INSTREAM FLOW PROTECTION:

A PLANNING STANDARD

FOR ILLINOIS STREAMS

SPECIAL REPORT NO. 6

OF THE

ILLINOIS STATE WATER PLAN TASK FORCE

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Introduction

The State of Illinois currently has neither a uniform policy nor standard for instream flow protection. The only standard that has periodically been used to condition some major water withdrawal permits was the "water quality standard" flow of $Q_{7,10}$. That is, the lowest flow expected for a 7-day period once in every ten years. This standard has been employed primarily because it was the "only" low flow standard in general use, even though it is widely recognized as highly inadequate for maintenance of most instream values.

One of the main issues discussed at a 1982 Instream Flow Workshop, attended by 30 State of Illinois water resource professionals, was the immediate need for a uniform interim instream protected flow planning standard for the State of Illinois. A list of workshop participants is included in Appendix C. Workshop participants recognized that, although the State must continue its instream flow research program, State agencies must also be prepared to make decisions on protected flow levels in the near future.

In recognition of this need, this special report presents a protected low flow planning standard, based on research to date, which can be used statewide for the planning of projects in the absence of a detailed instream flow needs analysis. Revisions in this planning standard will be considered periodically as research and experience in application accumulates.

This interim standard provides project planners and developers with base level protected flow values for their initial development and evaluation of project alternatives. It must be recognized that site specific considerations might require that higher protected flow values be set for final project implementation and operation.

Site specific considerations which could significantly affect a project's design include extreme modifications to flow duration curves or the reduced variability of seasonal flows, downstream water supply demands, recreational navigation needs, commercial navigation needs, protection of critical spawning flows, and the results of the Cooperative Instream Flow Service Group (IFG) incremental methodology evaluations if available.

Instream Flow Protection Policy of the State of Illinois

In addition to recognizing the need for an interim protected flow planning standard, the participants of the 1982 Instream Flow Workshop recommended that Illinois, through the State Water Plan Task Force agencies, adopt an instream flow protection policy. This policy is:

> The State of Illinois finds that the public health and safety, the water quality, the riverine flora and fauna, the aesthetic qualities and the recreational potential of the rivers of Illinois are dependent in substantial measure upon the protection of reasonable flows in the rivers of the State,
>
> and, therefore, that the protection and maintenance of such flows is in the public interest,
>
> and, further, that the mutual and coordinated action of the agencies of the State of Illinois is essential to the protection of reasonable rates of flow.
>
> In accordance with these findings, it is the policy of the State of Illinois that the protection of reasonable instream flows be pursued through appropriate regulatory, planning, and advisory authorities of the State and further that specific values of reasonable instream flows for the rivers of Illinois be established and periodically reviewed.

Interim Planning Standard Criteria

In the development of an interim planning standard, the following criteria were applied to evaluate the selected standard.

1. The standard must insure a reasonable degree of environmental protection.
2. The standard must allow a reasonable degree of cost effective water supply development.
3. The standard must to the degree possible be applicable statewide.
4. The standard must be sensitive to temporal and spatial flow variability in Illinois streams.

Recommended Standard

Numerous methodologies, procedures, and standards for protecting instream flows or determining instream flow needs were evaluated against the above criteria. Some of these methodologies, procedures, and standards are described later as they relate to both the above criteria and the selected interim statewide protected flow planning standard.

Based on these evaluations, analyses of the implications of alternative standards and input from workshop participants, the following interim planning standard for Illinois was selected.

> The flow available in a stream for offstream use (either storage or withdrawal) is the maximum value of either the streamflow minus the 75% duration flow or the difference of the streamflow minus the 7 day-ten year low flow divided by two.

In equation form, the standard is:

$$Q_{available} = \text{Maximum of} \left[\begin{array}{l} Q_{streamflow} - Q_{75} \\ \text{or} \\ \dfrac{Q_{streamflow} - Q_{7,10}}{2} \end{array} \right.$$

This standard is described in an Illinois State Water Survey publication prepared for the Illinois Division of Water Resources entitled "Hydrologic Design of Side-Channel Reservoirs in Illinois" by H. Vernon Knapp, 1982. This publication incorporates this standard into the statewide design curves for side-channel reservoirs.

Implementation

The protected flow planning standard adopted by Illinois best meets the criteria of reasonableness to various interests and statewide applicability. The standard is most suited for use in pre-project planning and design, where its application should save considerable time and effort and avoid uncertainty in the initial stages of project planning, site selection, and regulatory review.

The acceptance and application of this protected flow planning standard by all State agencies will ensure a more certain degree of environmental protection for Illinois while allowing responsible water supply developments.

