

September 30, 1997

EPA-SAB-EPEC-ADV-97-003

Honorable Carol M. Browner  
Administrator  
U.S. Environmental Protection Agency  
401 M Street, SW  
Washington, DC 20460

Subject: Advisory on the Development of Phase II of the Index of  
Watershed Indicators

Dear Ms. Browner:

On May 15, 1997, the Ecological Processes and Effects Committee of the Science Advisory Board met to review and provide comments on the National Watershed Assessment Project (NWAP), recently renamed the Index of Watershed Indicators (IWI), being developed by the Office of Water. The purpose of IWI is to provide available data in a Geographic Information System (GIS) format to interested parties, including state and tribal governments and members of the public, for assessing the condition and vulnerability of watersheds. The Committee's comments take the form of an SAB Advisory, because they are intended to guide improvements to IWI in the future (Phase II) rather than to revise the existing version, which has already been released to the states. This approach was agreed to by the SAB because of the schedule for release of Phase I (i.e., late June) that had already been established by the Office of Water.

This letter contains the Committee's overall comments on IWI, as well as responses to the five specific questions contained in the Charge. Although review materials provided to the Committee consisted of the January 1997 version of IWI, at the review meeting Agency staff circulated a revised (draft final) version of IWI that had been provided to states and EPA Regions on May 1, 1997. The following comments, therefore, are based primarily on the January version, but include some of the Committee's observations about changes that occurred between the January and May drafts.

Overall, the Committee feels that the basic concept of IWI, i.e., the provision to the public, decision-makers, and scientists of integrated watershed information maps for the nation, is a major step forward, but IWI is not yet applied by EPA in a clear and constant way. Nonetheless, the approach shows much promise. Despite its

enthusiastic support for state-of-the-science integrated environmental assessments, such as those conducted under the Agency's Environmental Monitoring and Assessment Program (EMAP), the Committee also recognizes an important role for less data-intensive watershed assessments such as IWI. The IWI approach will be valuable for a variety of reasons. It provides baseline maps at the national and watershed levels that show the current status of a variety of indicators. Integrating the information at the watershed, state, and national level is a very valuable product in itself, and we applaud the Agency for making the information easily available to the public via the World Wide Web. In addition, the preparation of watershed maps may help the states better understand the condition of their watersheds and perhaps seek to improve the environmental conditions of them. At a minimum, the maps, by highlighting gaps in the data, may act as an incentive for state and local environmental managers to provide additional existing data to EPA or to seek finer-scale indicator data for their own use in watershed management. We also feel that displaying watershed information in a map format may encourage people to ask questions about the data and its integration. Finally, the maps will provide a basis for Agency discussions with states about the status of and environmental improvements in their watersheds. In summary, we very much applaud the approach and the drive to disseminate the information on the Web and think that IWI will be a useful tool, but since IWI is very much a works-in-progress, the approach needs to be further evaluated after more experience is gained with its use before definite conclusions can be drawn about its utility in practice.

We are less enthusiastic about the content of some of the specific data layers, but recognize that the Agency was working with existing data sources that, despite their inadequacies, were often the only available alternatives. Many of the comments that follow relate to ways in which the scientific clarity and rigor of IWI can be improved, while retaining its current utility as a policy tool. Although the Committee did not evaluate the process employed by IWI to weight and combine the various watershed indicators to calculate total scores for watershed condition or vulnerability, we recommend that this algorithm receive peer review prior to the release of IWI Phase II.

The Charge to the Committee contained five questions in regard to the development of Phase II of IWI, which we deal with in turn below.

**Charge Question 1: Are the purposes of NWAP/IWI clearly stated?**

Yes, the purposes of NWAP/IWI described in the Charge to the Committee are clear and reasonable. The Committee noted, however, that this language differed in some respects from the description of the purposes of NWAP/IWI in the review documents. As discussed further under Charge Question 4, the documentation for IWI Phase I should be reorganized and integrated into a single document, rather than a confusing series of attachments. The purposes of IWI should be clearly described in that integrated document.

**Charge Question 2: Would the new data layers proposed for Phase II provide the most useful enhancements to NWAP assessments for both the watershed condition and for vulnerability? Should additional new data layers be considered?**

The current set of data layers included in Phase I of IWI are focused largely on water quality measures, with only minor consideration of terrestrial and landscape characteristics of watersheds that influence watershed condition. Thus, in addition to the six data layers proposed for inclusion in Phase II (biological integrity, habitat, groundwater, coastal condition indicator, air deposition, and downstream effects), the Committee suggests the addition of land use change and other indicators of terrestrial condition that influence watershed water quality. Additional terrestrial data layers that should be considered include: a) an index of potential phosphorus runoff from terrestrial sources, similar to Map 12b for nitrogen; b) terrestrial species at risk (a logical companion to Map 8: Aquatic/Wetland Species at Risk); c) indicators of terrestrial habitat quality, fragmentation, and soils; and d) population density. The population change data in Map 13 cannot be evaluated in the absence of population density data because a given percentage increase in the population in a watershed has a much greater impact in watersheds where population density is very high (e.g., coastal California) than in watersheds where population density is very low (e.g., the Adirondack Mountains of New York State).

