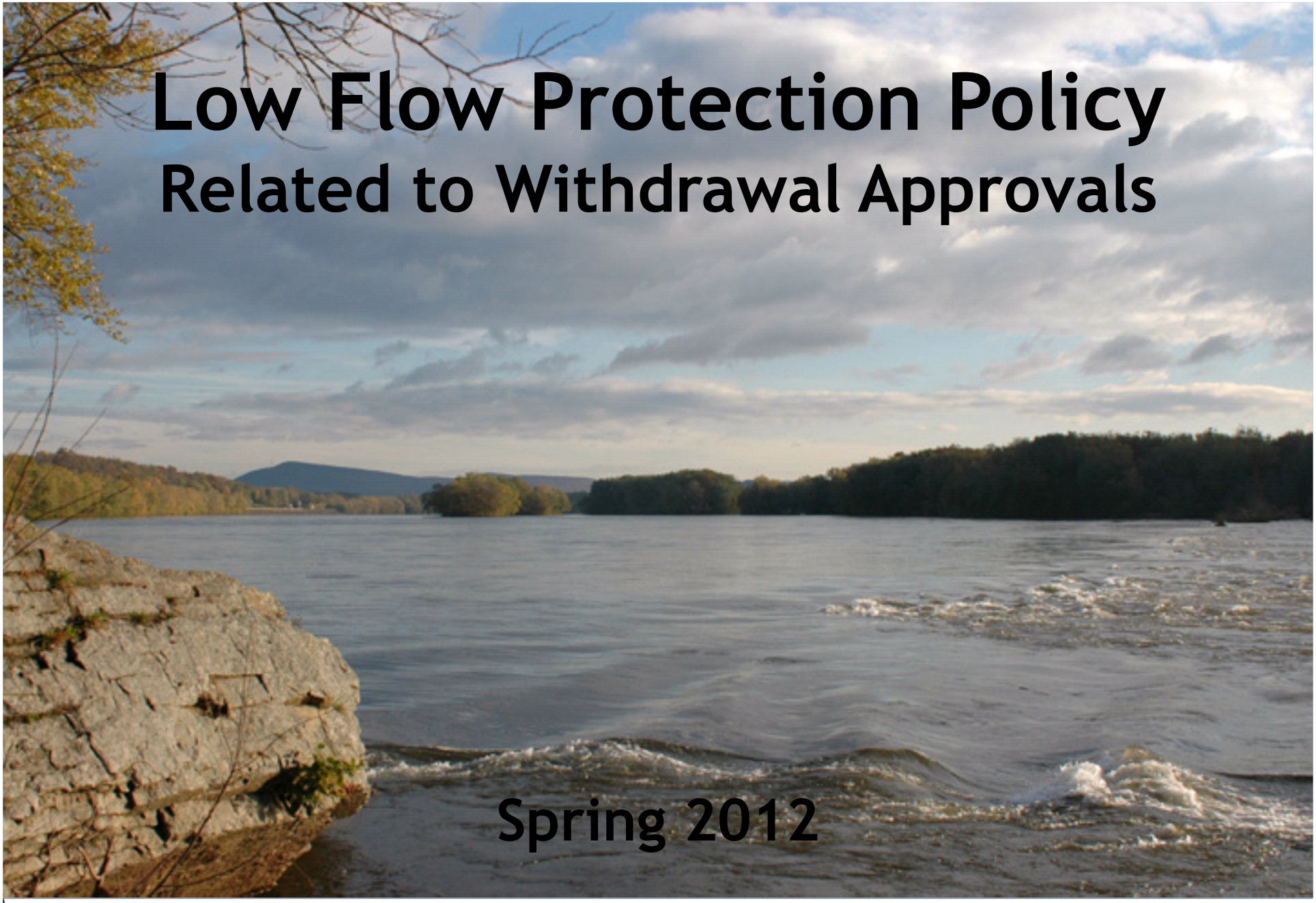


Low Flow Protection Policy
Related to Withdrawal Approvals

Spring 2012

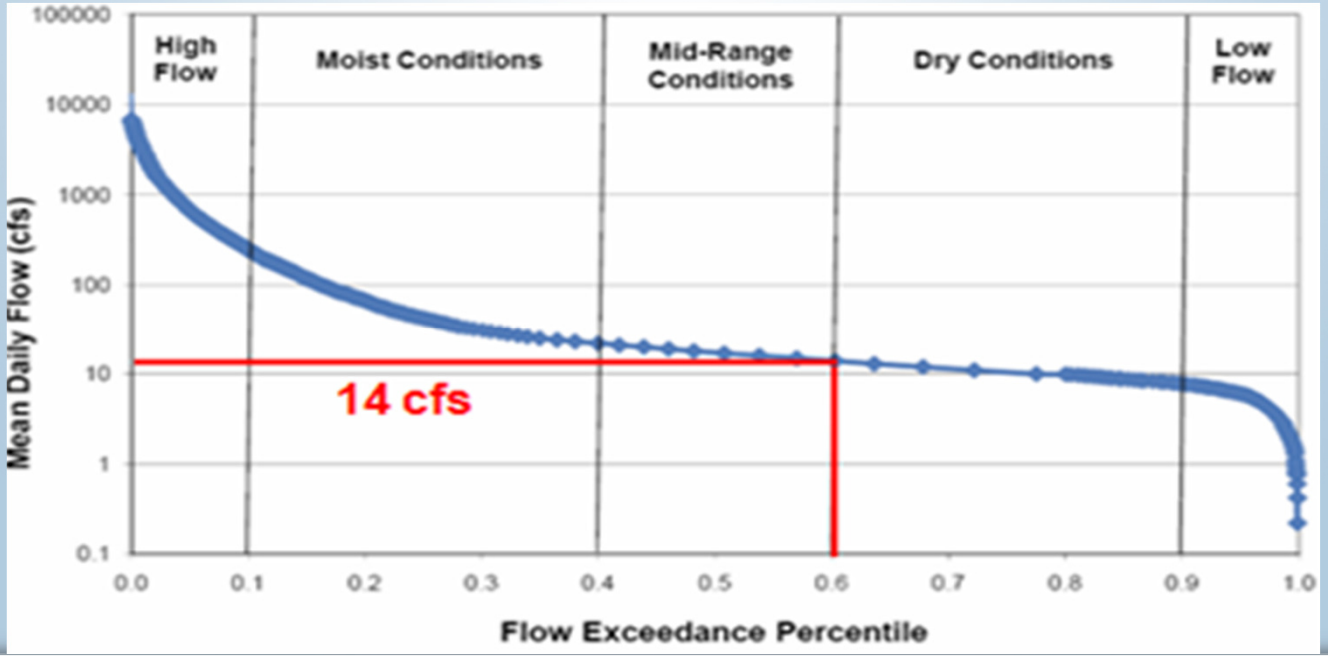
Definitions

- **Passby flow** - prescribed streamflow at which a withdrawal must cease

- **Conservation release** - prescribed flow quantity that must be continuously maintained downstream of an impoundment