It should be recognized that in the final design and review of a planned project, additional considerations must be evaluated for the project site. These considerations might require that a project's operation be modified to allow for protected flow values in excess of those set by the recommended planning standard.

Examples of considerations that could significantly affect a project's design are:

- seasonal variability in flows

  Maintenance of habitat quality, dependent on sufficient flow, is especially important during spring spawning months. Spawning success directly influences population size and, therefore, for sport species, the quality of fishing several years in the future. The presence of sport fisheries as well as threatened and endangered species and their habitat requirements, current type and level of angler use, and present and future intended management of aquatic resources must be considered in planning for adequate flows. For example, in some cases, maintenance of higher flows may be necessary to protect critical spawning habitat from March through June. In order to provide adequate diversity of critical habitat over the annual cycle for a species of particular management concern, variable protected flows may be necessary.

- flow duration curves

  While definitive evidence is not yet fully available, the weight of biological and hydrological judgement holds that extreme changes in flow duration curves from the norm of record may have a variety of negative impacts on aquatic systems. Therefore, an evaluation of this aspect of a project's effects and planning to minimize these variations is necessary.

- available evaluations based on the Cooperative Instream Flow Service Group (IFG) incremental methodology

  A considerable amount of study of the impacts of various flow levels has occurred both nationally and in Illinois. The development of the present interim protected flow standard is based in part on this work. In Illinois, specific basinwide evaluations have been carried out for the Little Wabash, Kaskaskia, Rock, Sangamon, and Kankakee River Basins. (See pp. 22-24.) Planning for proposed projects in these basins should benefit from study of these analyses. As additional basins are analyzed, valuable information for more specific planning will be provided.

- recreational navigation needs

  Each of the water-based recreation activities popular in Illinois has its own set of flow related requirements. For example, canoeists need a minimum depth of 1.5 feet. In contrast, power boating depends on flows providing depths greater than 3.5 feet. Current types and levels of recreation use, as well as existing plans for recreation development, must be considered in project planning.

- commercial navigation needs

  Commercial navigation in Illinois exists mainly on the Mississippi, Illinois, and Kaskaskia Rivers. Major water use developers within these basins must work with the Corps of Engineers and Division of Water Resources to insure that proposed projects do not adversely affect the movements of waterway traffic.

- downstream water supply demands

  All water users within a watershed must recognize that they share a common public resource. New or expanding water users must evaluate how their use affects other users in the watershed and prepare for reduced useage through sharing of the resource with other users in times of drought.

Standard Review

After a period not to exceed five years from the date of this report, the record of the application of the planning standard, applicable data, and relevant theoretical and methodological developments will be considered by the involved agencies and interested individuals and the planning standard adjusted as necessary. If it becomes clear prior to the end of the five year trial period that the planning standard is inappropriate or unworkable, a reevaluation will occur as soon as possible.

