DEVELOPMENT OF AQUIFER TESTING PLANS

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DEVELOPMENT OF AQUIFER TESTING PLANS

- Goals of Aquifer Testing
- What questions are we trying to answer
- Staff review and approval of Aquifer Test Plans
- Commission Aquifer Testing Guidance
- Components of a successful plan

Susquehanna River Basin Commission

a water management agency serving the Susquehanna River Watershed

Policy No. 2007-01
December 5, 2007

AQUIFER TESTING GUIDANCE

I. INTRODUCTION

This document provides guidance for the aquifer test that is required in Susquehanna River Basin Commission (Commission) Regulation 18 CFR §806.12. A project sponsor must complete an aquifer test according to a pre-approved testing plan for a well prior to submission of an application requesting to withdraw or increase a withdrawal of groundwater.

The Commission supports sustainable economic development in the basin and evaluates withdrawal applications for the long-term protection of water resources. Aquifer testing results are used to help evaluate the aquifer, the local groundwater basin, and the production capability of the well, ensuring that the resources are adequate to supply the needs of the project without significant adverse impact to the water resources of the basin. The Commission may consider factors, including but not limited to, the following in its consideration of adverse impacts: lowering of groundwater or streamflow levels; rendering competing supplies unreliable; affecting other water uses; causing water quality degradation that may be injurious to any existing or potential water use; affecting fish, wildlife, or other living resources or their habitat; causing permanent loss of aquifer storage capacity; or affecting low flow of perennial or intermittent streams.

The aquifer test procedures must incorporate monitoring of a type and frequency that is sufficient to allow evaluation of the above factors. The Commission recommends that a project sponsor retain a project hydrogeologist with substantial experience in the siting, drilling, testing, and permitting of water supply wells for the groundwater development project.[1]

An aquifer test plan must be reviewed and approved by Commission staff before a project sponsor undertakes the testing specified in Commission Regulation 18 CFR §806.12 to support a groundwater withdrawal application. Unless otherwise specified, Commission approval of an aquifer test plan is valid for two years from the date of approval.

[1] Note that projects must comply with laws of member jurisdictions, including professional licensing requirements. Currently, projects in Pennsylvania must use the services of a licensed professional geologist who is legally qualified to practice in Pennsylvania.

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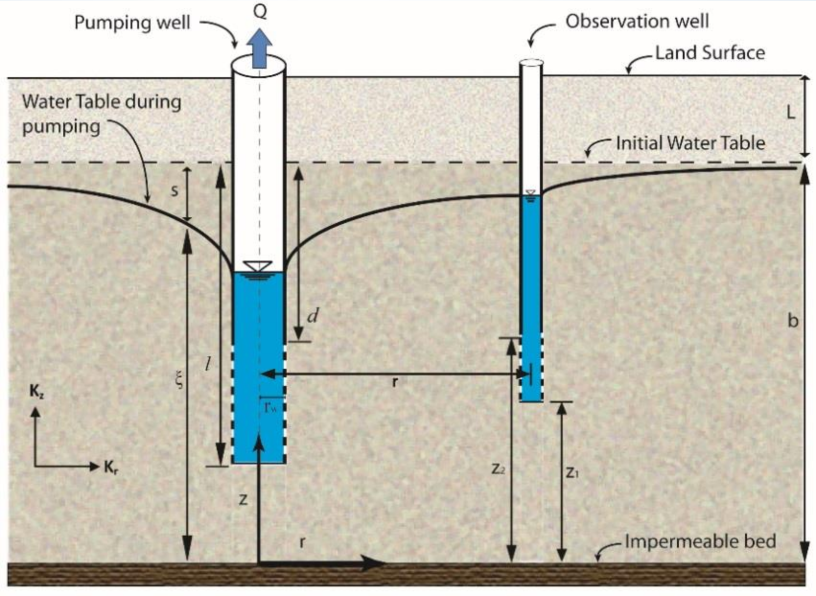
CONSTANT-RATE AQUIFER TESTING

Pumping a production well at a rate greater than or equal to the desired rate of withdrawal and observing the induced changes in groundwater levels, surface water bodies, and wetlands.

The constant-rate test allows the evaluation of the aquifer, the local groundwater basin, and the proposed production well to supply the requested quantity of water and the potential impact of the proposed withdrawal on existing water supplies and environmental resources.



AQUIFER TESTING PLANS

- **Required under 18 CFR 806.12**

  "The project sponsor shall prepare a constant-rate aquifer test plan for prior review and approval by Commission staff before testing is undertaken."

- **What questions are we trying to answer**
  - Sustainability of the withdrawal
  - Impacts to competing groundwater or surface water users
  - Impacts to the Environment

COMPONENTS OF AN AQUIFER TESTING PLAN

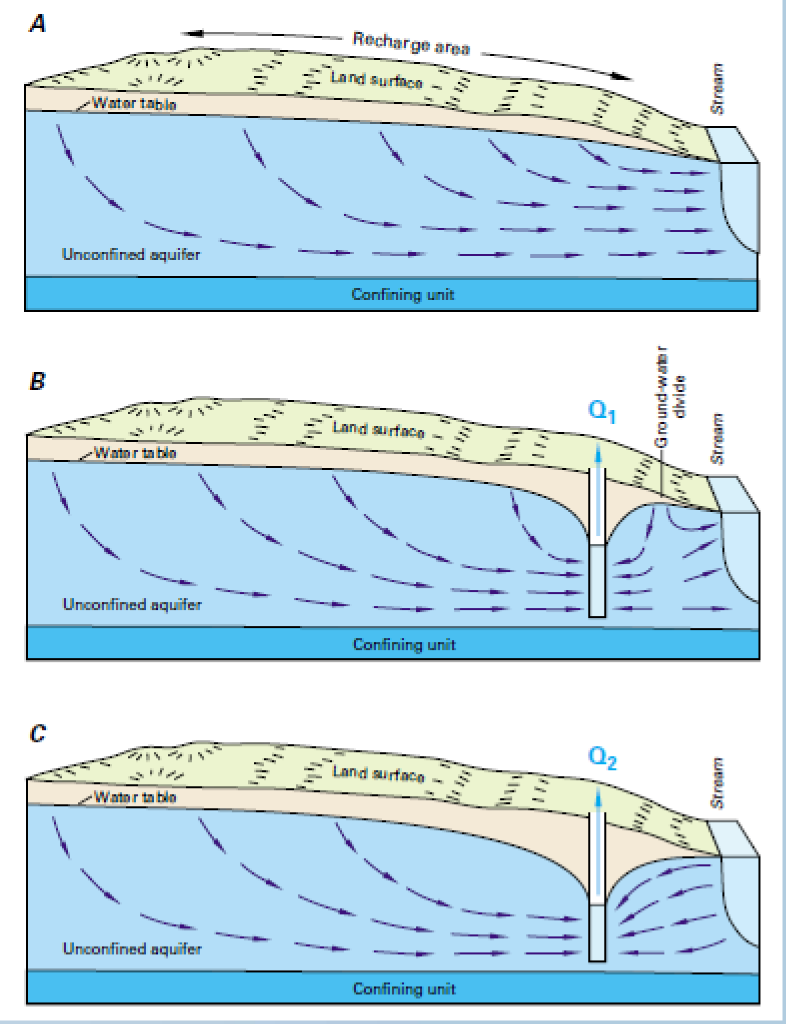
A. Hydrogeologic Description
B. Groundwater Availability
C. Aquifer Testing Procedures
D. Step Testing
E. Background Monitoring
F. Constant-Rate Aquifer Test
G. Recovery Testing
H. General Performance Requirements