Definitions

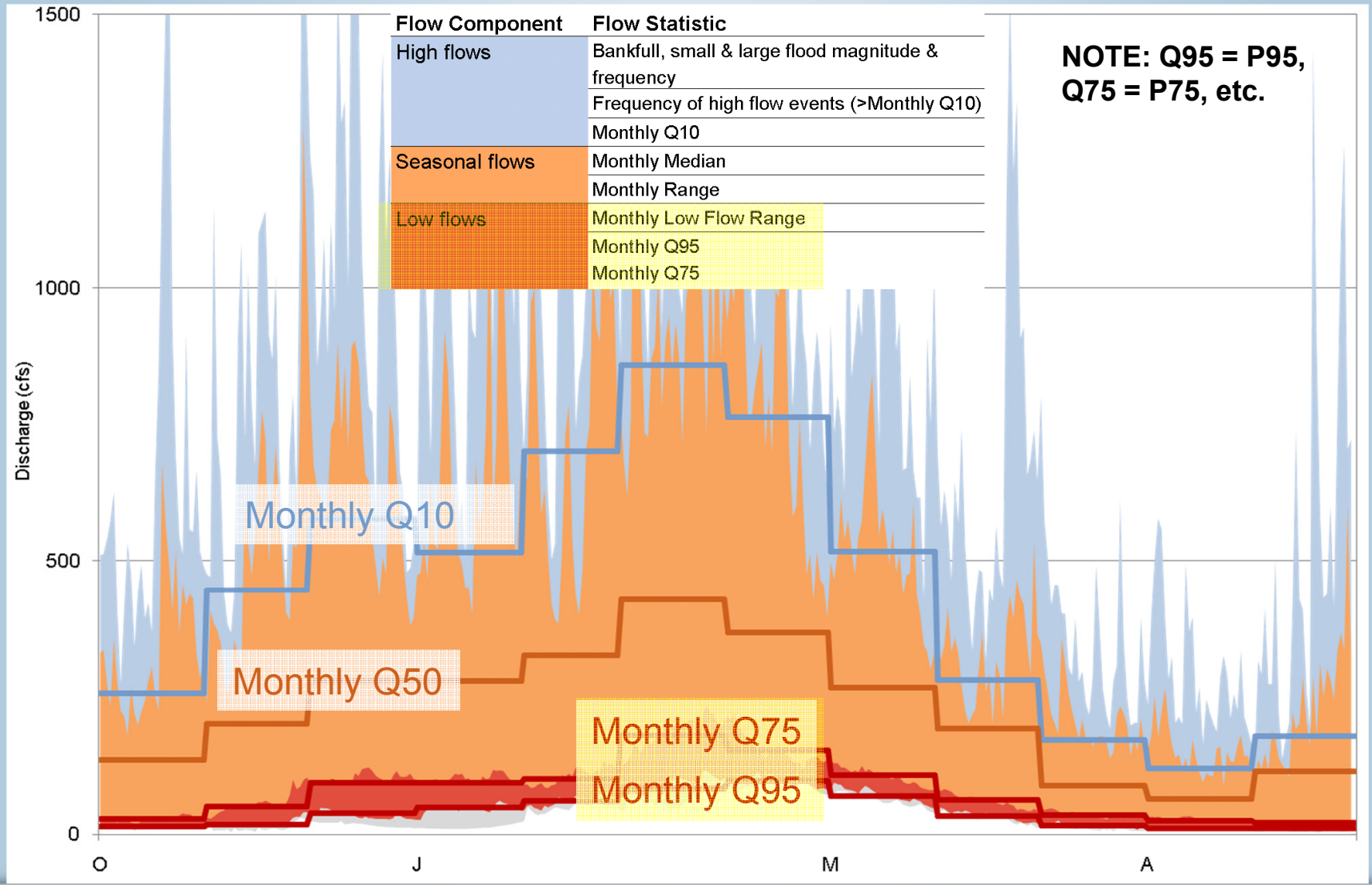
- **Percent exceedance flow** - flow value exceeded a certain percentage of time over a period of record
  - 60th percent exceedance flow (P60) = flow value exceeded 60% of time by mean daily flows in record



TNC Ecosystem Flows Study

- Collaboration between TNC, SRBC & USACE under Section 729 of WRDA
- Goal: Determine ecological flow needs for Susquehanna River & tributaries
- Flow goals to guide withdrawal approval conditions, releases from storage during low flow periods & CU mitigation planning

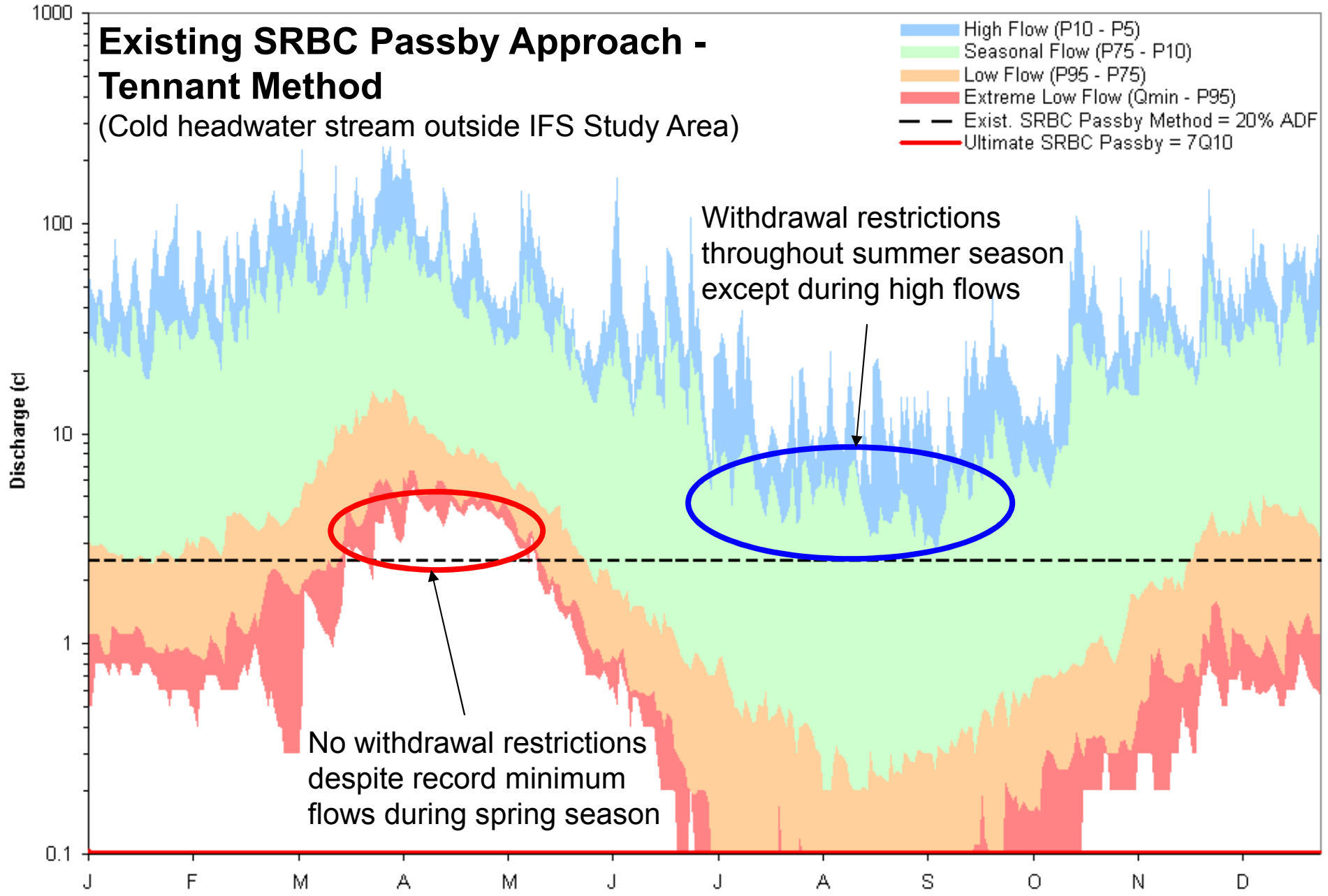
Ecosystem Flow Components & Statistics



Ecosystem Flow Recommendations

Table 5.1 Flow recommendations for the Susquehanna River ecosystem.