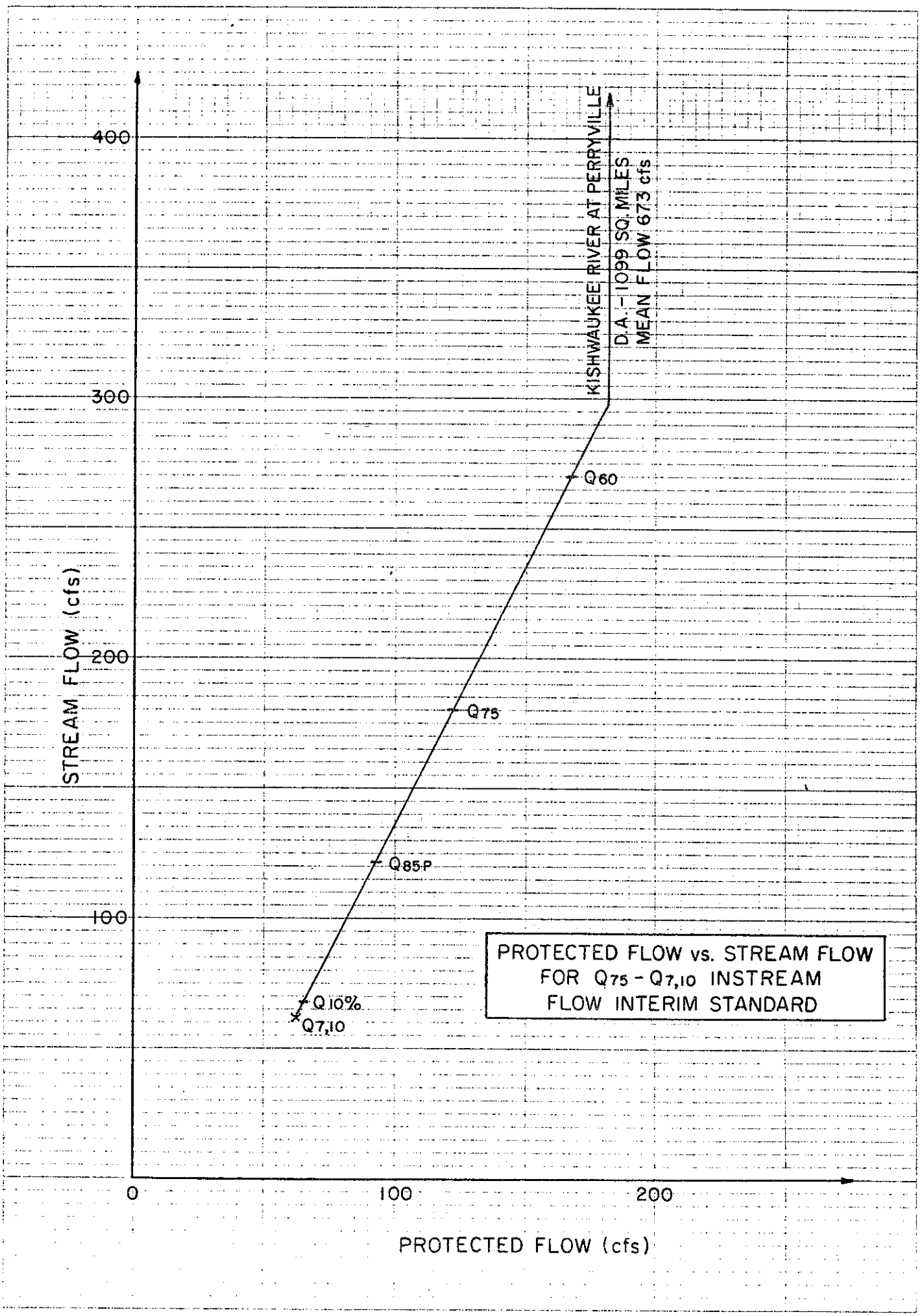
A planning and research agenda was discussed by participants in the 1982 Instream Flow Workshop and is presented in Appendix B. These activities will provide information relevant to standard review.