**SRBC Aquifer Testing Guidance*

http://www.srbc.net/policies/docs/2007-01AquiferTestingGuidance.PDF

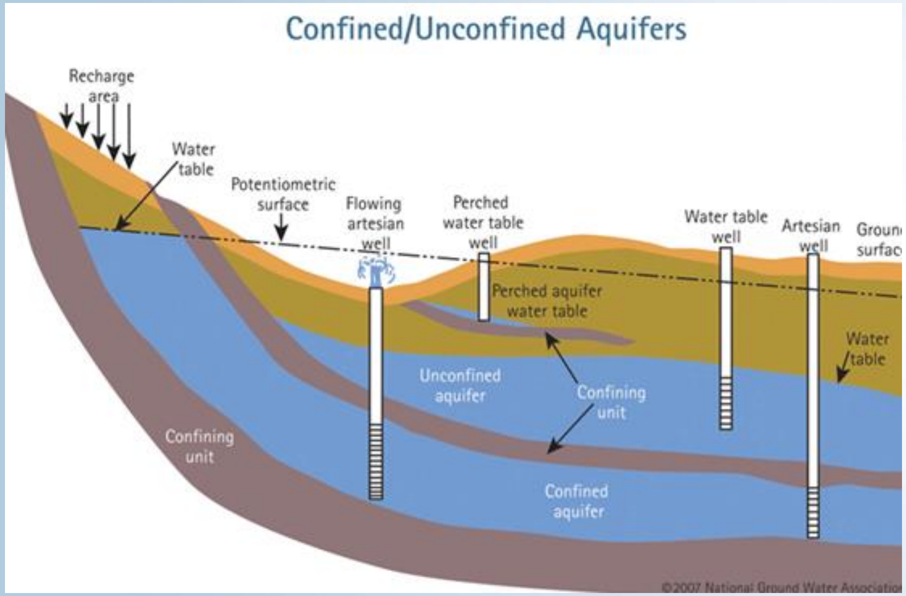
HYDROGEOLOGIC DESCRIPTION

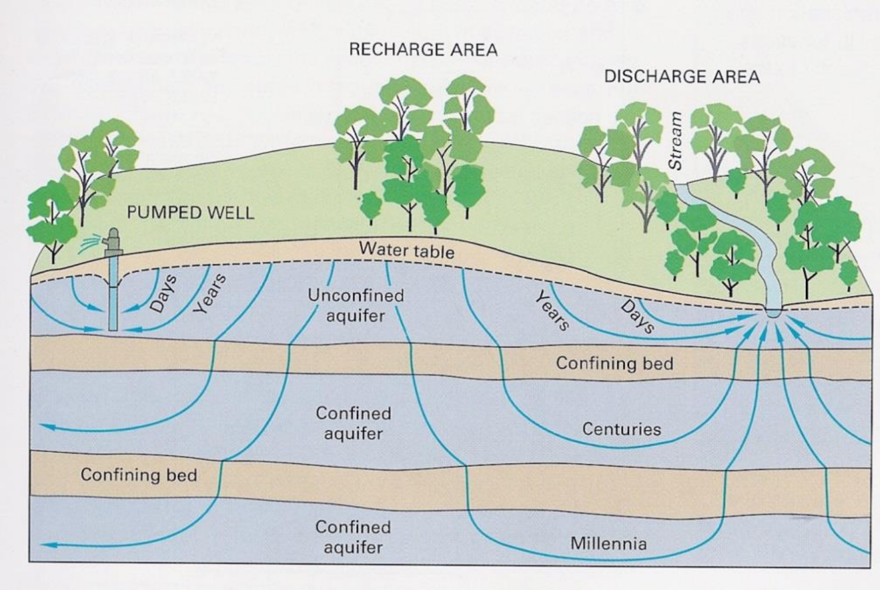
- Geologic setting
  - Site Conceptual model
  - Local vs. Regional Flow Systems
  - Formation(s), field measurements, boundary conditions
- Figures / Maps
  - Well Logs
  - Geologic Maps
  - Contour Maps
  - X-Sections



SITE CONCEPTUAL MODEL

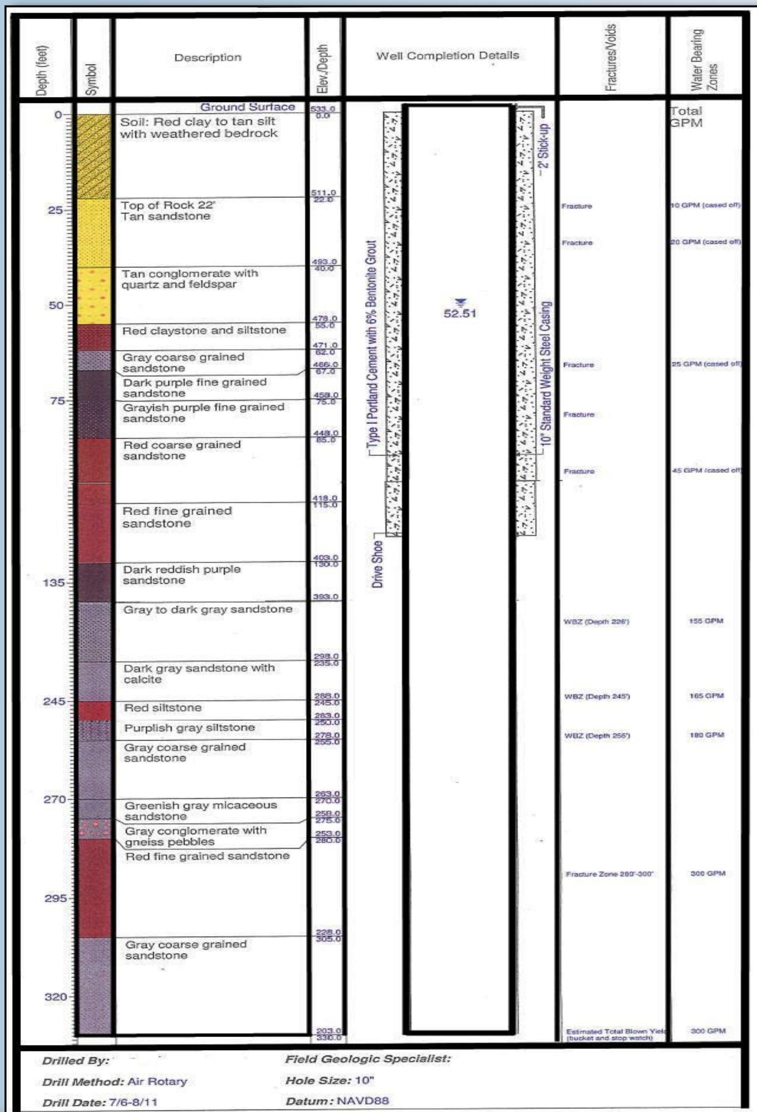
LOCAL V. REGIONAL FLOW SYSTEMS





Groundwater flow path vary greatly in length, depth, and travel-time from the points of recharge to the points of discharge in the groundwater flow system

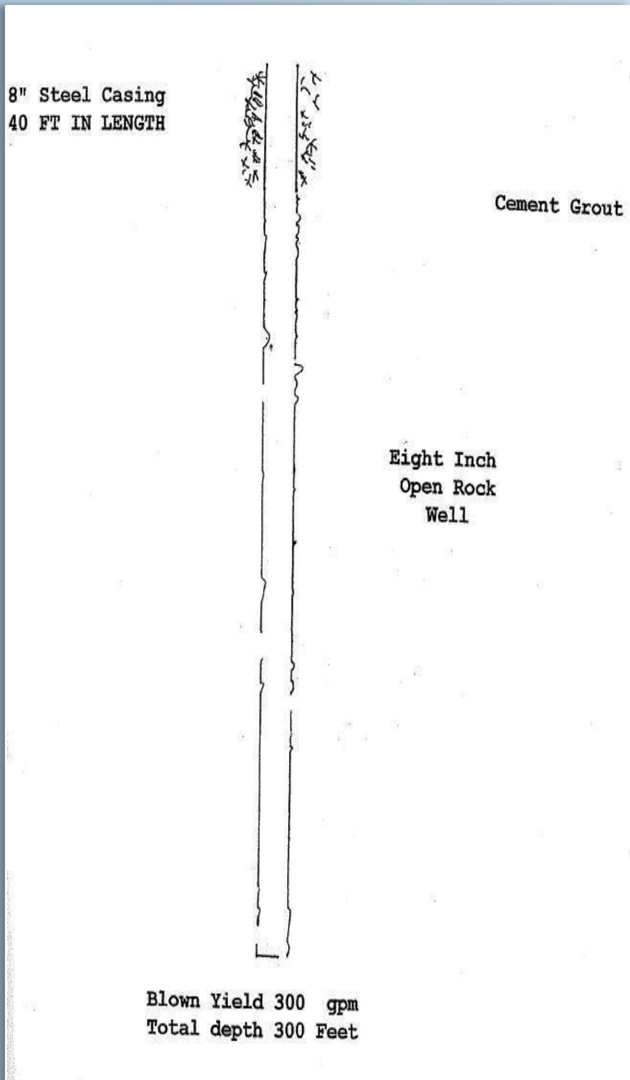
WELL LOGS



Commission Guidance requests:

- *A scaled diagram showing well construction and geology.*
- *The geologic description should include lithology, lithologic contacts, and the depth, yield, and lithologic characterization of water-bearing zones (fractures, conduits, clay seams, gravel beds, etc.).*
- *A textural and mineralogic description of the unconsolidated and weathered materials.*

