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## EQB Water Availability Project Technical Focus Group DRAFT Survey #3 Results Compiled

### Statutes, Rules and Standards

#### Do current statutes/rules provide adequate authority and direction for deciding how to allocate resources when there is not enough to go around, either today or long-term?

- They do not seem to be adequate.
- I do not know about the details of the authority or exactly how the rules are stated. I do know what the DNR says is their requirement and that is that there not be any use that will harm the long-term needs of humans and nature. That is fine, but how is that assessment of what is available for the allocation of resources. And the allocation, it should be done so as to meet some objective that maximizes the value of competing uses. This would involve the calculation of the monetary benefits of the human uses and the ecological services; the allocation should be done so that the capital stock does not decrease.
- It seems to me the legal framework is adequate on which to develop a more considered and comprehensive policy/procedure for evaluating water use decisions. However, the force of rule, and not just policy, can be very helpful when difficult decisions must be made. It may be that authorities need to be clarified to make the process go smoothly. (More below)
- It seems that they provide a very strong basis. The state seems to be struggling less with rules/statutes than with: -lack of funding -lack of ability to prioritize -lack of good data for some parameters -lack of strong interagency coordination. It also seems that the current system is too labor intensive. It works now when there are few water conflicts. However, I think it will be prohibitively challenging to address each and every water conflict with the level of staff time that is currently being devoted to some areas (e.g. Brooten).
- It seems to me the legal framework is adequate on which to develop a more considered and comprehensive policy/procedure for evaluating water use decisions. However, the force of rule, and not just policy, can be very helpful when difficult decisions must be made. It may be that authorities need to be clarified to make the process go smoothly. (More below) Water use priority is very clear in rule, but how to work out solutions with existing permittees and new applicants when there are questions about availability/sustainability is not. This is clearly an important issue (see below).
- I do not feel well versed enough to address this, in spite of the information provided. I am unclear how much current procedure is required by law and how much is policy adapted to fit the requirements of law. Clearly a broader evaluation that is less rigid and allows the DNR to request additional tests and information for specific permit requests is

needed. DNR also needs the latitude to adjust decision points to fit specific circumstances.

- I am not to pretend to be an expert in developing statutes/rules, but the logic suggests what the meaning of “not enough” is. First of all, the question should be framed enough to whom, what is the resilience and feedback of the system, what is today and long-term? In other words, we must have information first on water resources sustainability, land use changes and climate change.
- I am not an expert on Minnesota statutes and rules. However, from the discussions of the group and the insights of people who have worked in the state for a long time, the challenge for Minnesota seems to be assessing the \*cumulative\* impacts of water withdrawal (and water quality degradation). Water seems to be monitored mostly on a project-by-project, well-by-well basis (unless there is particular concern about a certain aquifer or watershed, in which case a more comprehensive study is commissioned). The challenge is, how do we get an overall picture of the state of the water resource in Minnesota?
- No, although they go a lot farther than we have been able to take advantage of.
- According to Jim Japs, it sounds like MN has a good definition, although it is impossible to predict future economic, social, and environmental needs. At this point, I think we need to do a better job of evaluating the groundwater resources that we have. Water conservation and reuse should be researched and promoted.
- I'm not qualified to address statutes, rules, and standards.
- Yes to a degree, but this is an area that needs more attention and foresight into determining what is needed in a time when there is not enough to go around.
- Don't know.

**What statutes, rules or standards do you think need to be modified and how would you suggest they be altered?**

- Sustainability needs to be adequately defined and then standards need to be established to meet that definition
- Again, I do not have those statutes, rules or standards in front of me, but I am sure they are pretty vague. In the response to the first question I am suggesting that a very quantitative cost analysis be included into the decision-making process. This is all very new thinking, and such an approach will need to be included in many other statutes, etc. that involve society besides the water resources sustainability issue.
- Current statutes/rules do not provide a PROCESS for figuring out how to allocate resources when there is not enough to go around. Priority is clear, process is not. Availability of water is a critical consideration for many businesses and may affect personal and business decisions. Having a process laid out by which decisions will be made to reduce water usage in times of drought or when it becomes apparent that water has been over-allocated is critically important to both the DNR, who must work with these users to achieve a sustainable solution, and for the water users. They need to be able to assess their overall risk of an allocation reduction using their priority ranking and with knowledge of the general process that will be used to make the reduction decision.
- They cannot be modified without new information. These statutes, etc. were developed based on unsustainable foundation. To move toward sustainability, we must discard old

statutes, etc. and create new one based on the new paradigm of water resources sustainability. Again, this will require new information. Like and old house you have to level down, the old rules must come down to create new ones.