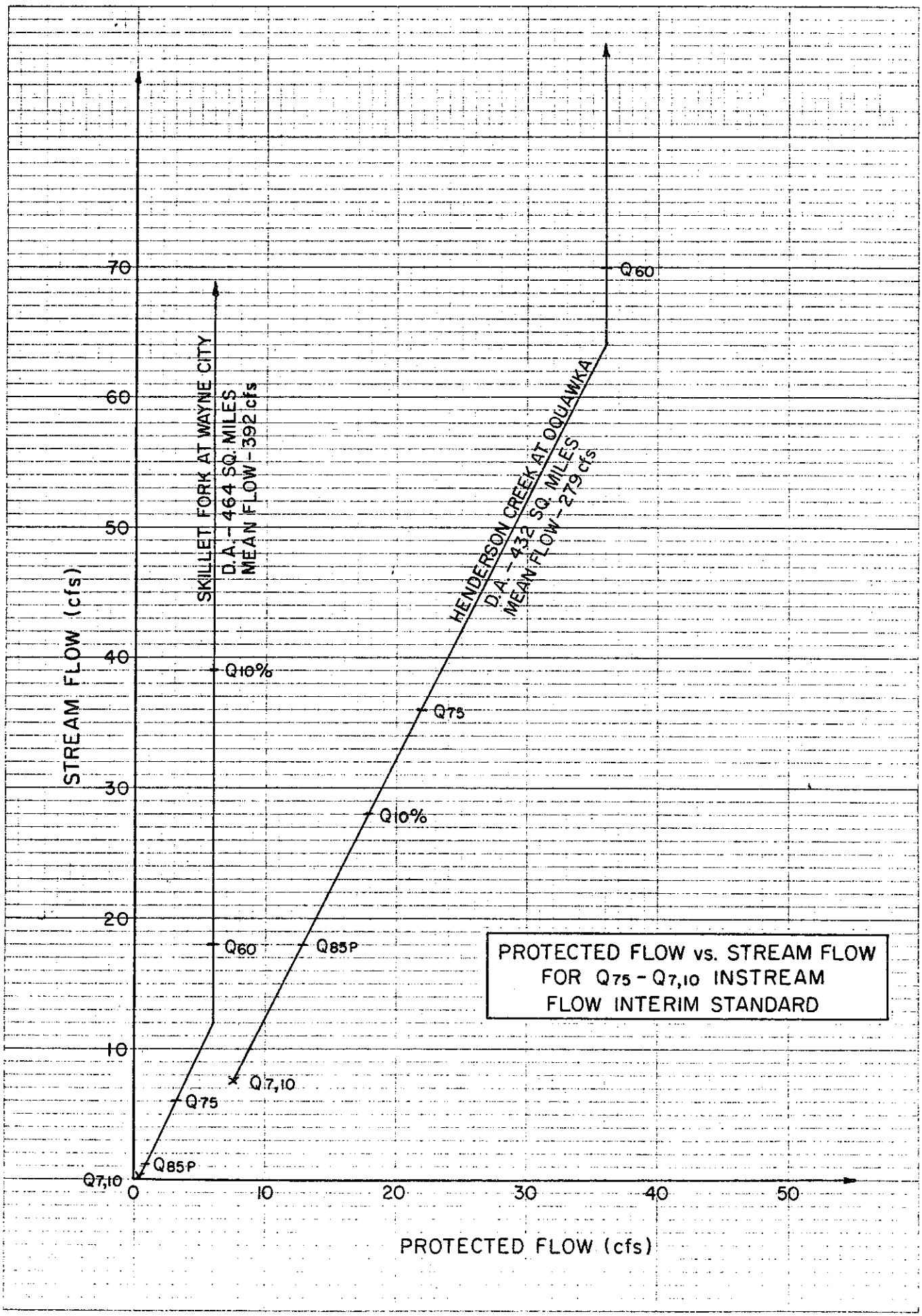
Key Aspects of Recommended Standard

The selected planning standard is presented graphically on the following pages for five watersheds (stream gaging locations) in the State of Illinois.

Detailed review of the graphs on the following pages shows how the recommended protected low flow standard relates to various stream flow values. Table 1 on page 13 presents various duration and frequency flows for the graphed gage locations.

Note on all graphs that the "protected flow" first comes into effect at a specific "break point" stream flow value. The protected flow at this stream flow break point is Q_{75} which is the streamflow value that is equalled or exceeded 75% of the time at a specific location on a stream. This break point is mathematically a stream flow value that equals $(2\ Q_{75} - Q_{7,10})$. Table 1 also indicates that Q_{75} is in all cases approximately equal to Q_{61P}, the median 61-day low flow during the period of May through October which can be considered the "normal summer low flow".


KISHWAUKEE RIVER AT PERRYVILLE
D.A. - 1099 SQ. MILES
MEAN FLOW 673 cfs
Q60
Q75
Q85P
Q10%
Q7,10
400
300
200
100
0
100
200
STREAM FLOW (cfs)
PROTECTED FLOW (cfs)
PROTECTED FLOW vs. STREAM FLOW
FOR Q75 - Q7,10 INSTREAM
FLOW INTERIM STANDARD


STREAM FLOW (cfs)
PROTECTED FLOW (cfs)
0
10
20
30
40
50
60
70
SKILLET FORK AT WAYNE CITY
D.A. - 464 SQ. MILES
MEAN FLOW - 392 cfs
HENDERSON CREEK AT OQUAWKA
D.A. - 432 SQ. MILES
MEAN FLOW - 279 cfs
Q60
Q10%
Q75
Q85P
Q7,10
PROTECTED FLOW vs. STREAM FLOW
FOR Q75 - Q7,10 INSTREAM
FLOW INTERIM STANDARD