WELL LOGS

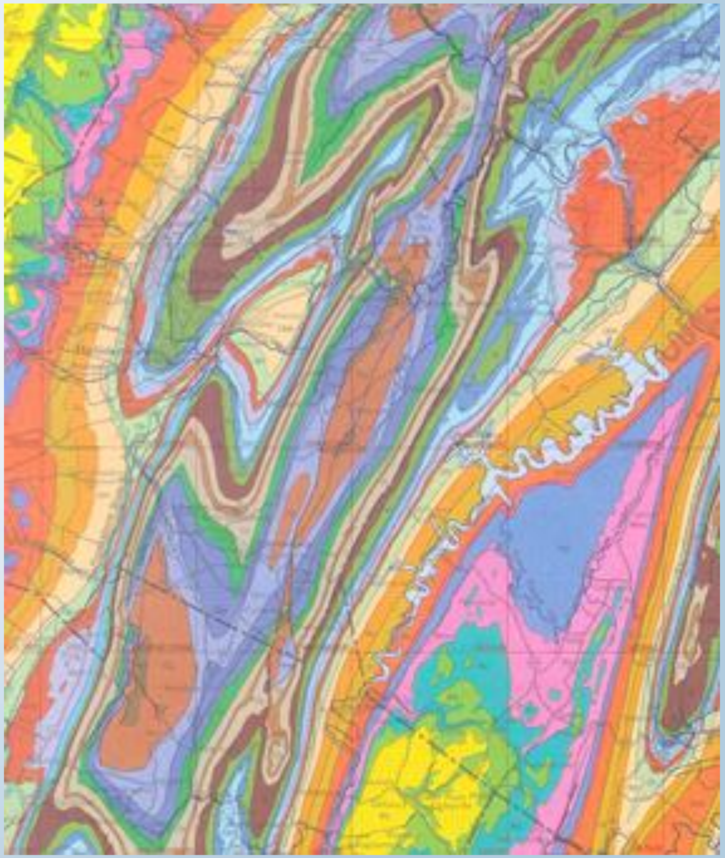


- For existing wells, detailed well logs may not be available. Acceptable well log varies depending on what is being requested:
  - For existing well with no requested increase, historic use demonstrating the requested rate, and/or historic water level data, less information may be required.
  - For existing well with a requested increase, the project sponsor should provide as many details as possible.

GEOLOGIC MAPS

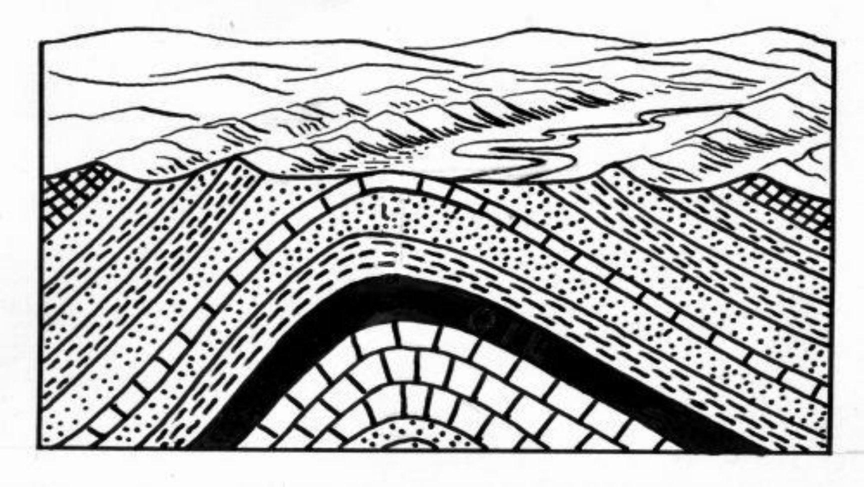
"A geologic map is a textbook on one sheet of paper. In its cryptic manner – its codes of color and sign-it reflects (or should reflect) all the important research that has been done on any geologic topic within its boundaries. From broad formational measurements down to patterns in the fabric of the rock, a map should serve as an epitome of what is known and not known about a region, up to date."

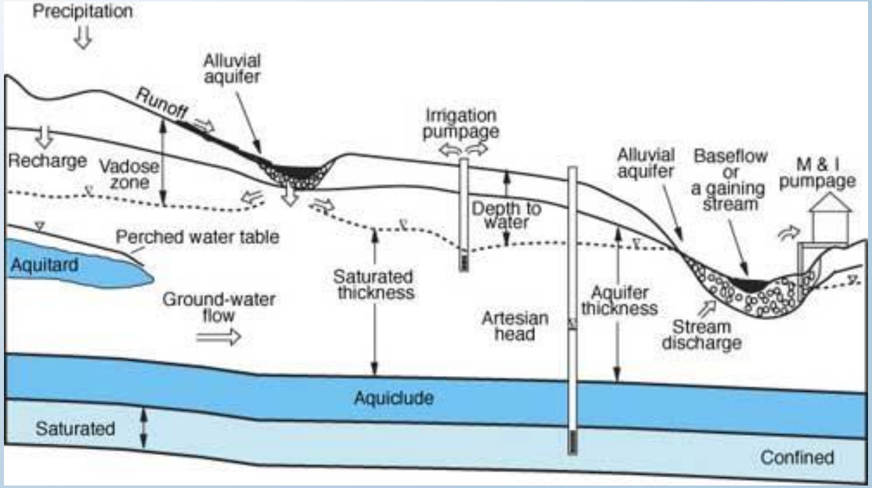
Annals of The Former World by John McPhee



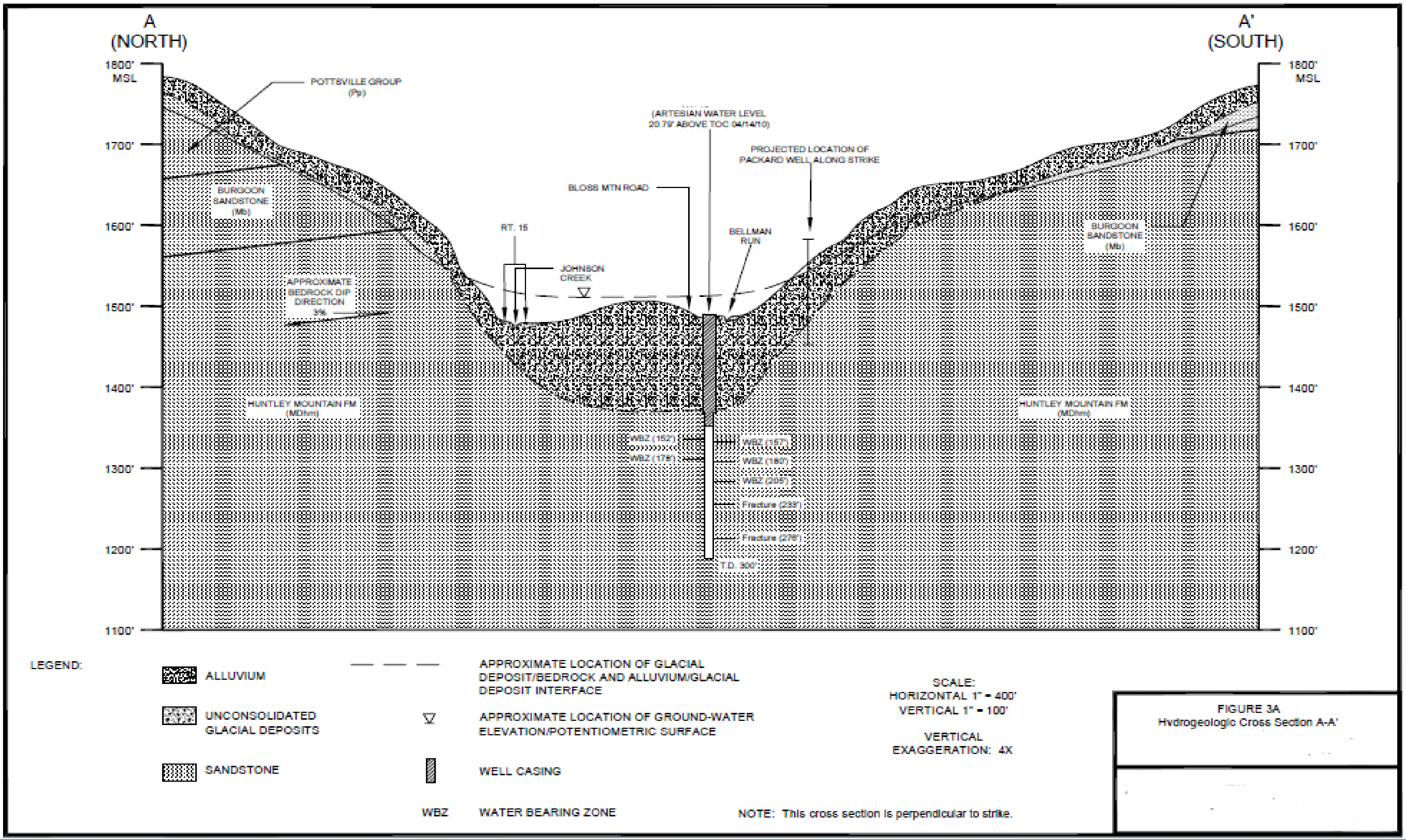
HYDROGEOLOGIC CROSS SECTION

- Geologic structure
- Potentiometric surface
- Surface water features and wetlands
- Aquifers, aquitards, and hydrogeologic boundaries
- Top of rock; Unconsolidated deposits – thickness and extent
- Well bore, casing, pump intake, and water-bearing zones, or screened intervals;
- Monitoring Locations (GW, SW, Wetlands)
- Scale: 1:1 to 5:1 (adjust dip projections to account for VE)
- Tan(dip) =VE*Tan(dip)