Season	Flow Component	Flow Statistic	Flow Recommendations		
			Headwater streams < 50 sq mi	Streams and small rivers (50 – 200 sq mi)	Major tributaries and mainstream (>200 sq mi)
Annual and Interannual Events	High Flows	Large flood	Maintain magnitude and frequency of annual Q0.05 (20-yr flood)	Same for all streams	Same for all streams
		Small flood	Maintain magnitude and frequency of annual Q0.2 (5-yr flood)	Same for all streams	Same for all streams
		Bankfull	Maintain magnitude and frequency of annual Q0.5 (Approx. 1 to 2-yr flood)	Same for all streams	Same for all streams
All Months	High flows	Monthly Q10	<10% change to magnitude of monthly Q10	Same for all streams	Same for all streams
	Seasonal flows	Monthly Median	Between 45th and 55th percentiles	Same for all streams	Same for all streams
		Monthly Range	≤ 20% change to area under curve between Q10 and Q75	Same for all streams	Same for all streams
	Low flows	Monthly Low Flow Range	No change to area under curve between Q75 and Q99	≤ 10% change to area under curve between Q75 and Q99	≤ 10% change to area under curve between Q75 and Q99
		Monthly Q75 Monthly Q95	No change	No change	No change
Fall	High flows	Frequency of events > Monthly Q10	NA	NA	1-5 events
Summer		Frequency of events > Monthly Q10	2-8 events	2-8 events	2-8 events


Existing SRBC Passby Approach - Tennant Method
(Cold headwater stream outside IFS Study Area)
High Flow (P10 - P5)
Seasonal Flow (P75 - P10)
Low Flow (P95 - P75)
Extreme Low Flow (Qmin - P95)
Exist. SRBC Passby Method = 20% ADF
Ultimate SRBC Passby = 7Q10
Withdrawal restrictions throughout summer season except during high flows
No withdrawal restrictions despite record minimum flows during spring season
Discharge (cf
1000
100
10
1
0.1
J
F
M
A
M
J
J
A
S
O
N
D

Purpose & Need

- Develop new policy to replace existing "passby" policy (No. 2003-01) that:
  - Reflects current science & standards
  - Addresses lessons learned over last 9 years
  - Incorporates TNC ecosystem flow recommendations
  - Provides provisions for protection of headwaters to mainstem rivers

LFPP – Main Components

1. Aquatic Resource Classes
2. Headwaters Protection
3. Hydrologic Analyses
4. Cumulative Water Use Assessment
5. Passby Flow / Conservation Release Calculation
6. Special Cases

1. Aquatic Resource Classes

- Permit consistent classification system across member states
- Criteria assessed using desktop analyses
- Provide hierarchical levels of protection
  - More protective for smaller, higher quality sources
  - Incentivize siting of withdrawals on larger, more sustainable sources

Aquatic Resource Class Criteria

- **Class 1** - Headwaters & Exceptional Quality Streams

  - Generally, DA < 50 mi^2, RTE species, wild trout, EV/HQ classification or equivalent

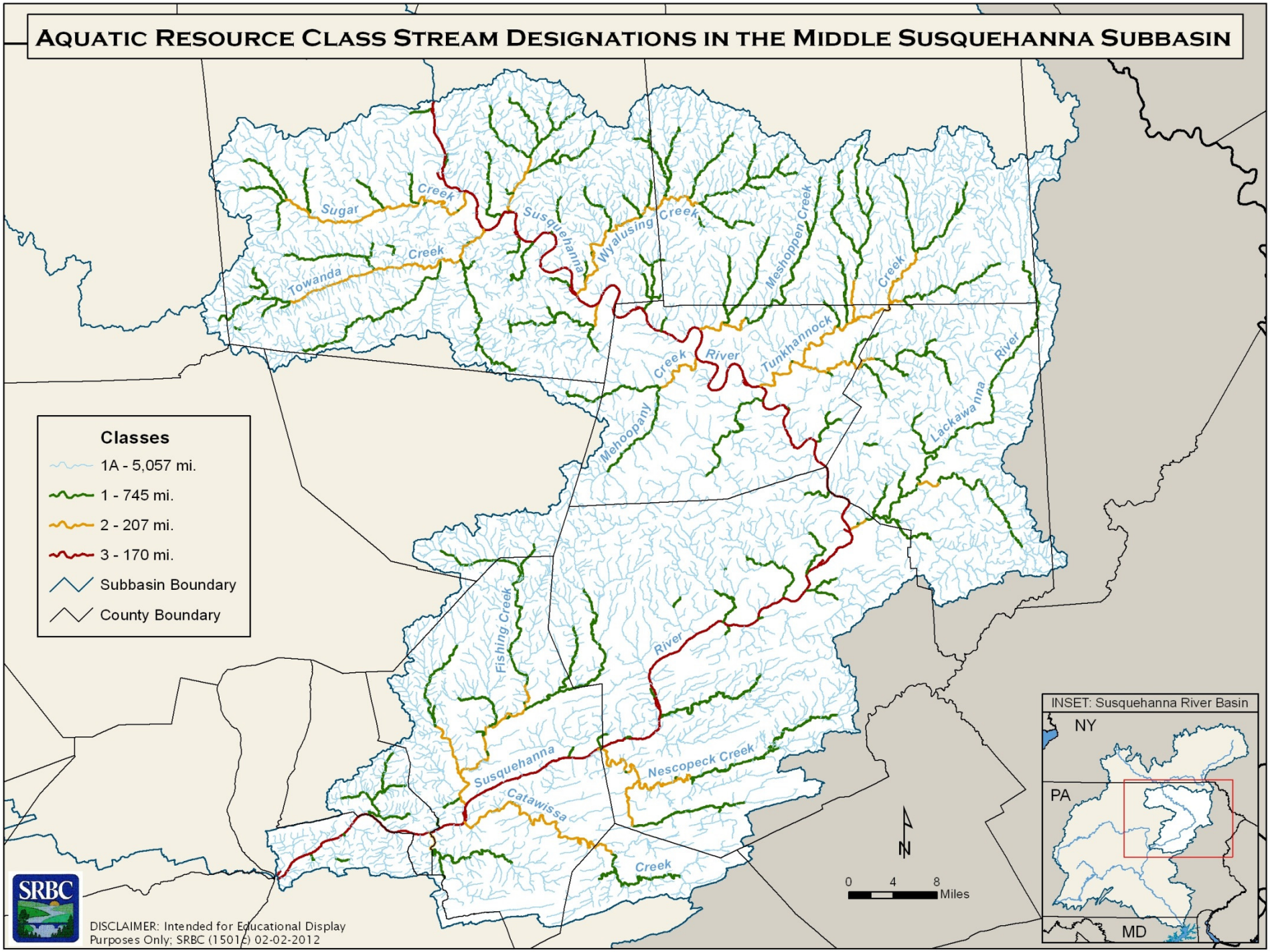
  - **Subclass 1a -** 0, 1st, 2nd & select 3rd order streams