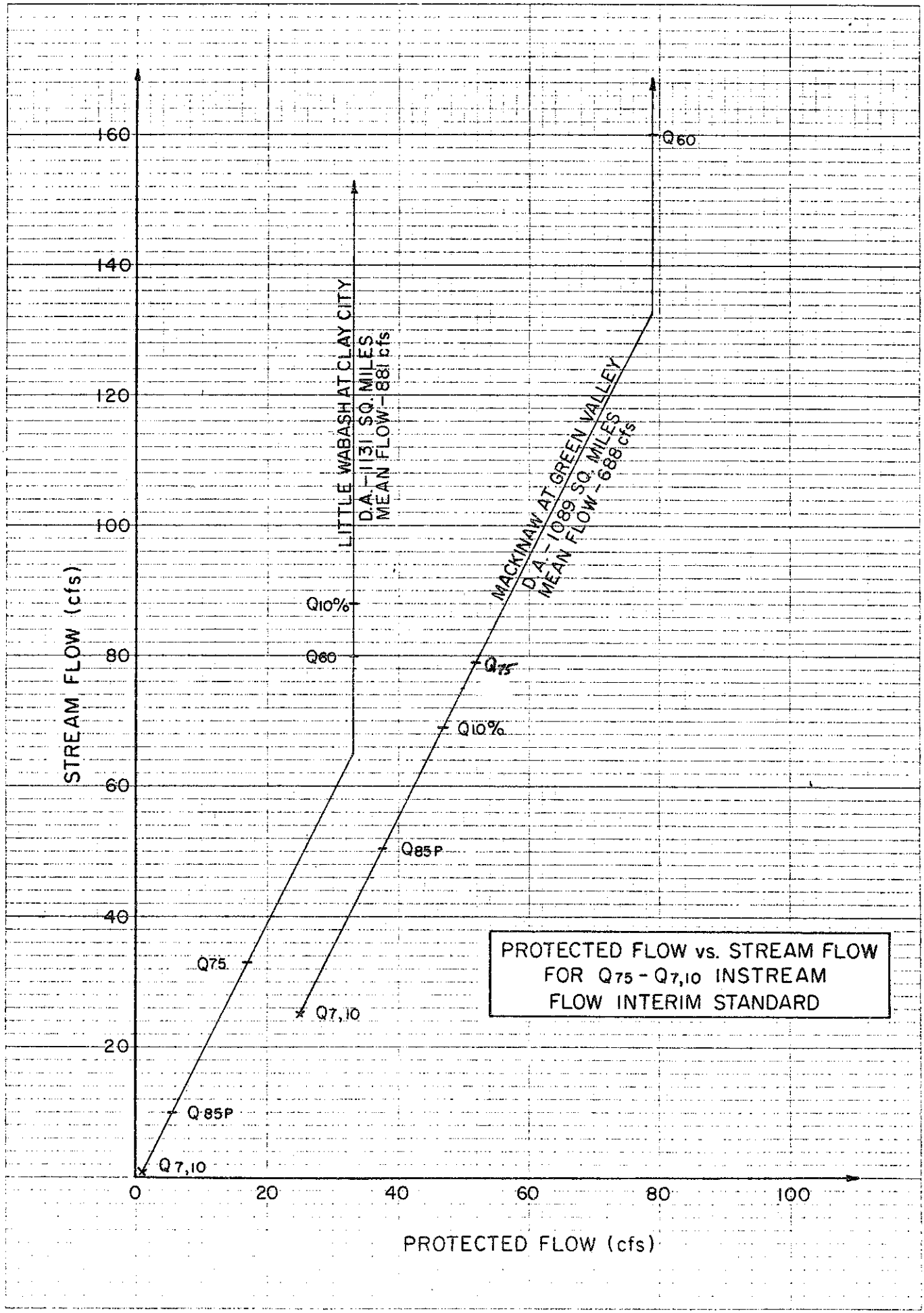

STREAM FLOW (cfs)
PROTECTED FLOW (cfs)
0
20
40
60
80
100
120
140
160
LITTLE WABASH AT CLAY CITY
D.A.-1131 SQ. MILES
MEAN FLOW-881 cfs
MACKINAW AT GREEN VALLEY
D.A.-1089 SQ. MILES
MEAN FLOW-688 cfs
Q60
Q10%
Q60
Q75
Q10%
Q85P
Q75
Q7,10
Q85P
Q7,10
PROTECTED FLOW vs. STREAM FLOW
FOR Q75 - Q7,10 INSTREAM
FLOW INTERIM STANDARD

TABLE 1: STREAM FLOW VALUES FOR SAMPLE GAGE LOCATIONS (C.F.S.)

GAGE	1 D.A.	2 Q	3 $Q_{7,10}$	4 Q_{85P} May-Oct	5 Q_{61P}	6 Q_{90}	7 Q_{85}	8 Q_{75}	9 Q_{60}	10 Q_{pool} +Riffle	11 Q_{50}	12 $Q_{30\%}$
Little Wabash @ Clay City	1131	881	.47	10	38.5	9.8	14.9	33	80	4.7	111	264 F=.40
Skillet Fork @ Wayne City	464	392	0	1.2	7.8	1.5	2.2	6	18			
Mackinaw R. @ Green Valley	1089	688	25.5	53	71	45	53	79	160			
Henderson Crk. @ Oquawka	432	279	7.8	18	35.5	17	21	36	70			
Kishwaukee @ Perryville	1099	673	62.3	121	156	110	128	180	270	100	360	200 F=.70

Explanation

1. Drainage area in sq. miles
2. Mean flow
3. Seven day-10 year flow
4. 85% duration for daily flows from May-Oct
5. Median 61-day low flow (May-Oct.)
6. 90% duration flow
7. 85% duration flow
8. 75% duration flow
9. 60% duration flow
10. Flow for pool and riffles
11. 50% duration flow
12. 30% of mean flow and frequency

The graphs also show that as the streamflow falls below the break point, the protected flow values drop 1 cfs for every additional 2 cfs reduction in actual streamflow. The net effect of this is that off stream water users must share any natural reductions in stream flow at least equally with instream water users.