**Charge Question 3: Are the description and display of data limitations and uncertainties in Phase I an appropriate model to use in Phase II? How can these descriptions be improved?**

It is highly likely that, as databases are refined and new ideas are incorporated into the indicators, the maps will change over time. As new maps are developed, they will replace the original maps. In order to avoid confusion and assist in communication to users of IWI, therefore, we recommend that each of the indicator maps be annotated to specify the version and release date (e.g., Version 01-97). As new indices are developed or suggested changes are brought forth and incorporated, it will be important that the system allow for trends to be back-calculated using the new approaches. A key part of IWI is the development of trend data. Therefore, the ability to plot the trends with new or revised indices will be important.

In addition, the Committee recommends that each map at the national level should contain an explicit explanation of the degree of uncertainty that the Agency feels is associated with the information that it displays. An uncertainty icon, such as a barometer scaled from 0 to 10, should also be displayed on each map to give a quick visual summary of the level of uncertainty associated with the map. The inclusion of uncertainty information will assist decision-makers in the use of the IWI maps and

should stimulate efforts to improve the databases and/or components of the indicator to decrease that uncertainty.

Other critical information that should be included for each map includes the source of the underlying data, sampling methods, and the geographic scale of aggregation of the source data. Where source data are published, those publications should be fully referenced in the map documentation. For example, the wetland loss data used as one of the data layers for Map 7 are from a published document that should be referenced (see Attachment A to this letter regarding this data source, which was incorrectly attributed to the National Wetlands Inventory).

Information about the sampling methods and geographic aggregation of source data is included for some maps, but not all. For example, the Natural Resources Conservation Service (NRCS) NRI (does this stand for Natural Resources Inventory?) data set is described well for Map 12a, but not for Map 7. If space is a limitation, perhaps those data sources that were used for several of the maps (e.g., STORET, NRI) could be put in the introductory documentation and then referenced on the individual maps that used them. The narrative descriptions of data sources would be enhanced by including inset maps showing the spatial aggregation of source data (e.g., for Map 7, a map of state boundaries for the historic wetland loss rates used and a map of the 6-digit accounting unit boundaries for the NRI-derived wetland loss rates used )

Maps showing the separate data layers that were integrated into composite data layers (e.g., Maps 3a, b, and c) were very helpful. The use of such supplemental maps is encouraged for Phase II, and could be increased in future revisions of the Phase I maps. For example, maps for each of the four heavy metals that went into the composite "Ambient Water Quality Data - Four Toxic Pollutants" (Map 5) should be shown, particularly in view of the changes that occurred in this composite map when a difference suite of heavy metals was used for the April 18, 1997 vs. the January 9, 1997 version (see comments in Attachment A regarding Map 5). Similarly, supplemental maps should be used to show the individual data layers that were used to generate Maps 6, 7, and 11.

**Charge Question 4: Can the Phase I approach to integration of the separate data layers be improved in Phase II to provide a more useful illustration of how to understand the overall condition and vulnerability of watersheds?**

With regard to the overall IWI documentation, the Committee recommends that the maps, data caveats, and description of the scoring/index algorithm be integrated into a single document. Members noted that this had been partially achieved in the May 1 version of the documentation insofar as the maps and data caveats are now displayed on facing pages. Nonetheless, the description of the algorithm used to

weight and combine the various watershed indicators should be part of the integrated documentation, rather than a separate attachment.

The decision rules used to combine individual data layers into a composite index should be stated in the supporting documentation because changes in these decision rules can lead to changes in the composite maps even when the source data remain the same. Indeed, the maps provided to the Committee for review had already been significantly revised by the time of the review meeting. In some cases, the changes resulted in significantly different characterizations of watersheds due solely to changes in the manner of data presentation or aggregation, rather than to changes in the underlying data themselves. The Committee's comments on some of the changes that occurred between different versions of specific maps are contained in Attachment A.

Overall, the Committee concluded that the best maps are those derived from a single data layer that was collected using consistent methods nationwide (i.e., Maps 12, 13, and 14). Maps that combine multiple and/or disparate data layers are much more subjective and difficult to interpret, making them less meaningful. Maps that combine finely sampled data with coarsely sampled data into a composite index should be used with extreme caution. For example, the wetland losses data set used in Map 7 contains only 50 values (one for each of the 50 states), whereas the NRI data set used for the recent wetland loss rates consists of thousands of data samples distributed throughout the country. The composite index is only as precise as its least precise component (in this case, the 50 values from the Wetland Losses report), a fact that is not evident from the map.

The rationale behind including or excluding separate data layers in composite index maps needs to be stated explicitly. For example, the two versions (dated January 9, 1997 and April 21, 1997) of Maps 5 and 6 used different combinations of chemicals, with no explanation for why the original suite of chemicals was used in the January version, nor why it was deemed necessary to change it for the April version (also see comments on Maps 5 and 6 in Attachment A to this letter).