- **Class 2** - Small Rivers & Medium Tributary Rivers

  - Generally, DA = 50 - 1000 mi^2, candidate RTE species, stocked trout, CWF/TSF classification or equivalent

- **Class 3** - Medium Mainstem Rivers & Large Rivers

  - Generally, DA > 1000 mi^2, WWF classification or equivalent


AQUATIC RESOURCE CLASS STREAM DESIGNATIONS IN THE MIDDLE SUSQUEHANNA SUBBASIN
Classes
1A - 5,057 mi.
1 - 745 mi.
2 - 207 mi.
3 - 170 mi.
Subbasin Boundary
County Boundary
Sugar Creek
Towanda Creek
Susquehanna River
Wyalusing Creek
Meshoppen Creek
Tunkhannock Creek
Lackawanna River
Mehoopany Creek
Fishing Creek
Susquehanna River
Catawissa Creek
Nescopeck Creek
N
0 4 8
Miles
INSET: Susquehanna River Basin
NY
PA
MD
SRBC
DISCLAIMER: Intended for Educational Display Purposes Only; SRBC (1501c) 02-02-2012

2. Headwaters Protection

- Aquatic Resource Class 1
  - Headwaters & exceptional quality streams
    - Requires alternatives analysis

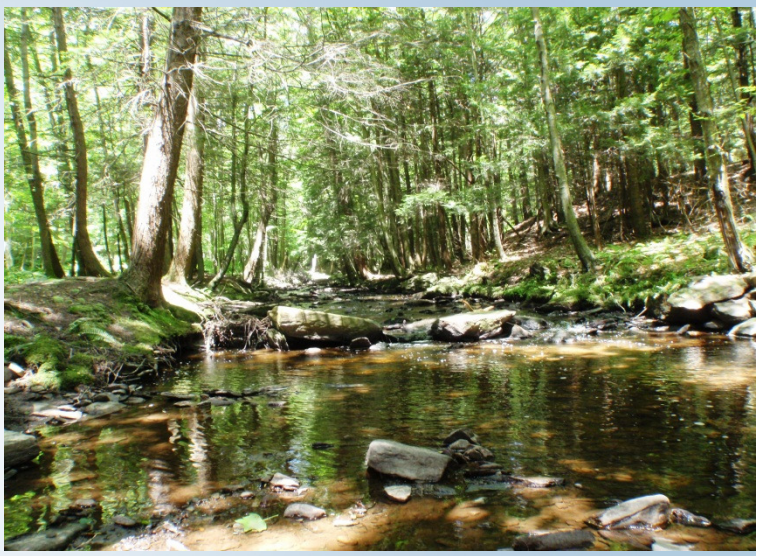
      - reasonable alternatives, economic/technical investigation, environmental impacts, etc.

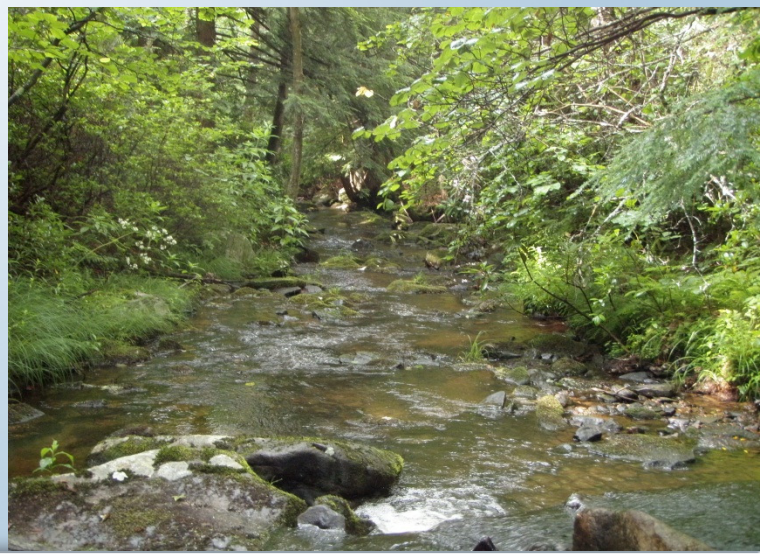
    - Requires impact assessment

      - flood damage, recreation, fish & wildlife, natural environment, site development, cultural resources, etc.

2. Headwaters Protection

- Aquatic Resource Subclass 1A
  - Extremely sensitive & exceptional quality headwaters
  - Withdrawals will not be approved except for public water supply or riparian uses
    - Demonstrate reasonable use, benefit:impact analysis & no reasonable alternative source