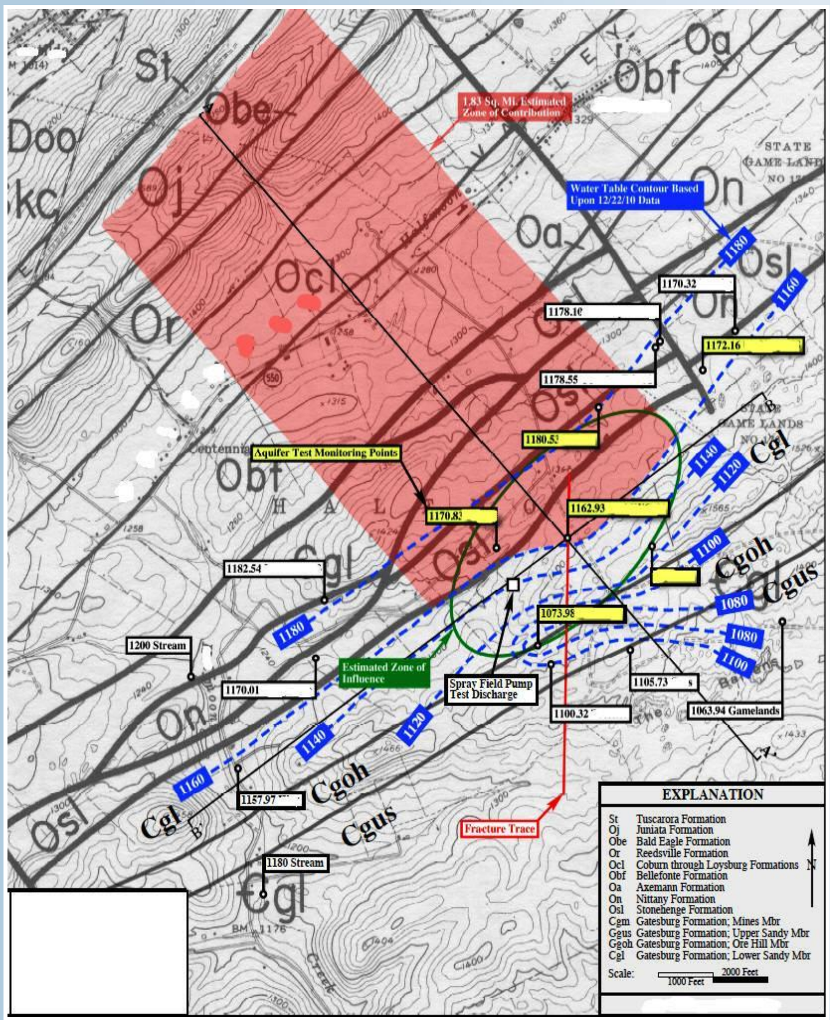




HYDROGEOLOGIC CROSS SECTION



PLAN-SPECIFIC MAPS



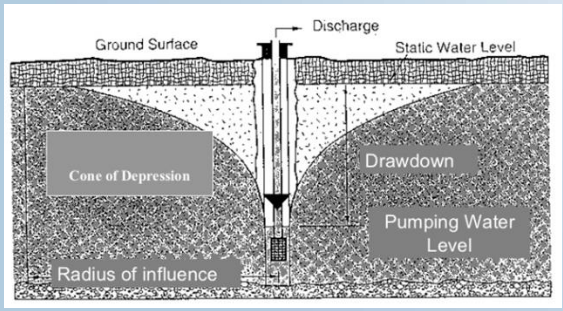
- Contributing geology within the area of contribution of the proposed well.
- Location(s) of recorded field measurements (water elevations, structural geologic features, lithologic changes, etc.).
- Locations of surface water features.
- Fracture traces.
- Contributing aquifer(s) and the presence of any aquitards.
- Boundary conditions.
- Hydrogeologic cross section transects.
- Groundwater Contours
- Estimated Zone of Influence
- Proposed Discharge Location

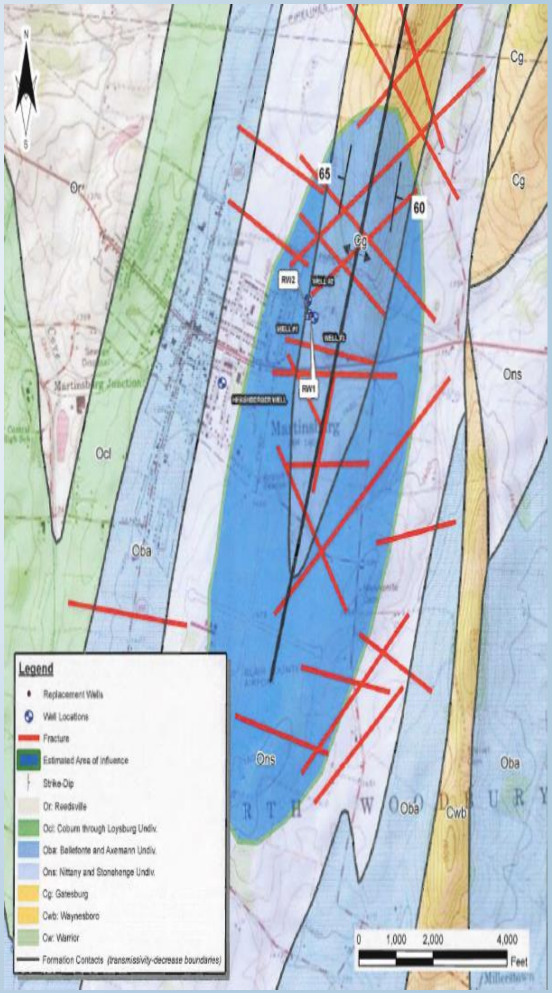
ESTIMATED AREA OF INFLUENCE

AOI should be based upon aquifer properties including:

- dominant types of permeability and their spatial characteristics such as bedding and fracture orientations, anisotropy, etc.
- topography, hydraulic gradient, groundwater flow directions, recharge boundaries, confining boundaries, etc.

Mapping should depict the aquifer properties (bedding strike, fracture traces, joints, etc.) used to determine the area of influence.





GROUNDWATER AVAILABILITY

- Project Hydro should evaluate prior to well siting
- 18 CFR 806.12(b) – Requires completion of a groundwater availability analysis using 1-in-10 year recurrence interval (drought conditions).
- The Commission considers the cumulative effects of existing and proposed withdrawals within a watershed, and can limit approvals to ensure the sustainability of the stream/aquifer system based on this standard.

GW Availability Analysis Steps

- Select applicable recharge rate;
- Delineate GW recharge basin;
- Calculate Unit Area Recharge
- Complete Phase I Analysis; and
- Phase II Analysis, if necessary.