The recommended standard as shown graphically also sets as the absolute minimum protected low flow standard the 7 day-ten year low flow.

In general, the recommended standard, therefore, sets a range of protected instream low flow values varying from Q_{75} (approximate average year summer low flow) down to the "water quality" low flow standard of $Q_{7,10}$.

The following section, which discusses the recommended standard in comparison with other standards and methods, also identifies some of the key environmental and economic development aspects of the recommended standard, which are discussed more fully in the references cited in Appendix A.

The references cited in Appendix A are relevant to understanding the significance of this standard from both an environmental standpoint as well as the economic aspects of water supply development.

Recommended Standard In Comparison

The following sections compare the recommended interim protected low flow planning standard with other instream flow methodologies, procedures, and/or standards presented in the literature.

1) $Q_{7,10}$ Standard

As discussed in the previous section, the $Q_{7,10}$ standard is incorporated into the recommended standard as the absolute minimum protected low flow value.

A graphical comparison of the $Q_{7,10}$ standard in relation to the recommended standard is presented in the State Water Survey Report "Hydrologic Design of Side-Channel Reservoirs in Illinois" (Knapp-1982). This graph presents the effects of various minimum flow policies on the quantity of flow available for pumping.

2) Montana Method (Tennant)

This method is based on a percent preservation of the mean annual low flow assuming that 10% of mean annual flow represents "poor preservation of aquatic habitat; 30% represents flow

necessary for "good" habitat, 60% represents flow necessary for "excellent" habitat.

The problem with this standard is the extreme variability of annual mean flow values in Illinois streams in relation to average summer low flow values. For example, the table on page 13 shows that the 30% of mean flow value is 700% greater than Q_{75} on the Little Wabash at Clay City but is only 10% greater than Q_{75} on the Kishwaukee at Perryville. The table also shows that on the Skillet Fork at Wayne City the 10% of mean flow value is over 550% greater than Q_{75}.

It would appear that the result of using the Montana Method in Illinois would be the prohibition of virtually any surface water supply developments in central and southern Illinois.

3. Connecticut River Basin Method

This method basically assumes that June flows appear to be "optimum" flows for fisheries in the Connecticut River Basin. Other monthly flow values are set according to a percentage of the mean June flow. The minimum flow is set at 30% of the June flow.

The recommended standard apparently matches the Connecticut method quite well in Northern Illinois streams but appears to set quite

high protected values on many southern Illinois streams with mean flow values for the month of June which in many cases exceed the annual mean flow values.

4. Washington "Base-Flow" Method

This method evolved in the State of Washington after 1967 legislation recognized the value of fishery resource rights. Generally, in periods of low flow (usually summer) the recommended flows are those equaled or exceeded 60-70% of the time.

This method is nearly identical to the recommended standard in the selection of a normal year protected aquatic base flow.

5. State of Iowa Standard

The designated protected flow levels for most Iowa streams are set at the flow value of 84% duration of the daily flows of record for the six months of April through September. This flow value is similar to the flow value shown in the table on page 13 and on the graphs as Q_{85p} which is the 85% duration flow for the six month period of May through October.

This flow value of Q_{85p} is naturally lower than the flow value of Q_{75} in the recommended method and, therefore, within the range of protected flows covered by the recommended method. The recommended method will, however, allow for protected flow levels lower than Q_{85p} during drought events.

6. Side-Channel Reservoir Report Low Flow Analysis

The previously referenced report by Vern Knapp of the State Water Survey entitled "Hydrologic Design of Side-Channel Reservoirs in Illinois" basically evaluates and incorporates seven "low flow policies" into the report's design procedures for side-channel reservoir projects. These seven policies are defined by the following equations:

Policy A) $QA = Q$

B) $QA = Q - Q_{7,10}$

C) $QA = Q - Q_{90}$

D) $QA = Q - Q_{75}$

E) $QA = Q - Q_{60}$

F) $QA = \max \left[Q - Q_{60}, \frac{Q - Q_{90}}{2} \right]$

G) $QA = \max \left[Q - Q_{75}, \frac{Q - Q_{7,10}}{2} \right]$

in which Q is the streamflow, QA is the flow available above the minimum pumping level, and $Q_{7,10}$, Q_{90}, Q_{75}, and Q_{60} are the 7-day, 10-year low flow, the 90% duration flow, the 75% duration flow, and the 60% duration flow, respectively. Policy G which was selected for the specific development of the design curves is the same as the recommended standard.