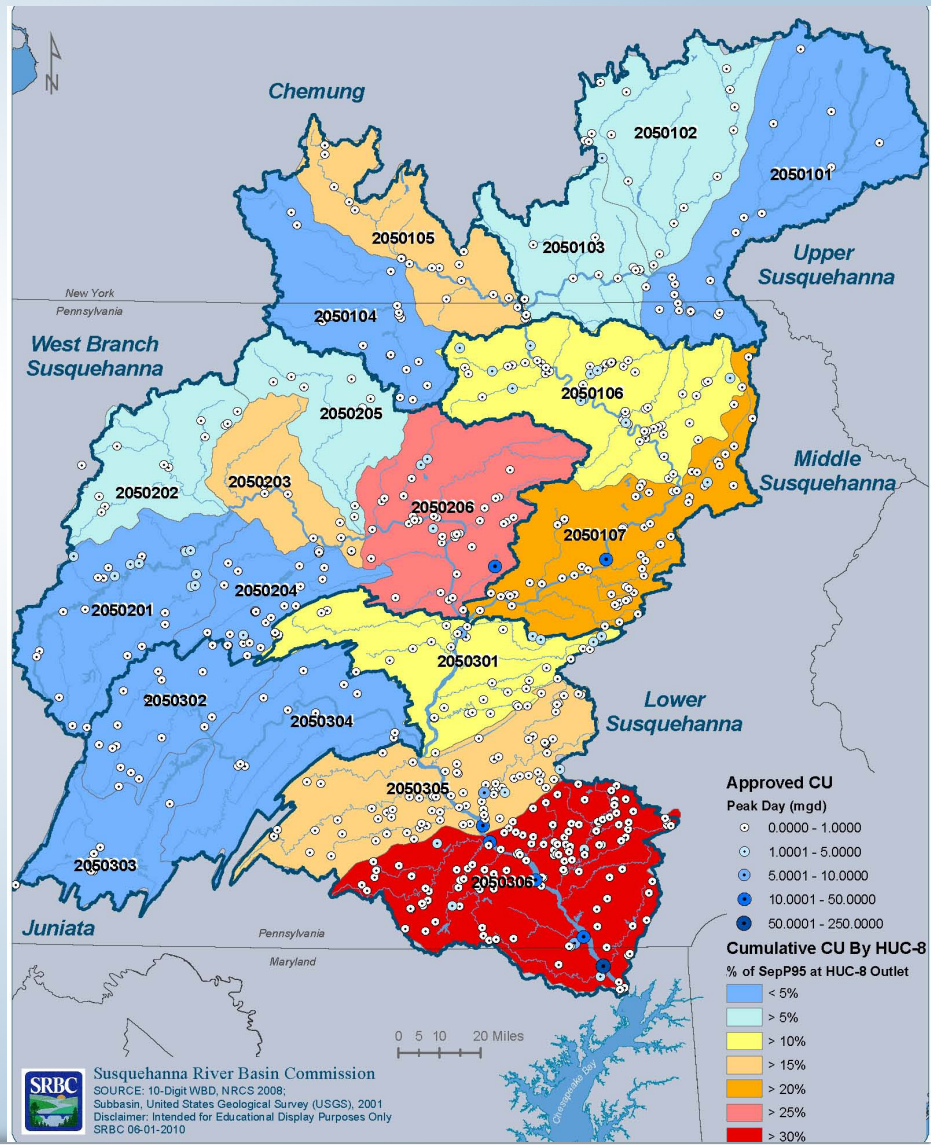


3. Hydrologic Analyses

- Gaged Sources
  - Compute flow statistics from USGS gage records
- Ungaged Sources
  - USGS reference gage analysis
    - Period of record, drainage area ratio & basin characteristics criteria
  - Regional regression tools & equations
    - USGS StreamStats & BaSE (pending)
    - Published regression equations

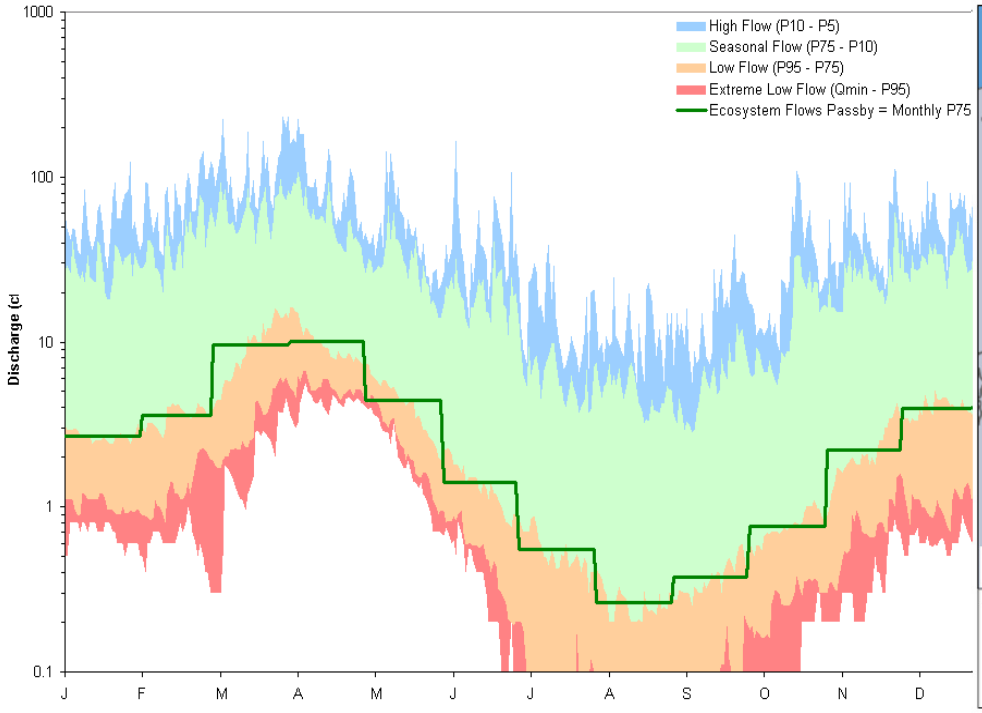
4. Cumulative Water Use Assessment

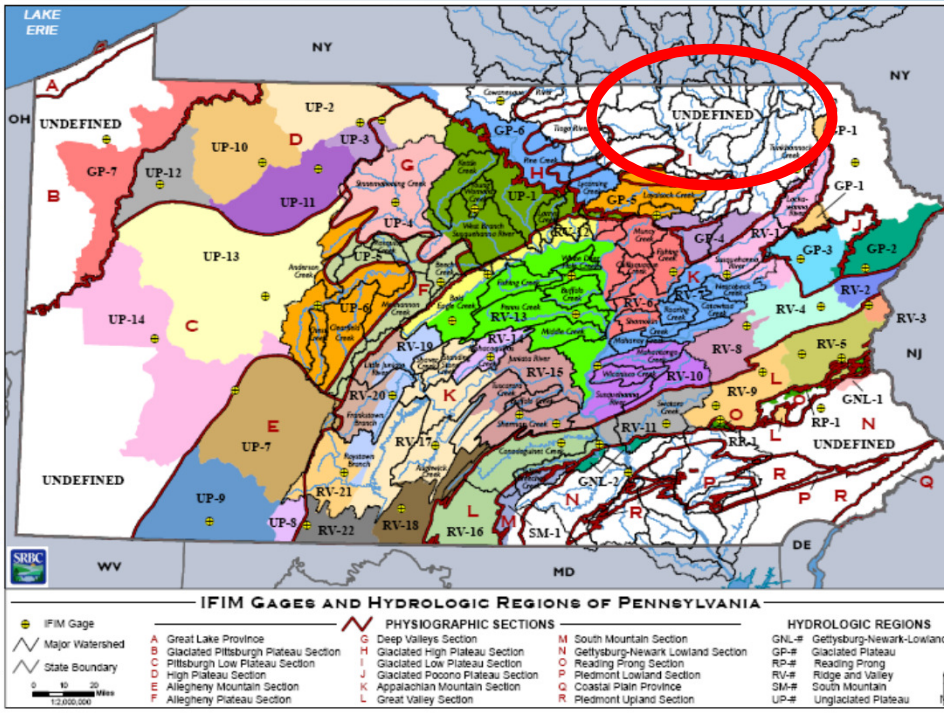
- Not only consider proposed withdrawal but all other existing water uses within a watershed
  - Assess cumulative net withdrawals upgradient of the proposed withdrawal point
    - Used to inform limiting, conditioning or denying a proposed withdrawal to avoid adverse impacts



5. Passby Flow/Conservation Release Calculation

1. Percent Exceedance Value Method
2. PA-MD Instream Flow Study (IFS) Method





5.1 Px Value Method

- Applicable to all stream types throughout basin
- Hydrologic variability accommodated by regional reference gages & regression equations
- Monthly Px values specified per Aquatic Resource Class
  - Elevated Px values for traditional dry months
  - May be simplified to seasonal values