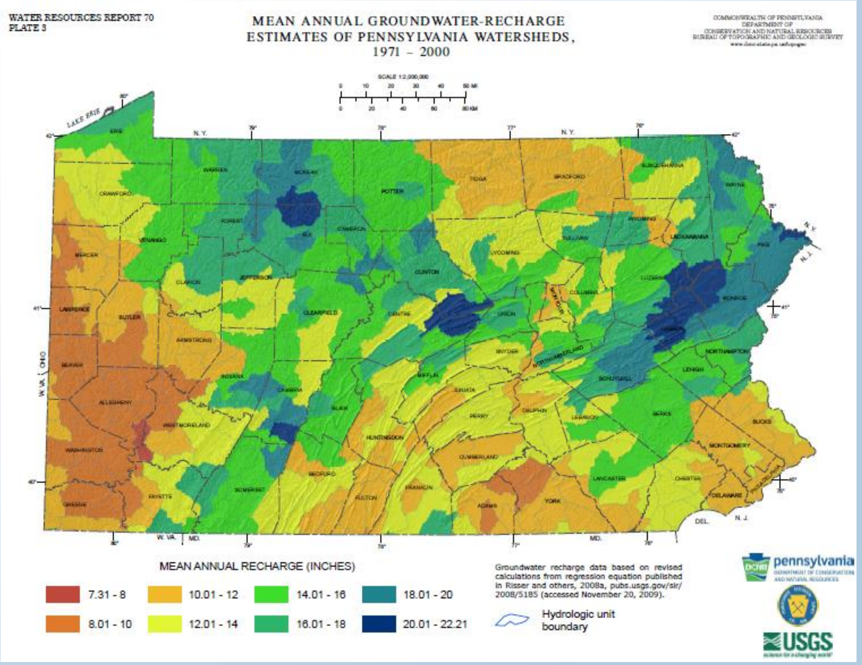
"Finding scientific and technical solutions to problems of water availability and quality will require extensive cooperation and collaboration among Federal, State, and local agencies, private sector water experts, stakeholders, and the public..."

From "A Strategy for Federal Science and Technology to Support Water Availability and Quality in the United States," National Science and Technology Council (2007)

SELECTION OF RECHARGE RATE

- Provide reference and rationale for chosen recharge rate
- Do not select the highest rate available, unless it can be demonstrated that the highest rate is the most appropriate rate
- Do not average recharge rates: select a source and justify that selection

- Water Resource Report 70 (Reese and Risser) is a good starting point.
- Commission does not approve recharge rates or groundwater availability analyses



STAFF REVIEW OF RECHARGE RATE

- Staff evaluate numerous gauges reference reports to determine appropriate recharge rate
- List of commonly used recharge references included with CD handout.

Source	1-in-10 year	Distance from Site (miles)	Used in evaluation?	Rationale	Formations	Regulated	Record Period	Years of Record	Mean Annual Precip (in)	Basin Size (square miles)	Basi Elevati (ft)
StreamStats BF10 Regression for well field centroid - 0.0234cfs	0.262	0	N	StreamStats BF10 Regression based on well field centroid - Regression equations not for valid for DA less than 4.93 mi2; DA	Hamilton, Onondaga, Old Port	NA	NA	NA	41	0.8	
Gage 01539500 Little Fishing Creek at Eyers Grove - Gage	0.325	19	N	~77% Trimmers Rock - less permeable than rocks underlying well field recharge	Burgoon SS, Huntley Mtn, Catskill, Trimmers Rock, Hamilton	N	1940-1958	18	41	56.5	
Gage 01539500 Little Fishing Creek at Eyers Grove - PART	0.317	19	N	~77% Trimmers Rock - less permeable than rocks underlying well field recharge	Burgoon SS, Huntley Mtn, Catskill, Trimmers Rock, Hamilton	N	1940-1958	18	41	56.5	
Gage 01539500 Little Fishing Creek at Eyers Grove - RORA	0.425	19	N	~77% Trimmers Rock - less permeable than rocks underlying well field recharge area	Burgoon SS, Huntley Mtn, Catskill, Trimmers Rock, Hamilton	N	1940-1958	18	41	56.5	
Gage 01542500 WB Susquehanna River at Karthaus, PA - Gage	0.436	69	N	**REGULATED GAGE/Physiographic**	Casselman, Glenshaw, Allegheny, Pottsville, Mauch Chunk, Burgoon SS,	Y	1940-1995	56	42	1460	
Gage 01550000 Lycoming Creek near Trout Run, PA - Gage	0.300	36	N	Olean till	Allegheny, Pottsville, Mauch Chunk, Burgoon SS, Huntley Mountain, Catskill,	N	1913-2003	90	37	173	
Gage 01550000 Lycoming Creek near Trout Run, PA - PART	0.420	36	N	Olean till	Allegheny, Pottsville, Mauch Chunk, Burgoon SS, Huntley Mountain, Catskill,	N	1913-2003	90	37	173	
Gage 01550000 Lycoming Creek near Trout Run, PA - RORA	0.534	36	N	Given soil and rock type underlying the project's expected recharge area, 1-in-10 yr	Allegheny, Pottsville, Mauch Chunk, Burgoon SS, Huntley Mountain, Catskill,	N	1913-2003	90	37	173	
Gage 01553130 Sand Spring Run near White Deer PA - Gage	0.655	16	N	1-in-10yr greater than used for carbonate formation - watershed primarily sandstone	Clinton, Tuscarora, Juniata, Bald Eagle	N	1968-1981	13	45	4.93	
Gage 01553130 Sand Spring Run near White Deer PA - PART	0.602	16	N	1-in-10yr greater than used for carbonate formation - watershed primarily sandstone	Clinton, Tuscarora, Juniata, Bald Eagle	N	1968-1981	13	45	4.93	
Gage 01553130 Sand Spring Run near White Deer PA - RORA	0.674	16	N	1-in-10yr greater than used for carbonate formation - watershed primarily sandstone	Clinton, Tuscarora, Juniata, Bald Eagle	N	1968-1981	13	45	4.93	
Gage 01553600 EB Chillisquaque Creek near Washingtonville - Gage	0.269	14	N	Included in Gage 01553700; does not include carbonates; Gage 0153700 better	Trimmers Rock, Hamilton	N	1960-1978	19	41	9.24	
Gage 01553600 EB Chillisquaque Creek near Washingtonville - PART	0.231	14	N	Included in Gage 01553700; does not include carbonates; Gage 0153700 better	Trimmers Rock, Hamilton	N	1960-1978	19	41	9.24	
Gage 01553600 EB Chillisquaque Creek near Washingtonville - RORA	0.342	14	N	Included in Gage 01553700; does not include carbonates; Gage 0153700 better	Trimmers Rock, Hamilton	N	1960-1978	19	41	9.24	
Gage 01553700 Chillisquaque Creek at Washingtonville - Gage (includes 01553600)	0.355	12	Y	Located in close proximity well field, geology in recharge area similar to project well field, located within the same basin with	Trimmers Rock, Hamilton, Onondaga, Old Port, Keyser/Tonoloway, Wills Creek	N	1979-2003	24	41	51.5	
Gage 01555000 Penns Creek at Penns Creek, PA - Gage	0.397	13	Y	Viking well 2 completed in Swc; Wells 1 and 4 in Dskt/Swc; Viking recharge area	Onondaga, Old Port, Keyser, Tonoloway, Wills Creek, Bloomsburg, Mifflintown,	N	1929-2003	74	44	301	

Source
1-in-10 year
Distance from Site (miles)
Formations
Basin
Physiographic Province/Section
Regulated
Record Period
Years of Record
Mean Annual Precip (in)
Basin Size (square miles)
Basin Elevation (ft)
Basin Slope (°)
Depth to Rock (ft)
Siliciclastic (%)
%Carbonate
% of Glaciation
Forested (%)
Agriculture (%)
Urban (%)
Storage (%)
Stream Density (mi/mi2)

GROUNDWATER BASIN MAP

- Topographic map with contributing geology
- Potential hydrogeologic boundaries (divides, discharge areas or points [springs], dikes, sharp permeability changes).
- Production wells within the contributing recharge area of the proposed pumping well (residential, municipal, industrial, irrigation, etc.).
- Surface water withdrawals.

Geologic Formation	Map Symbol	Age	Rock Type	Recharge Area (mi²)	1-in-2 Recharge Rate (mgd/mi²)	1-in-10 Recharge Rate (mgd/mi²)	1-in-10 Recharge (mgd)
Annville Fm	Oan	Ordovician	High-calcium limestone	0.18	0.76	0.46	0.08
Cocalico Fm	Oco	Ordovician	Shale, Siltstone, Argillaceous Sandstone	0.78	0.64	0.39	0.30
Epler Fm	Oe	Ordovician	Limestone, Dolomite	3.0	0.76	0.46	1.38
Hershey and Myerstown Fm, undivided	Ohm	Ordovician	Argillaceous limestone, Limestone	0.15	0.76	0.46	0.07
New Oxford conglomerate	Trnc	Triassic	Quartz conglomerate	0.28	0.46	0.28	0.08
New Oxford Fm	Trn	Triassic	Arkosic sandstone, Shale, Mudstone, Sandstone	1.47	0.46	0.28	0.41
Stonehenge Fm	Os	Ordovician	Limestone, Conglomeratic siliceous limestone	0.31	1.01	0.61	0.19
			Total Recharge Area =	6.17	Total 1-in-10 Recharge =		2.51

mgd = million gallons per day
mi² = square mile
mgd/mi² = million gallons per day per square mile

PHASE I GROUNDWATER AVAILABILITY

Table 4.4 Utilization Summary	
	Volume
Available 1-in-10-year Drought Recharge	.662
Existing Groundwater Withdrawal(s)	.272
Remaining 1-in-10-year Recharge Available (minus existing withdrawal)	.39
Proposed Withdrawal (anticipated withdrawal rate)	.187
Remaining Groundwater Availability	.203
Percent Utilization 1	69.325

Note:

1. A Phase II Groundwater Availability Analysis will be required if the Phase I Groundwater Availability Analysis indicates that the anticipated withdrawal rate will be greater than 50 percent of the available resources (i.e. Percent Utilization > 50%) during a 1-in-10-year drought.