The discussion of the statewide impacts of the various low flow policies included in the State Water Survey report points out that there is indeed an increased sensitivity of required storage (i.e., water supply development costs) to instream flow needs associated with stations in the northern part of the state due to the reduced variability in stream flow frequency and durations. This tendency is less apparent but similar as watershed size increases. This tendency occurs because larger watersheds have relatively larger low flows than do smaller watersheds, such that the imposition of instream flow restrictions has a comparatively greater effect on larger watersheds. This report further suggests that instream flow limitations might best be judged for individual cases or be established for separate regions of the state.

In the State Water Survey report, it is further suggested that the recommended policy may be construed as too restrictive in some northern streams and possibly not restrictive enough in many

streams in southern Illinois. The analysis developed for this report on an instream flow protection planning standard show this not to be true in most cases.

7. Impounding Reservoirs Low Flow Release Analysis

Another State Water Survey contract report by Singh and Ramamurthy entitled "Desirable Low Flow Releases From Impounding Reservoirs: Fish Habitats and Reservoir Costs" evaluates the economic and environmental impacts of the eight low flow release levels listed below.

1) Median 31-day low flow during the period May-October, Q(31)P
2) Half median 31-day low flow during the period May-October, Q.5Q(31)P
3) Median 61-day low flow during the period May-October, Q(61)P
4) Half median 61-day low flow during the period May-October, Q.5Q(61)P
5) Flow at 90 percent duration using daily flows May-October, Q(90)P
6) Flow at 85 percent duration using daily flows May-October, Q(85)P
7) Flow at 90 percent duration using daily flows for the record, Q(90)
8. Flow at 85 percent duration using daily flows for the record, Q(85)

The recommended planning standard is, at the upper end of its range, similar to low flow release level number 3 above (i.e., Q61P) for reasons mentioned earlier. This report then provides some insight statewide as to the impacts of the recommended standard on both fish habitats and reservoir costs.

A review of this report and its conclusions tends to support the criteria of economic and environmental reasonableness and statewide applicability of the recommended interim standard. For example, the report states that "the fish suitability or preference values of the nine target fish in the Little Wabash River below Clay City indicate that generally a flow of 15 to 20 cfs during drought conditions will be adequate with the exception of the bluntnose minnows (for which the conditions are quite different than those for the others)." This range of flows is adequately protected by the recommended standard as shown on page 5.

This report states that for the Little Wabash River below Clay City, the average fish preference for the riffles is negligible for the adults and rather small for the juveniles for the low flow release range of 6.66 to 38.50 cfs. In the pools, the juvenile fish preference increases from 0.62 to 0.66 with MIN and 0.70 to 0.73 with GM as the flow increases from 6.66 to 38.5 cfs. MIN and GM refer to either the minimum or geometric mean

values of combined fish preference values. The preference for the adults increases from 0.24 to 0.57 with MIN and 0.41 to 0.66 with GM. The cost preference curve steepens beyond C/C_o = 1.15 which corresponds to a flow of 15 cfs.

For the Kishwaukee River, near Perryville, Singh's report states that the average fish preference for the riffles is negligible for the adults and is 0.14 with MIN and 0.18 with GM for the juveniles, for the flow range of 69 to 156 cfs (the 7-day 10 year low flow is 62.3 cfs). In the pools, the juvenile fish preference is about 0.66 with MIN and 0.72 with GM over the low flow range studied. Similarly, the preference for the adult fish is about 0.55 with MIN and 0.66 with GM. The fish preferences need to be calculated at flows less than 69 cfs to determine if a lesser flow release may be appropriate. Furthermore, at Clay City the increase in reservoir costs for the flow range of the recommended standard varies from 5% to 40%.

For the Kishwaukee River, near Perryville, the recommended standard would increase reservoir costs in the range from 150% to over 600% for developments requiring a supply greater than 10% of mean flow. Supplies requiring less than 10% of mean flow at this location would not require a reservoir development.

In general, the conclusions of this report would tend to support as acceptable the protected flow ranged covered by the recommended standard.

8. IFG Incremental Methodology

In the previous section low flow impacts were described for the stream gage location on the Little Wabash at Clay City and Kishwaukee River at Perryville. The statewide instream flow needs analysis using the incremental methodology has also modeled these two watersheds and these two gage locations specifically.

In reviewing Herricks, et. al. report entitled "Instream Flow Needs Analysis of the Little Wabash River Basin" the minimum discharges necessary in this basin during the "low flow" months to provide a habitat frequency of F=0.5 are 57 cfs for August, 38 cfs for September, and 28 cfs for October. The "break point" value for this location as shown on the protected flow graph is 32.5 cfs for a stream flow value of 65.5 cfs. In the streamflow range of 30 to 50 cfs the protected flow varies from 18 to 24 cfs. Note that the pool and riffle condition flow values appear to be reasonable in comparison to the flow values existing species now experience at the 50% duration habitat.