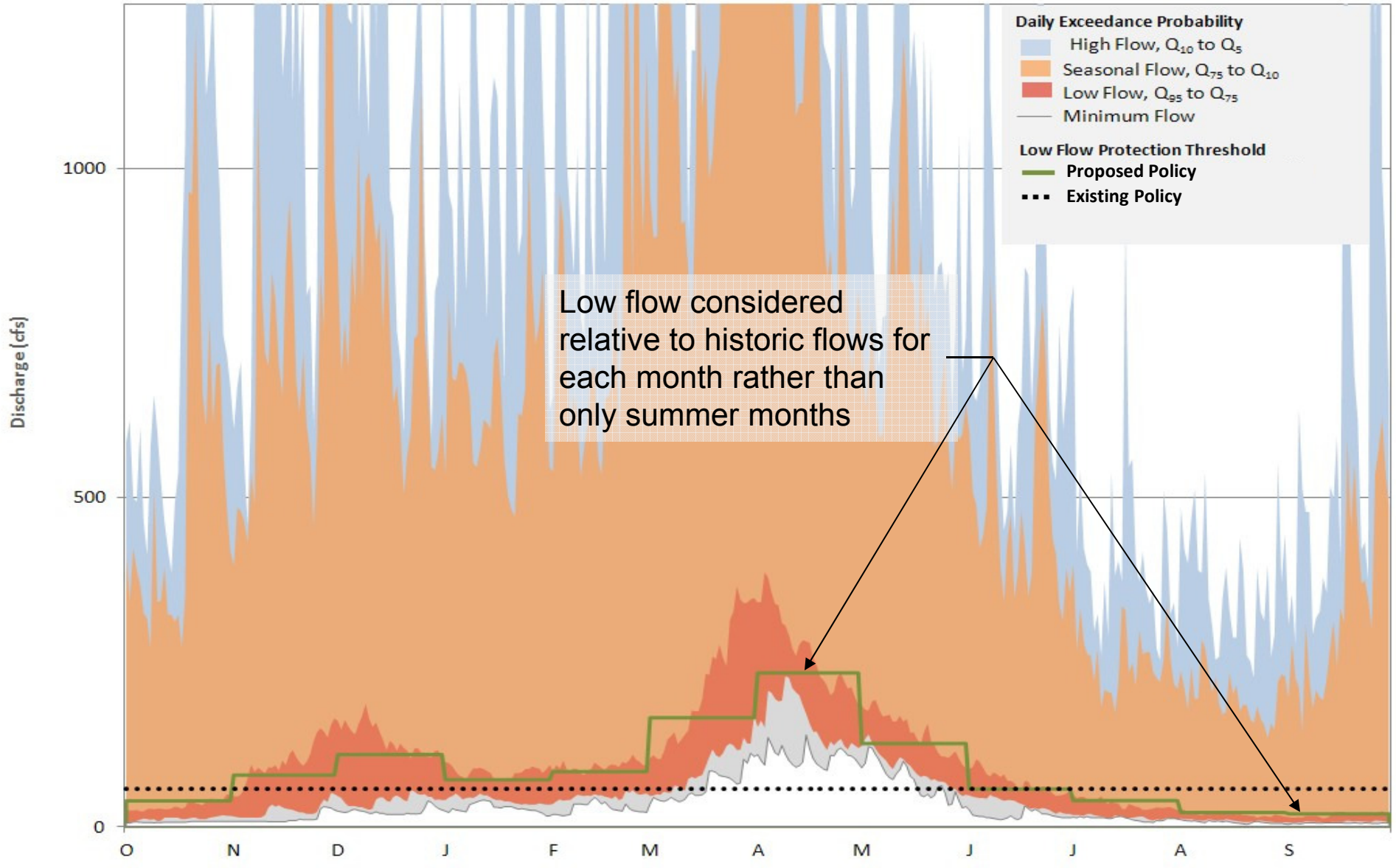
Passby Flow / Conservation Release Schedule

MONTH	AQUATIC RESOURCE CLASS 1	AQUATIC RESOURCE CLASS 2	AQUATIC RESOURCE CLASS 3
January	Monthly P70	Monthly P80	Monthly P90
February	Monthly P70	Monthly P80	Monthly P90
March	Monthly P70	Monthly P80	Monthly P90
April	Monthly P70	Monthly P80	Monthly P90
May	Monthly P70	Monthly P80	Monthly P90
June	Monthly P70	Monthly P80	Monthly P90
July	Monthly P50	Monthly P70	Monthly P85
August	Monthly P50	Monthly P70	Monthly P85
September	Monthly P50	Monthly P70	Monthly P85
October	Monthly P50	Monthly P70	Monthly P85
November	Monthly P70	Monthly P80	Monthly P90
December	Monthly P70	Monthly P80	Monthly P90

5.2 PA-MD IFS Method

- Applicable to CW streams < 100 mi^2 in study area
  - Aquatic Resource Class 1 (most) & 2 (some)
    - Class 1 - </= 5% habitat loss
    - Class 2 - </= 10% habitat loss
  - Seasonal and/or monthly habitat loss criteria
  - Compare results with other applicable methods
  - Passby flow/conservation release not to be less than monthly P70 for Class 1 or less than monthly P90 for Class 2 and 3

Existing Policy 2003-01 vs. Proposed LFPP



Example Low Flow Protection Thresholds

Aquatic Resource Class 2

Attachment E3. Example Low Flow Protection Thresholds (USGS Reference Gage 01574000 West Conewago Creek near Manchester, PA, Class 2)