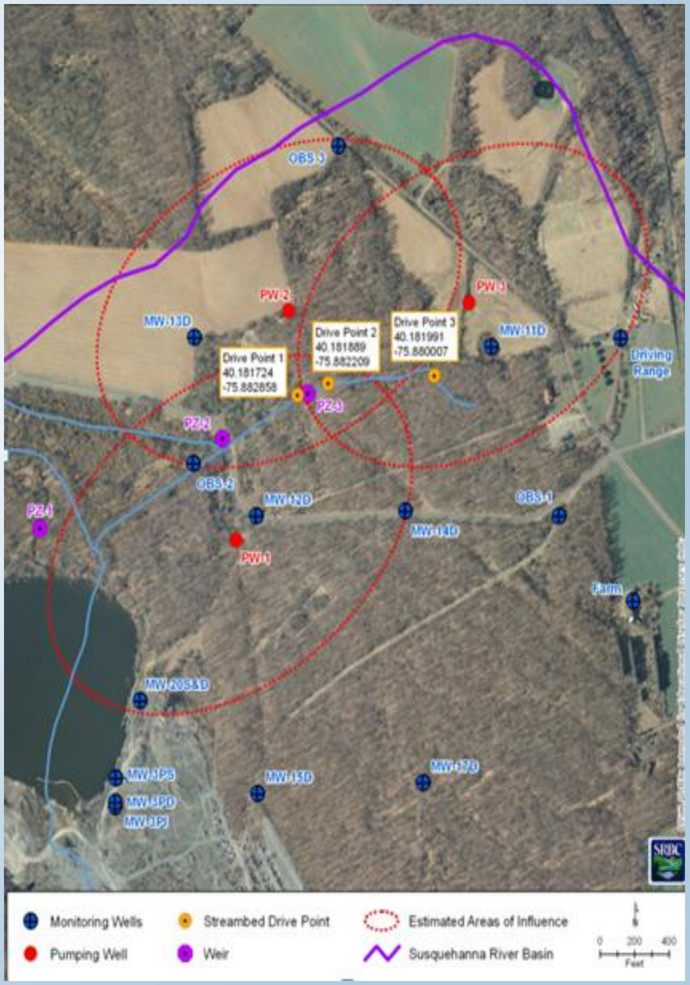
PHASE II GROUNDWATER AVAILABILITY ANALYSIS

- Required where utilization exceeds 50%
- Considers:
  - Impervious cover (land development)
  - NPDES discharges
  - Surface water withdrawals
  - Contributions to aquifer from surface water (setting dependent)

AQUIFER TEST MONITORING LOCATIONS

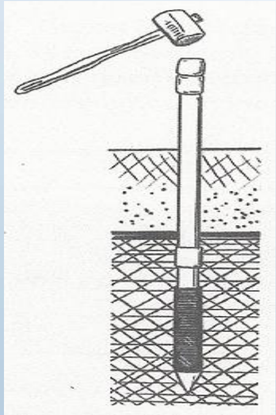
Monitoring should be:

- Focused on the AOI, especially along high permeability trends, generally in the up-dip or k-max direction, where impacts are most likely to occur.
- Selected to adequately characterize impacts in the k-max and k-min directions.
- Coordinated with member jurisdiction agencies to ensure monitoring meets all requirements



GROUNDWATER MONITORING

- Observation well selection should be based on the expected area of influence , and the distribution and construction of existing wells.
- It may be necessary to monitor wells outside the anticipated area of influence due to impact sensitivity or uncertainty in the estimated area of influence or area of contribution.
- All observation points should be monitored with digital data loggers. Staff recommend the collection of back up manual water levels.

SURFACE WATER MONITORING

- Surface water monitoring locations should be selected to adequately characterize surface water impacts. These will generally be in the k-max or up-dip direction(s) and in the proximity of the well being tested.
- The location of high permeability features should be taken into consideration (fracture trends, gravel beds, etc.) that likely have an efficient hydraulic connection to the well being tested.

SURFACE WATER MONITORING HEADWATER SETTINGS
(AQUATIC RESOURCE CLASS [ARC] 1)

For streams, springs and other surface water feature with channelized flowing water:

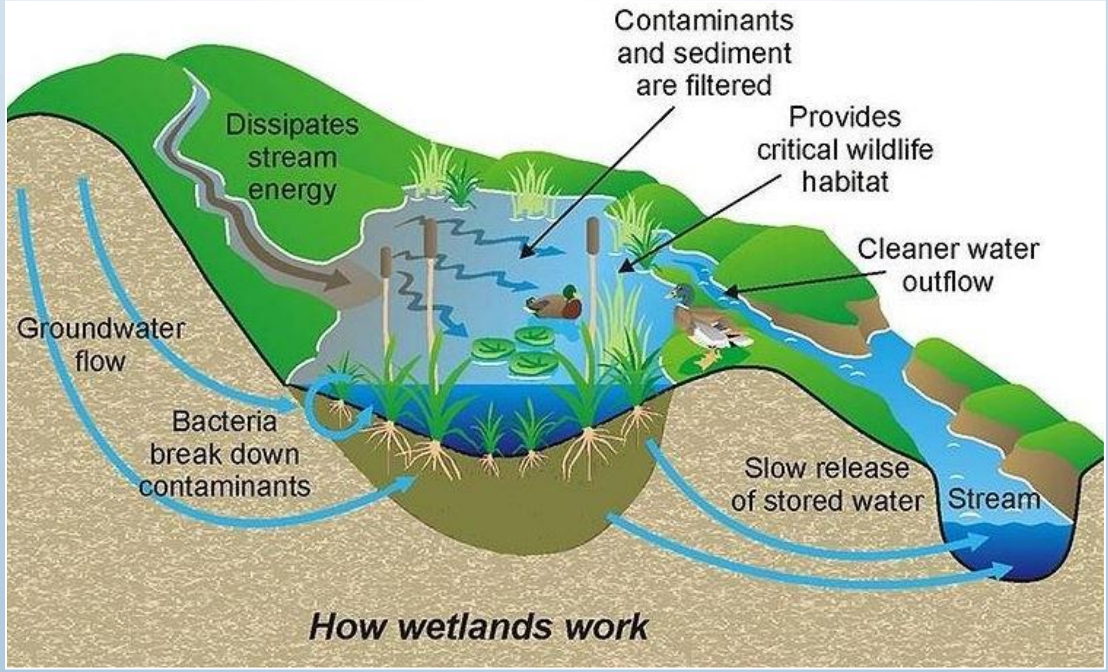
1. Monitor water levels. SRBC has zero de minimis standard for withdrawals in headwaters; includes groundwater withdrawals that show connection to headwaters (e.g., a pass/fail standard). Connection to headwaters could result in passby flow or some other required protective flow condition.
2. Monitor flow to quantify impact/interception of flow, which will assist in any considered mitigation options, if warranted.

SURFACE WATER MONITORING
ALL OTHER SETTINGS

- Use best professional judgment, based on operational goals;
- Quantifying flow impacts can yield a stronger argument about impact and required mitigation, but can be difficult in larger streams; whereas monitoring water level changes precludes a discussion of “how much” mitigation should occur beyond modeled flows; staff would rely on policy standards in decision-making about protective conditions.

WETLAND MONITORING

- Monitoring important for assessing water level drawdown, particularly important in exceptional value wetlands. Wetlands have specific hydrology that support vegetation and ecosystem functions. Impacts to that hydrology, especially during the growing season, could result in significant adverse impacts to wetland plant diversity, quality, and eventual ecosystem functions.
- Nested piezometers should be designed so that the shallow PZ targets wetland roots zone (0-18”) bgs; deep PZ targets are project specific.



POND/LAKE MONITORING

Monitoring is important for assessing potential water level drawdown and reduction in outflow (if present). Water level drawdown could result in adverse impacts to connected wetlands, reduction in quality of in-pond aquatic communities, diminution of flow to downstream surface waters/wetlands, or limitations to a user's ability to recreate in the system.