- I don't feel qualified to comment on this; only see above.
- We must change the reference from "safe yield" to "sustainable yield" with the latter defined in both its short-term sense and its long-term system capacity sense, and to include water quality concerns and the land use linkage. We need to explicitly recognize in law how "reasonable" use is dependent on: a) a need test, b) a short term sustainability test, and a long-term sustainability test. Also we should add the concept of priority sustainability management areas, building off of the aquifer management zone authority, except that these areas would address surface and ground water as one system, and be triggered by any land and water uses or expected future uses, and quality concerns, that indicate a system approaching a sustainability limit or threat. We also should explicitly require local, regional and state governments (all agencies) to build these concerns into their planning and development considerations, even to the point where a state agency (perhaps, with broader focus than DNR) could be required to approve decisions that would risk the deterioration of a system's sustainability status. This also would require establishment of a routine, interdisciplinary monitoring and assessment program, and routing reporting of sustainability indicators based upon it. These would drive or trigger the whole process, or at least that component of the process beyond that driven by reaction to individual permit requests. We must get beyond reactionary approaches to managing water. I also would introduce the concept of permit trading as a legitimate part of the modified riparian water law in Minnesota, with conditions and subject to the same tests outlined here.
- Whatever the DNR wants!
- I'm not qualified to address statutes, rules, and standards.
- DNR rules on pump test maximums for an example. The agency staff should be allowed the opportunity to provide input on this, they would know best what needs adjustment. But leave the upper management (directors and commissioners) out of the discussion. It is the staff and program managers who know where the problems are that need modification and they to talk without big brother listening. Talk to some of the older staff, I hear from them and sense they are ignored and not given the due for their years of experience.

**What additional statutes, rules or standards would you suggest to give the state the tools needed to manage water sustainably?**

- Same as question above: Sustainability needs to be adequately defined and then standards need to be established to meet that definition
- I know that no such cost analysis currently exists. The details of how to do the cost analysis do not need to be put into the statutes, rules, etc., but the requirement to not allow a decrease of the capital stock needs to be included. The details of the approach can be worked out separately. I am sure that we can provide these details.
- There is clearly a need for more information and/or tools to manage water sustainably - and if DNR/others are prevented from gathering that information by existing statute, or need explicit authority to use specific tools, then it should be provided.

- I don't know if there is a need for additional statutes, etc. But there is clearly a need for more information and/or tools to manage water sustainably - and if DNR/others are prevented from using these tools by existing statute, or need explicit authority to use specific tools, then it should be provided.
- There is clearly a need for more information and/or tools to manage water sustainably - and if DNR/others are prevented from using these tools by existing statute, or need explicit authority to use specific tools, then it should be provided. Certainly, more funding will be needed to obtain and evaluate this information. Funding could be provided by the legislature or via permit fees.
- As I said above it is not possible to have any addition to a crumbling building (in other words, the old way of doing things). It must be build a new, from foundation up. To have this foundation we must have information first.
- See above.
- Permanent funding should be appropriated 1) to investigate and document current groundwater conditions and 2)for maintaining databases, developing compatible formats, and the electronic network needed to share information. b) Give DNR the authority to know when high capacity wells are proposed and a time frame for evaluating the impacts of that high capacity well and issuing a permit before the high capacity well is installed.
- I'm not qualified to address statutes, rules, and standards.
- We have too many agencies involved with water and to recommend the regulatory needs for managing water sustainability makes for a long list of suggestions. Perhaps it is time to overall the system and consolidate all the users into one agency with one set of statues, rules and standards. How about the Minnesota Department of Water, okay, this is not going to happen. I am not convinced that the current statutes give any of the agencies the ultimate ability to make very hard, tough decisions in times of a water crises without the lawyers queuing up. I do not have any specific recommendations with the exception that we should consider a task force that focuses only on this issue.
- Need to have rules in place to allow artificial recharge of water, for conservation credits for minimizing water use or maximizing reuse.