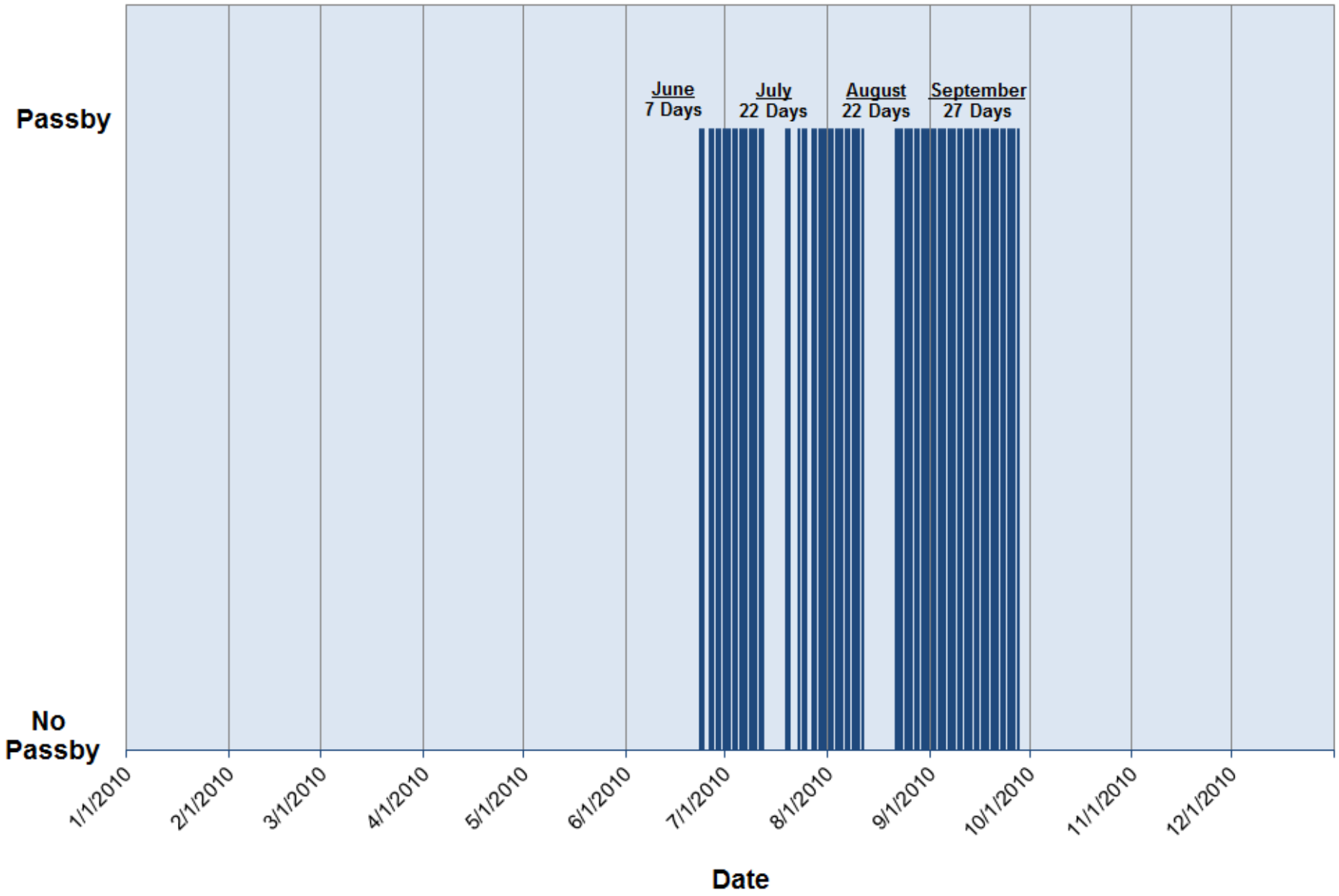
	Existing Policy		Proposed Policy	
Month	Flow Statistic	Flow_value (cfs)	Flow Statistic	Flow_value (cfs)
January	20% ADF	123	Monthly P80	164
February	20% ADF	123	Monthly P80	230
March	20% ADF	123	Monthly P80	405
April	20% ADF	123	Monthly P80	314
May	20% ADF	123	Monthly P80	190
June	20% ADF	123	Monthly P80	102
July	20% ADF	123	Monthly P70	67
August	20% ADF	123	Monthly P70	52
September	20% ADF	123	Monthly P70	43
October	20% ADF	123	Monthly P70	57
November	20% ADF	123	Monthly P80	78
December	20% ADF	123	Monthly P80	121

Q_{today} = ~300 cfs

7Q10 = ~11 cfs

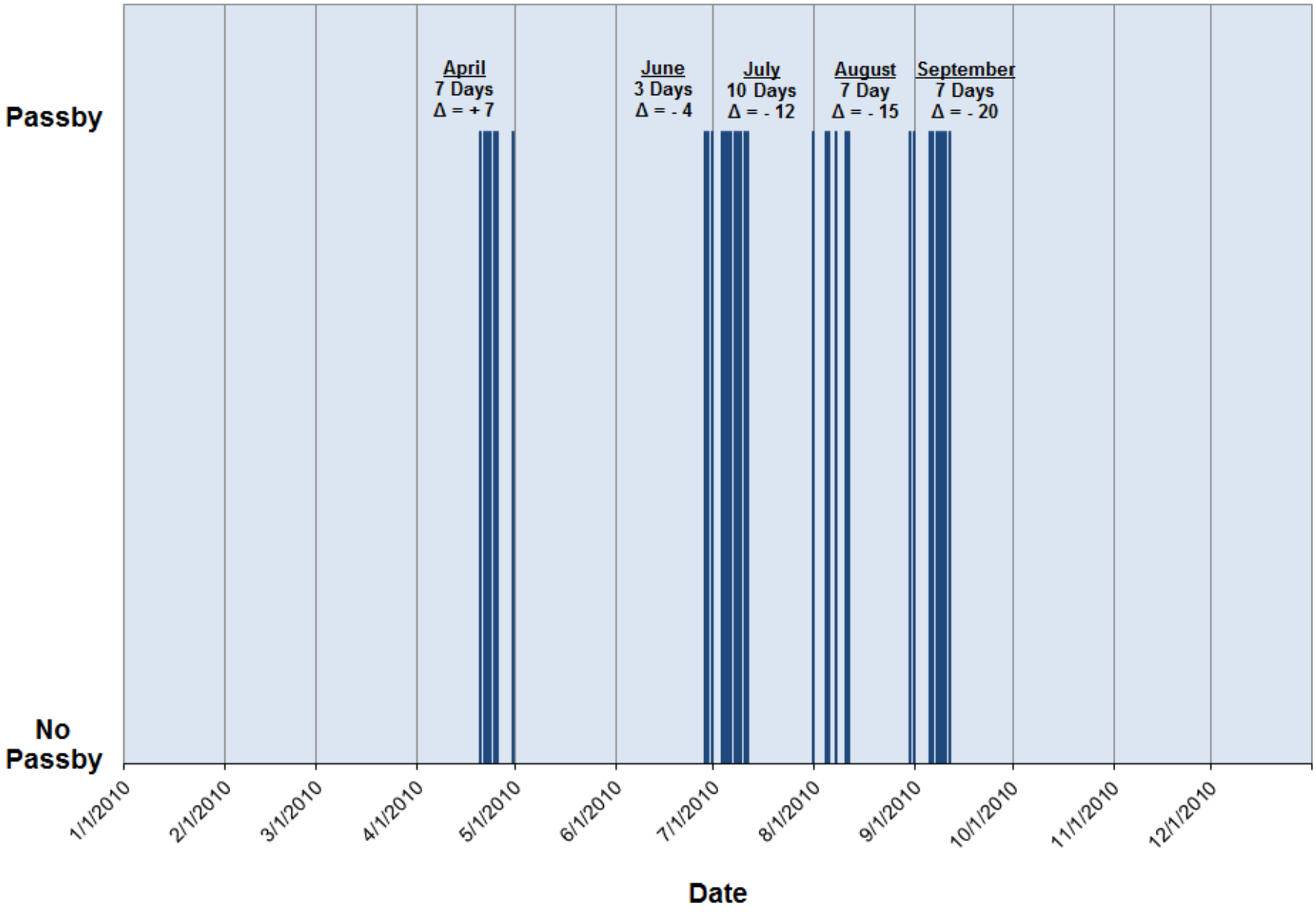
Distribution of 2010 Passby Days for Class 2 Source - Existing Policy