- Ponds and wetlands without flow – monitor using nested piezometers
- Ponds and wetlands with flow – monitor flow using an instrumented weir or flume, as appropriate

PRECIPITATION MONITORING

- Precipitation should be monitored (on-site) on a 12-hour interval through the background, pumping, and recovery phases of testing.
- Liquid precipitation should be recorded to the nearest 0.1 inch.
- Precipitation as snow should be reported in a liquid equivalent.
- An attempt should be made to note the duration (i.e., the start and stop times) of any precipitation events that occur during the aquifer testing.

ENVIRONMENTAL REVIEW

AQUIFER TESTING PLAN

SRBC ENVIRONMENTAL REVIEW INFORMED BY:

SUSQUEHANNA RIVER BASIN COMMISSION

REGULATION OF PROJECTS

18 CFR PARTS 801, 806, 807 AND 808

806.23(b)(2) Standards for Water Withdrawals

(2) The Commission may deny an application, limit or condition an approval to ensure that the withdrawal will not cause significant adverse impacts to the water resources of the basin. The Commission may consider, without limitation, the following in its consideration of adverse impacts: Lowering of groundwater or stream flow levels; rendering competing supplies unreliable; affecting other water uses; causing water quality degradation that may be injurious to any existing or potential water use; affecting fish, wildlife or other living resources or their habitat; causing permanent loss of aquifer storage capacity; or affecting low flow of perennial or intermittent streams.

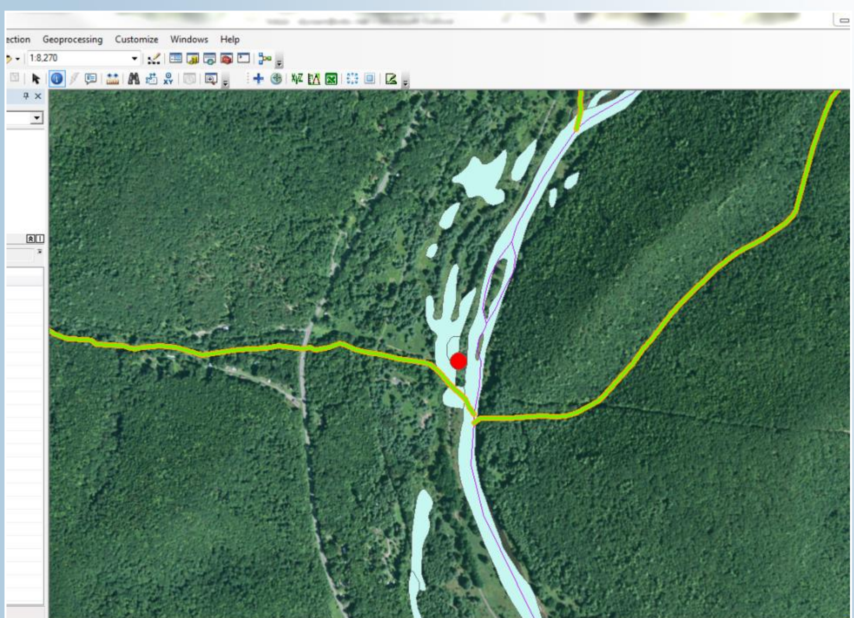
ENVIRONMENTAL REVIEW – AQUIFER TESTING PLAN

1. Desktop environmental screening to assess mapped natural resources & review proposed monitoring network.
2. Site visit to assess on-the-ground natural resources & proposed monitoring network, as needed.
3. Both efforts inform final monitoring network for the aquifer test so that sensitive natural resources, that could potentially be impacted by the withdrawal, are properly monitored. This may include coordination with partner resource agencies.

ENVIRONMENTAL SCREENING

Desktop Review – GIS based

- Identify nearby SW classifications
- Identify mapped wetlands
- Coordinate with resource agencies re: rare, threatened, endangered species
- Review monitoring network where potential for impact to streams/wetlands is possible



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DRAFT

Project Review Environmental Checklist

Ground Water Withdrawal Application

Site Background Information:

Facility Name:

SRBC Pending Number:

Well Location (lat/long):

Drainage Area: mi²

Aquatic Resource Class of stream/spring: Class

County: County

Municipality: Township

USGS Quadrangle:

WBD (HUC10) and Name:

Watershed Major:

Subbasin:

Geologic Formation:

Depth to Water:

Is the project new? ☐ modified withdraw? ☐ ATP? ☐

Notes:

Well Location in Proximity to Surface Water Body?
Yes ☐ No ☐ (if No, move down to Wetlands section)

Comments:

If Yes, is the well located in a geologic formation hydrologically connected to the surface water?
Yes ☐ No ☐

Comments:
Surface Water Body Name:

Stream or River Designated or Existing Use Classification:
Aquatic Life:
☐ CWF: *Cold Water Fishes*-Maintenance and/or propagation of fish species including the family Salmonidae and additional flora and fauna, which are indigenous to cold water habitat.
Class A ___ High Class B ___ Class B ___ Class C/D ___

ENVIRONMENTAL SCREENING

Assists in desktop review of proposed monitoring locations.

Does the proposed area of influence include any…?

- Headwater streams
- Exceptional value or high quality wetlands or streams
- Naturally reproducing trout streams
- Rare species or sensitive settings
    - Coordinate with member jurisdiction agencies about monitoring locations (PFBC, DCNR, PADEP, NYDEC, etc)

There are protective conditions that may be assigned if impacts are detected in any of the settings listed above; emphasizes importance of appropriate monitoring network.

SITE VISIT

SRBC biologist may attend field visit to meet project sponsor and go over proposed monitoring locations based on results from desktop environmental screening. This effort works to ensure streams, wetlands, and/or sensitive natural features are included in the aquifer testing plan monitoring network.

Results from these monitoring points can be used to inform docket conditions during the Groundwater Withdrawal Application phase.

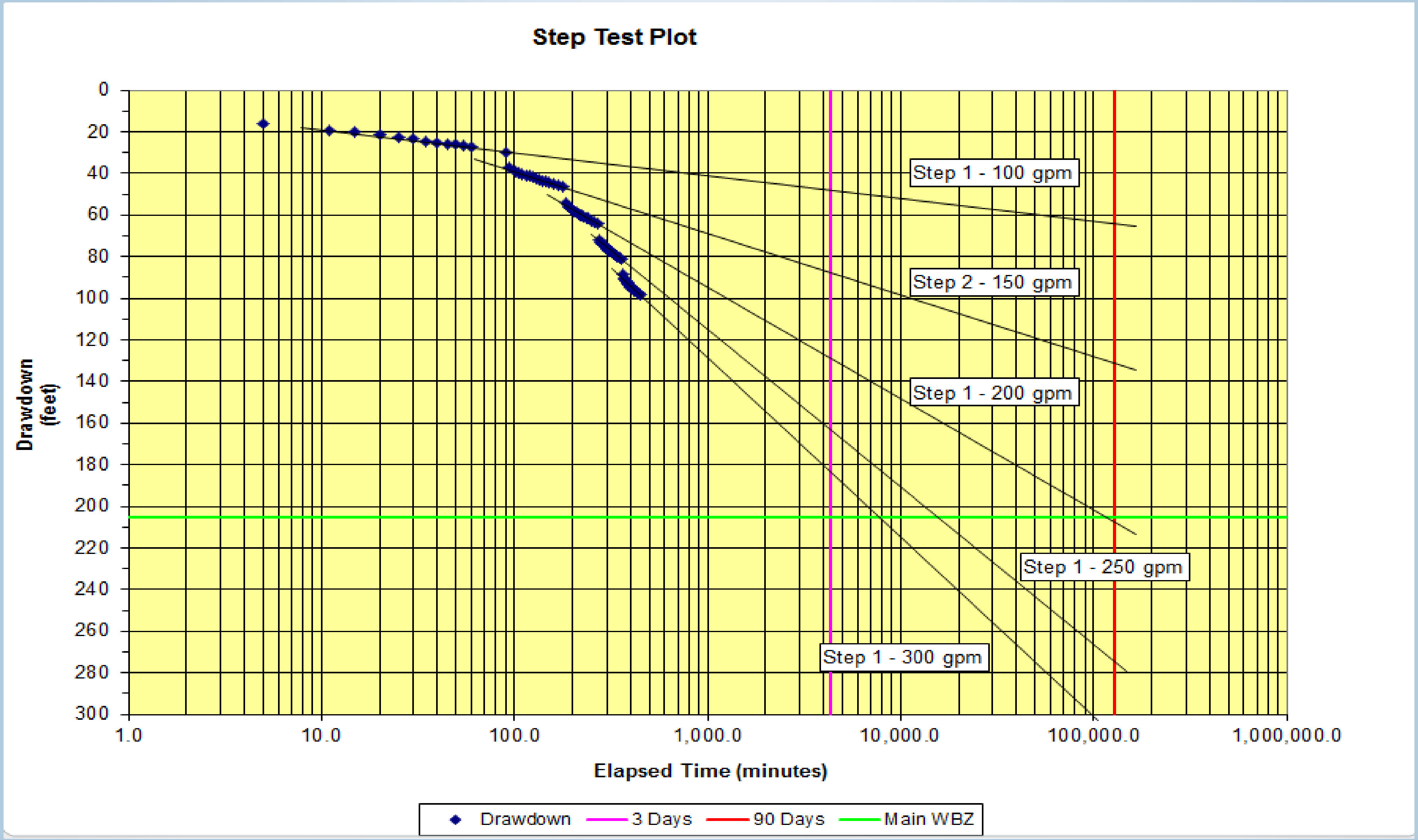
AQUIFER TEST PROCEDURES

- The aquifer test is comprised of four parts:
  - Step test;
  - Background monitoring (48 hours);
  - Constant-rate aquifer test (72 hours); and
  - Recovery monitoring (24 hours or 90 percent recovery).

