 feet)
- Septic Tanks/Holding Tanks (50 feet)
- Chemical Storage/Preparation Area (300 feet)

More Information at
<http://www.h2otest.com/regs/pa/montgomery/>
<http://www.h2otest.com/regs/pa/chester/index.html>

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Importance of Groundwater Analysis and Planning

- Protect the health, security, and well-being of the current residences and water users.
- Protect the environmental and recreational activities that rely on surfacewater – Groundwater and Surfacewater are linked.
- Protect long-term economic growth by properly managing are resources.
- Evaluate projects to make sure that proposed densities or demands do not exceed the natural recharge capacity of the site or establish artificial recharge systems, such as: stormwater recharge and land-based wastewater disposal.

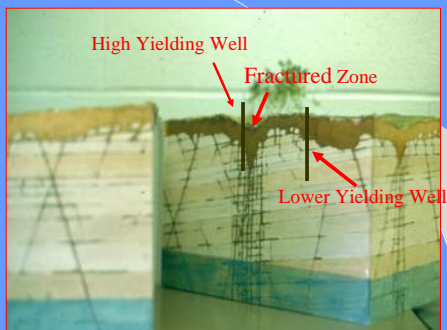
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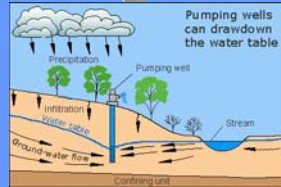
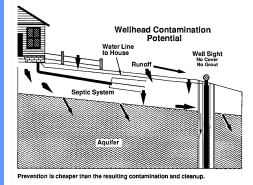
County	# of homes served by private water systems			Avg. Change in homes served by private water systems per year	% of all homes served by public water	% of all homes served by private water system
	1980	1990	2000			
Bradford	13,443	16,865	20,287	+342	37	63
Carbon	6,594	12,235	17,876	+564	55	45
Lackawanna	9,952	12,745	15,538	+279	86	14
Luzerne	19,994	24,662	29,330	+467	82	18
Monroe	21,129	37,246	53,363	+1612	32	68
Pike	9,441	16,875	24,309	+743	45	55
Sullivan	2,147	4,727	7,307	+258	13	87
Susquehanna	9,423	15,212	21,001	+579	25	75
Tioga	9,126	11,888	14,650	+276	35	65
Wayne	9,913	19,097	28,281	+918	33	67
Wyoming	7,236	8,657	10,078	+142	27	73
Region	118,398	180,209	242,020	+562	43	57

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Bedrock Fractures and Fractured Zones



Induced Recharge or Artificial Discharge



Artificial Recharge- Septic Systems Pumping Well - Artificial Discharge

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Keys to Groundwater Resource Management and Planning

- Local or County regulations related to land-use, zoning, and wellhead protection- (Need to be Linked).
- Well Siting, Drilling, and Construction Standards.
- Groundwater Availability Analysis for Proposed Subdivisions or Proposed Expansions of Unregulated Water Systems.
- Community Education and Outreach
- Water Reuse, Conservation, and Stormwater Management.
- Developing a Well Ordinance as part of the Act 537 Plan and Encouraging Land-Based Wastewater Disposal.
- Act 220 and Watershed Withdrawals – Susquehanna River Basin Commission.



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Presentation Sponsors

- Carbon County Groundwater Guardians
<http://www.carbonwaters.org>
- C-SAW Program - Consortium for Scientific Assistance to Watersheds Program
<http://pa.water.usgs.gov/csaw/>
- Pocono Northeast Resource Conservation & Development Council
<http://www.pnercd.org>
- Wilkes University
<http://www.wilkes.edu>

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Announcements

- **2009 Pennsylvania Stormwater Management Symposium** - the title of the Symposium is "Bailing Out Stormwater". The event will occur on October 14 - 15, 2009 at Villanova University.
- At the same site, the **Municipal Workshop** is being held on October 14, 2009 at Villanova University.
- **To Register for either event, please visit:**
<http://www3.villanova.edu/VUSP/PASWM/index.htm>

Announcements

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<http://www3.villanova.edu/VUSP/PASWM/index.htm>
- **Announcement 2**
Pocono Northeast Resource, Conservation & Development Council is looking for Community Partners and Developing Local Projects
<http://www.pnercd.org>





Ground Resource Management
Luzerne County, Pennsylvania



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Professional Geologist, Soil Scientist,
PASEO, Certified Geothermal Installer, Licensed Well Driller
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<http://www.bfenvironmental.com>





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