## **Framework and Criteria**

**At the final meeting there was discussion of creating criteria for determining priority areas of water sustainability concern. Do you have any comments on this proposal? What types of criteria do you believe should be evaluated?**

- Yes, priority areas need to be defined based on water-balance criteria.
- I agree with this idea. But the development of those criteria will require first the development of the groundwork for putting quantification into those criteria. There would be physical, biological, chemical, economic, and maybe social criteria. What goes into those criteria?
- The development of priority areas is important. I think criteria should include(not in any particular order): projected demand for water (# of households/population trends, industry trends), adequacy of local water resources to supply projected need, presence of potentially affected surface water resources (lakes, wetlands, rivers, trout streams),

existence of contrasting ground water quality zones/aquifers, quality/quantity of existing hydrogeologic and ground water quality data.

- It's a good idea. Some criteria should include thresholds for development (e.g. X % of the land area is developed, or Y # of users are in the aquifer).
- The development of priority areas is important, given the limited resources currently available and the existing demands. Criteria should include (not in any particular order):
  - projected demand for water (# of households/population trends, industry trends);
  - perceived or known adequacy of local water resources to supply projected need (both quantity and quality);
  - number and quality of potentially affected surface water resources (lakes, wetlands, rivers, trout streams);
  - existence of contrasting ground water quality zones/aquifers that may be induced to recharge the aquifer under high pumping stresses;
  - and the amount and quality of existing hydrogeologic and ground water quality data available to assess the aquifer system.
- Creating criteria requires information. That information is not yet fully developed. However, for Twin Cities area we have a map of sustainable supply, but we need to develop an intelligent monitoring framework to measure sustainability. Then we need to know what are the requirements for ecological services. The possible criteria could be the ratio of sustainable supply to human and ecological services need. This could be on water quantity side. On the water quality we do not have yet even estimate of sustainability, which should be the concentration of chemical constituent per parcel of land. So, the question is coming back to information. Remember, we are talking about sustainability which is long term framework, and in principle, it is indefinably. We cannot create criteria on "sand". We need information first.
- It seems that we need some way of prioritizing regions of the state for more careful assessment and monitoring. Otherwise, we will be reacting to water shortage crises as they emerge, rather than planning carefully to avoid them in the first place. I recommend a 'triage' approach, using large scale modeling to determine areas of potential concern (including regions where demand is expected to increase dramatically), then perhaps collecting more data in the watersheds/aquifers where problems may occur (or have already occurred), and if necessary set up continuous monitoring. For example, I would tag Ramsey County as an area of prime concern right now. Several models and observational data have all indicated that water is being over-used in Ramsey. Once there is cause for concern, various water management schemes should be considered.
- I think it's a good idea and should be used as a way to trigger sustainability conversations by the various agencies and levels of government, and water and land users. The state must be able to manage these forums; they cannot be governed by local fiat, but must be science based. Perhaps a third party state entity should run these to avoid putting DNR into the position of being both facilitator and judge/decision-maker.
- I think that this would be a good idea. We should not promote activities that will increase groundwater consumption if water is not available. Knowing where limited water conditions exist will help planners and developers refrain from investing funds where there is insufficient water to meet their needs.
- Our resources for addressing these issues are always limited. Therefore we should use criteria to define the most important places to focus our efforts. The criteria should be a combination of evaluating the vulnerability and importance of the water resources (sole

source, sensitive, etc.) and the impact on humans (population density, economic factors, emergency situations, etc.).