USGS Reference Gage 01574000 West Conewago Creek near Manchester, PA



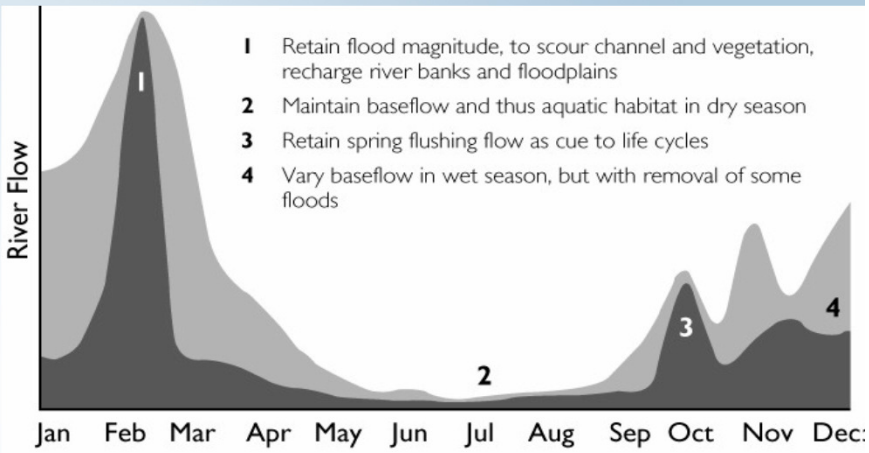
Distribution of 2010 Passby Days for Class 2 Source - Proposed Policy

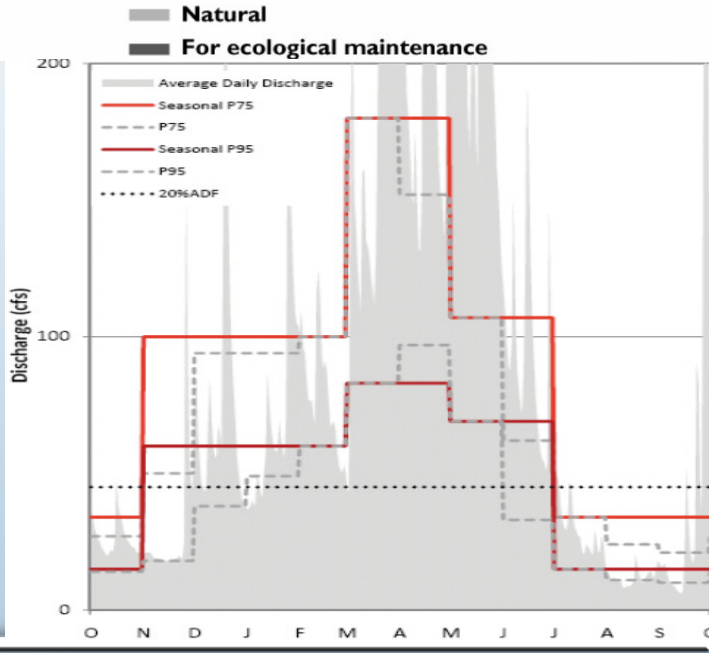
USGS Reference Gage 01574000 West Conewago Creek near Manchester, PA



6. Special Cases

1. Withdrawal limits
   - Ecological limits of hydrologic alteration
2. Seasonal passby flows / conservation releases
   - Monthly Px standards
   - Simplify operations & compliance
   - DJF, MAMJ, & JASON monthly groupings

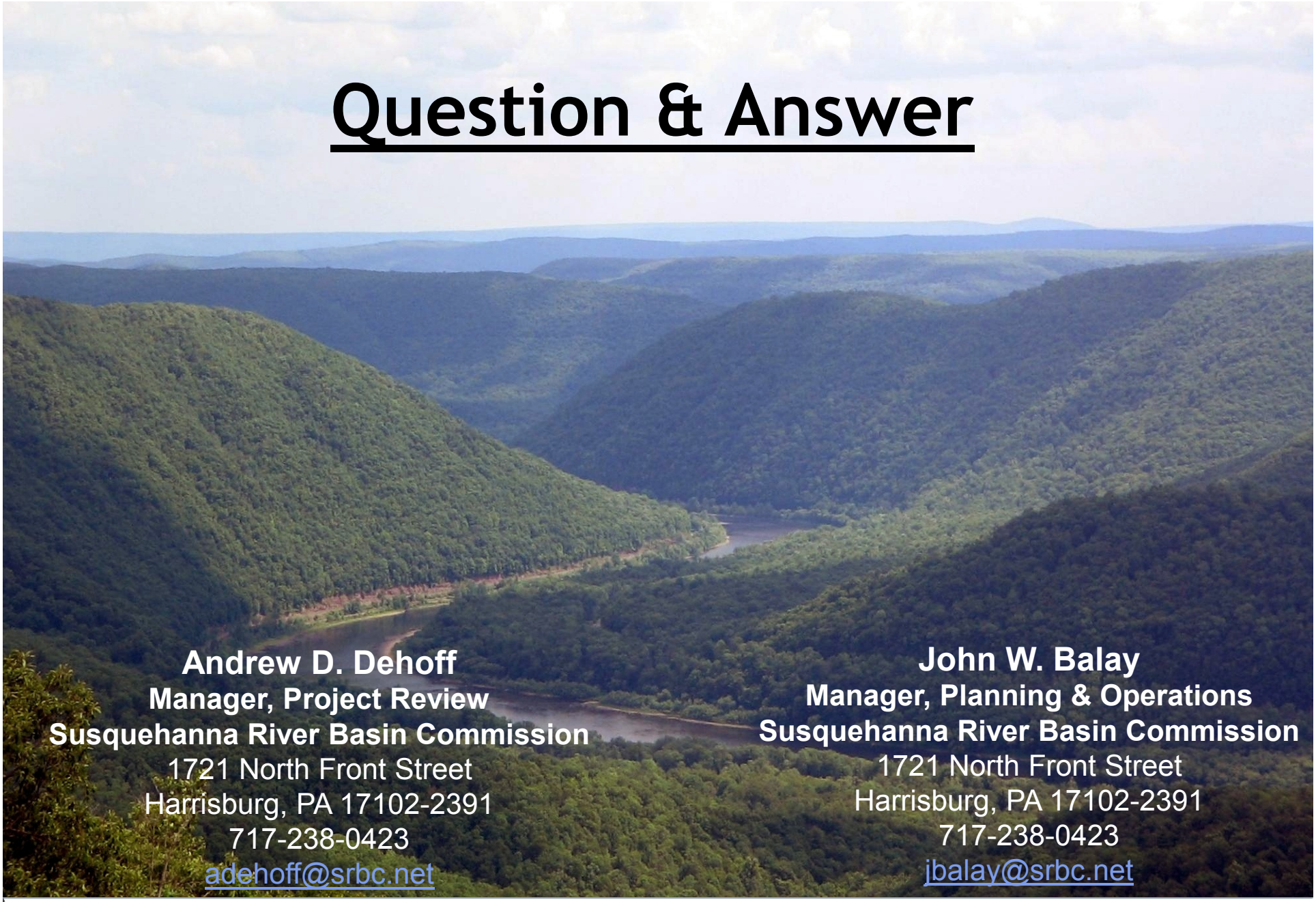




6. Special Cases

3. Project specific instream flow studies
   - Demonstrate lower standards are adequate
4. Agency coordination
   - Case-by-case, coordinated determinations
5. Adaptive management
   - Updates as science evolves
6. Reservation of rights

Question & Answer



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