Data thresholds used also should be stated explicitly. Sometimes this information is contained in the map legends, but sometimes it is not. For example, the data thresholds used to define low, moderate, and high levels of wetland loss presumably changed between January and April because the two version of Map 7 were drastically different despite the use of identical source data (see Attachment A); it was unclear what ranges of percent wetland loss were used for these low, medium, and high categories.

**Charge Question 5: What additional steps, including additional research, could be undertaken to improve watershed assessments?**

The watershed assessment maps and associated data base will realize their greatest benefit if they are linked to the Agency's Environmental Monitoring and Assessment Program (EMAP), especially EMAP's regional assessments such as the Mid-Atlantic Integrated Assessment (MAIA) program. There needs to be close coordination between these efforts, because both data bases can enrich one another. There may also be the opportunity in this linking to make the IWI assessments more landscape-based, and less tied simply to water quality. A second important link would be to The Nature Conservancy's ecoregional planning effort now underway for all of the United States. Many of these TNC planning efforts are based on watersheds or subwatersheds and have already synthesized data of value to IWI. Conversely, IWI could provide data of value to the TNC efforts. One TNC watershed-based plan that is virtually complete is for the Columbia Plateau, which would be worth looking into carefully. In general, many federal and state agencies are engaged in ecoregional planning programs of different kinds, often watershed-based for data management purposes, although terrestrial in focus. In general, IWI needs to place itself in this milieu of regional planning and regional troubleshooting.

The Committee is encouraged by the initiation of the IWI project and would welcome the opportunity for continuing dialog with the Agency about IWI, such as reviewing the maps to be produced in Phase II and reviewing the integration and assessment algorithms as they are developed and refined.

We hope these comments will be useful to the Office of Water in the development of Phase II of IWI, and we look forward to a response from Robert Perciasepe, Assistant Administrator for Water.

Sincerely,

/signed/  
Dr. Genevieve M. Matanoski, Chair  
Executive Committee

/signed/  
Dr. Mark A. Harwell, Chair  
Ecological Processes and Effects  
Committee

Attachment

## Attachment A: Comments on Specific IWI Maps

Upon comparison of the June 1997 "Index of Watershed Indicators" maps (received at the May 15 EPEC Advisory Review of the National Watershed Assessment Project) with the January 1997 draft maps received as part of the review packet prior to the meeting, the Committee noted that differences between the two sets of maps were in some instances substantial. The following are selected comparisons and evaluations of the new and old maps:

**Map 1.** There were some changes in this map, presumably because the 1/10/97 version was for 1992-1994, whereas the 4/18/97 version was for 1997-1996. The data sufficiency threshold description ("...assessments were considered sufficient to characterize the condition of a watershed if more than 20% of the total perennial stream miles...met all designated uses") conflicts with one of the data categories shown in the legend (<20% met).

**Map 3.** There were big changes in this map. Although inclusion of the Supplemental Maps (3a, b, c) helps, the decision rules used to combine the 3 maps and define data sufficiency thresholds for the composite map were not documented.

**Map 5.** There were big changes in this map. Why were different metals used in the 1/9/97 version (Cd, Cu, Pb, and Hg) versus the 4/21/97 version (Cu, Cr, Ni, Zn)?

**Map 6.** There were big changes in this map. Why were different pollutants used in the 1/9/97 version (NH<sub>4</sub>, NO<sub>3</sub>, P, and suspended sediments) versus the 4/21/97 version (NH<sub>4</sub>, DO, P, and pH)?

**Map 7.** There were extreme changes in this map, which are difficult to explain given that the data sources and data categories (low, moderate, and high levels of wetland loss) are identical for both the 1/7/97 and 4/21/97 versions. This change illustrates that the decision rules used to combine and categorize the source data can be manipulated to skew the depiction one way or the other. A much higher proportion of the country has a "high level of wetland loss" on the 4/21/97 maps than in the earlier version. Supplemental maps should be included to show the recent (NRI) and historical (USFWS) data.

ERROR OF FACT: the USFWS data used are not from the National Wetlands Inventory (which is not yet completed); they are from the National Wetlands Status & Trends Reports, which should be correctly cited in the documentation:

Dahl, T.E. 1990. Wetland Losses in the United States, 1780's to 1980's. U.S.D.I., Fish and Wildlife Service, Washington, D.C., 21p.

**Map 9.** There were big changes in this map. As with Map 7, these changes are difficult to explain given that the data sources and data categories are identical for both the 1/8/97 and 4/21/97 versions. Why does the pollution picture improve so much between the 1/8/97 and 4/21/97 versions?

**Map 11.** There were big changes in this map, presumably because of the use of an additional data source (1978 USGS land use data) and different data categories. Supplemental maps should be included to show both the Census and 1978 USGS land use data. The "Description of the Data Layer" published with the 4/21/97 map is much more informative than the "Scoring for Urban Runoff Potential" descriptions; the latter is basically a restatement of the map legend.



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