STEP TESTING AND SELECTING A FLOW RATE

- Usually not required, but a good idea
  - If the proposed production well is to be used as one of the two monitoring points in a distance-drawdown analysis, then a step test is necessary to provide information on the efficiency of the well.
- Used to select appropriate rate for constant-rate test
- Steps of equal duration
  - First step 25% of blown yield; increase by 25% blown yield
  - Target 5 steps (until water level in well does not equilibrate during test period)

STEP TESTING AND SELECTING A FLOW RATE

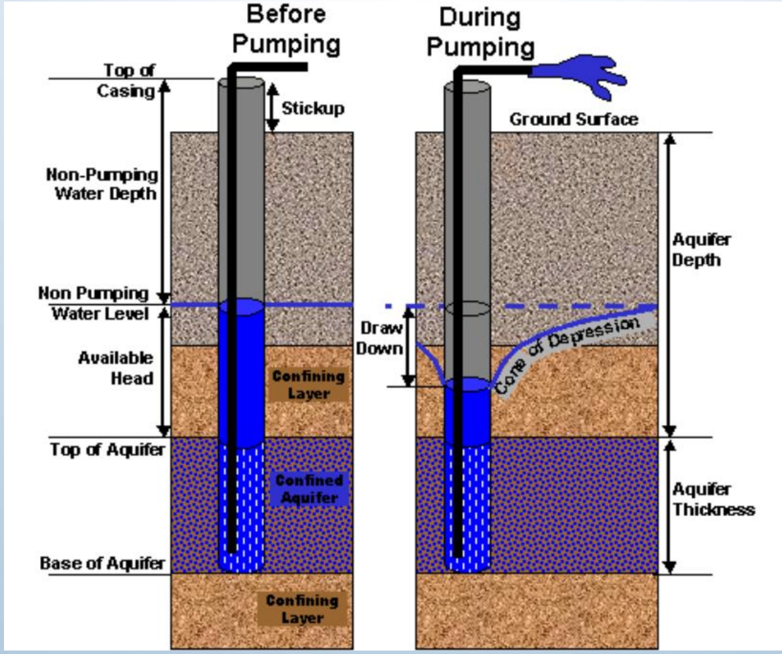


BACKGROUND MONITORING

- Begins after 90% recovery from step test
- At least 48 hours (72-hours in PADEP guidance)
- Demonstrate asymptotic recessional trends in surface water and ground water monitoring network prior to starting test
- Additional background monitoring may be required for some projects (e.g. projects with other pumping wells)
- No pumping of test well during background period.

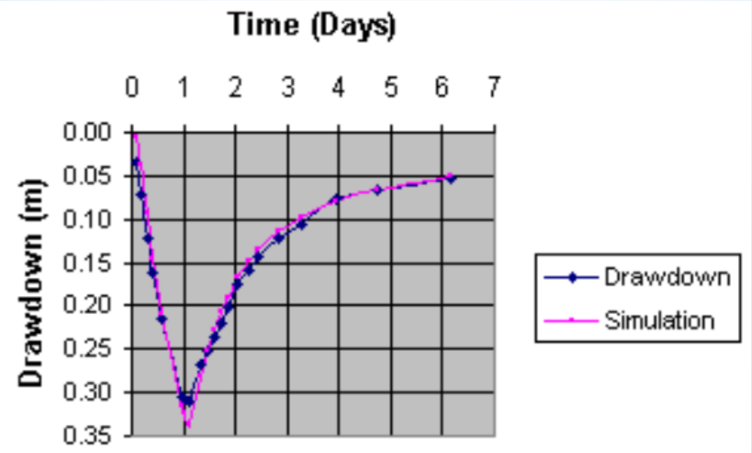
CONSTANT-RATE AQUIFER TESTING

- Immediately follows Background Monitoring Period
- The duration of pumping should be sufficiently long to establish the hydrologic changes and trend characteristics of the proposed production well operation, aquifer, and groundwater basin (recommended 72 hours).
- The consultant should be the expert on the site



RECOVERY TESTING

- The recovery test immediately follows the constant-rate test and consists of monitoring the recovery of water levels and flow rates at all of the monitoring locations, following pump shutoff.
- Duration is a minimum of 24-hours or until aquifer has recovered to at least 90% of pretest levels, minus groundwater recession
- The measurement interval for the first 15 minutes of recovery should be 1 minute or less.



GENERAL PERFORMANCE REQUIREMENTS

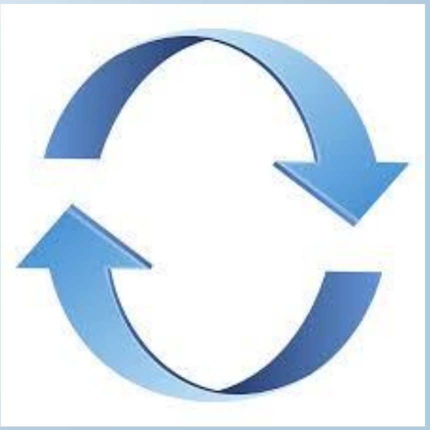
- **Appropriate Testing Conditions:** The background, pumping, and recovery phases of aquifer testing must be conducted during a period of asymptotic groundwater and surface water recession (base flow). The test should not be conducted during or shortly after a precipitation event that could result in a rapid change of water level or flow.

GENERAL PERFORMANCE REQUIREMENTS

- **Tested Rate:** The test well may be pumped at any rate desired, but must be pumped at a constant rate for the test duration. The Commission will not approve the well for operation at a rate higher than the average tested rate.
- **Maintaining a Constant Rate:** The tested rate must be monitored and maintained to within 5 percent of the target flow rate for the duration of the test or the test will likely not qualify as a constant-rate test and may have to be rerun.
- **Flow Rate Adjustments:** All flow rate adjustments must be documented with a measurement of flow before and after adjustment, the time at which the adjustments were made, and a rationale for the adjustment. This information must be included in the hydrogeologic report.

GENERAL PERFORMANCE REQUIREMENTS

- **<u>Test Discharge:</u>** Discharge from the test well must be routed such that recirculation does not occur. This typically results in a discharge point 300 to 500 feet down dip (bedding, schistosity, etc.) from the proposed pumping well, but may be 2,000 feet or more in karst or unconsolidated aquifers.
- **Discharge Approval:** Contact member jurisdiction agencies to determine if a temporary discharge approval is required.



WATER CHEMISTRY

- During the constant-rate testing, temperature, conductivity, turbidity, and any other agreed-upon chemistry measurements should be collected from the well being tested at a minimum of every 2 hours.
- Temperature and conductivity must be collected from all surface water features (streams, ponds, springs, and wetlands) being monitored at the start and end of the constant-rate test.
- Commission does not require laboratory analysis of water samples to evaluate water quality in relation to drinking water standards
- Coordinate with member jurisdiction agencies
- PADEP - New source sampling requirements and field measurements

SYSTEM OPERATION DURING TESTING

- Operations of systems during testing can be challenging
- Goal is to isolate impacts as a result of pumping the test well
- Extended background periods may be needed to establish steady-state or near steady-state conditions (especially for existing production wells)
- In some cases, it may be necessary to provide operational plans during the testing periods
  - Discuss how other on-site or system wells will operate to meet system/ facility demands during testing
  - Minimize interference during testing
- Use of test Discharge – In certain cases, test discharge water can be used by the project sponsor (renewal of approved source, or new source with member jurisdiction agency approval).

QUESTIONS…