The technical report entitled "Instream Flow Needs Analysis of the Rock River Basin" by Herricks, Eheart, and Stall presents minimum low flow values for a habitat frequency of F=0.5 for a reach of the Kishwaukee River at Perryville (Cherry Valley Reach). The F=0.5 habitat frequency flow values for the months of August, September and October vary from 178 cfs to 216 cfs. The break point value for this location as shown on the protected flow graph is 180 cfs for a stream flow of 300 cfs. In the stream flow range of 100 to 200 cfs the protected flow varies from 80 cfs to 130 cfs. The pool and riffle condition flow value for this location on the Kishwaukee is 100 cfs. It again appears that for this northern location of the state, the recommended standard protected flow values fall within a reasonable range in comparison to the 50% duration habitat.

APPENDIX A

REFERENCES

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APPENDIX B

PLANNING AND RESEARCH AGENDA

- Short Term Planning and Research Agenda - (3 years)

1. Evaluate the interim instream protected flow standard, using the IFG incremental and other methodologies.

2. Develop procedures for applying the calibrated results of the instream flow analysis methodology to the uncalibrated reaches and tributaries of a basin.

3. Collect additional data and modify species preference curves using techniques described by Larimore and Garrels' "Seasonal and Daily Microhabitat Selection By Illinois Stream Fishes" (Illinois Natural History Survey - 1982).

4. Define on a regional basis pool and riffle depth and velocity relations, reaeration rates for riffles, and deoxygenation rates for pools at low flow levels.

5. Develop an effective method for the combination of species preference values such as velocity and depth into a single preference value.

- Long Term Planning and Research Agenda (10 year)

1. Based on a prioritized list of Illinois aquatic species, develop revised species preference curves and continuously update them as additional data become available.

2. Determine appropriate species associations so that "indicator species" can be used for protected flow analyses.

3. Incorporate water quality (temperature and chemical) factors into the IFG incremental methodology.

4. Calibrate the instream flow needs analysis methodology for a far southern Illinois stream.

5. Identify the interrelationships among fish habitats and substrates for various Illinois streams in different physiographic areas.

6. Identify the impacts of water quality and in stream sediment load on stream habitats.

APPENDIX C

INSTREAM FLOW WORKSHOP
ATTENDANCE ROSTER

NAME	AGENCY/INSTITUTION
Dick Schicht	Illinois State Water Survey
Mike Terstriep	Illinois State Water Survey
Kris Singh	Illinois State Water Survey Surface Water Section
Vern Knapp	Illinois State Water Survey
Nani Bhowmik	Illinois State Water Survey Surface Water Section
Paul Risser	Illinois Natural History Survey
Weldon Larimore	Illinois Natural History Survey
Michael Wiley	Illinois Natural History Survey
John B. Stall	Consulting Engineer - Hydrology Past Head of SWS Surface Water Section
Ed Herricks	U. of Ill., Dept. of Civil Engineering
Wayland Eheart	U. of Ill., Dept. of Civil Engineering
Lewis Osborne	University of Illinois
Bob Thomas	IEPA - Div. of Water Pollution Control, Planning Section, Technical Standards Unit
Bill Rice	IEPA - Div. of Water Polluton Control, Planning Section, Project Mgmt. Unit.
Ken Rogers	IEPA - Div. of Water Pollution Planning Section, Monitoring Unit
Wendy Coleman	IEPA - Div. of Water Pollution Planning Section, Project Mgmt. Unit.

APPENDIX C

INSTREAM FLOW WORKSHOP
ATTENDANCE ROSTER

NAME	AGENCY/INSTITUTION
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Bob Hite	IEPA - Div. of Water Pollution Planning Section, Monitoring Unit
Bill Tucker	IEPA - Div. of Water Pollution Planning Section, Monitoring Unit
Jim Pendowski	IEPA - Project Management Unit
Ed Hoffman	DOC - Comprehensive Planning Sec.
Gregg Tichacek	DOC - Comprehensive Planning Sec.
Dick Lutz	DOC - Impact Analysis Section
Bob Schanzle	DOC - Impact Analysis Section
Randy Vogel	DOC - Impact Analysis Section
John Tranquilli	DOC - Div. of Fish & Wildlife Res.
Les Frankland	DOC - Div. of Fish & Wildlife Res.
Bill Bertrand	DOC - Div. of Fish & Wildlife Res.
Bill Boyd	DOC - Div. of Fish & Wildlife Res.
Butch Atwood	DOC - Div. of Fish & Wildlife Res.
Gary R. Clark	IDOT - Div. of Water Resources Bureau of Program Development
Case Grintjes	IDOT - Div. of Water Resources Bureau of Program Development
Siavash Mostoufi	IDOT - Div. of Water Resources Bureau of Program Development