- This is where we need to start, determining priority areas of water sustainability concerns. I suspect the DNR already has a list. The criteria should include water usage and management, evaluation of the adequacy of the data of the system (or do we really understand this aquifer, do we know the areal extent and the geology), and what is the current state of monitoring of the system.
- No

**There is broad agreement that water quality issues should be incorporated in water quantity decisions. How would you propose this might be done?**

- Water quality is included as one of the important elements of safe yield, per Rules handout. It is also included in the list of factors to be considered by the DNR when taking action on permit applications. However, I do not believe DNR routinely uses such information, assuming it is available, in making water permitting decisions. It seems to me the legal framework is adequate on which to develop policy and procedure for evaluating water use (not that it wouldn't be improved by adding more detail and clarity). It is simply that policy and procedures long used by DNR to make water appropriations decisions focus almost exclusively on issues of drawdown and interference have mostly been adequate.
- No there probably is not agreement. It would depend on how sustainability is defined
- Somehow the value of a unit of water needs to be quantified based on its quantity as well as its quality (chemical and temperature). One cubic meter of pristine water has less value than one cubic meter of water that is degraded by chemicals or temperature deviation. Some index needs to be developed to make this comparison between pristine and degraded water. Including this into the overall allocation of water will then push society towards the need to clean up and protect the quality of water.
- Somehow the value of a unit of water needs to be quantified based on its quantity as well as its quality (chemical and temperature). One cubic meter of pristine water has less value than one cubic meter of water that is degraded by chemicals or temperature deviation.
- I suggest the use of quality data on an aquifer wide basis, primarily to monitor for quality changes as another indicator of stresses, effects, sustainability. This obviously requires installation of specific monitoring locations for this purpose, and the monitoring of these points over time. Also some guidance on scale. However, for a highly utilized priority aquifer this would likely be a reasonable cost. On an individual well permit that is not part of a priority area, collection of initial water quality data from the well and some repeat sampling over time may be reasonable. For example, I am aware of some suburban cities that are seeing the quality of the water they pump decline over time as more and more municipalities add pumping wells into a shared aquifer. The types of water quality data the DNR already collects in preparing the County Hydrologic Atlases would be extremely helpful. Age dating, for one.....is the well going to extract old, vintage ground water (which will have to be replaced somehow, either by younger, possibility contaminated groundwater or even older, poorer quality (naturally - hardness, taste, radium, chloride, etc.) groundwater? DNR states that less costly chloride/bromide data can also be used indirectly to assess age.

- We need a plan for documenting MN's ground water in a similar manner to MPCA's new intensive watershed monitoring plan. We need more comprehensive databases of ground water quality.
- I suggest the use of quality data on an aquifer basis primarily to monitor for changes in quality (that are often indicative of flow) over time to assess when use of an aquifer is becoming unsustainable or is resulting in an overall decrease in quality of the water available. The types of water quality data the DNR already collects in preparing the County Hydrologic Atlases is one type of quality data that would be extremely helpful. Age dating, for one.....is the well going to extract old, vintage ground water (which will have to be replaced somehow, either by younger, possibly contaminated groundwater or even older, poorer quality (naturally - hardness, taste, radium, chloride, etc.) groundwater. DNR states that less costly chloride/bromide data can also be used indirectly to assess age. Quality data as well as indications of water level should be monitored at targeted locations in a priority area to look for changes over time. I am suggesting the use of quality data on an aquifer basis primarily to monitor for changes in quality (that are often indicative of flow) over time to assess when use of an aquifer is becoming unsustainable or is resulting in an overall decrease in quality of the water available.
- Water quality is included as one of the important elements of safe yield, per Rules handout. It is also included in the list of factors in the rule to be considered by DNR when taking action on permit applications. However, I do not believe DNR routinely uses such information in making water permitting decisions. (There is the issue of whether this information exists, which in most cases I believe does not). It seems to me the legal framework is adequate on which to develop a more considered policy/procedure for evaluating water use (not that it wouldn't be improved by adding more detail and clarity). That said, the policy/procedures long used by DNR to make water appropriations decisions need to be adjusted to reflect the higher demand on ground water resources which is creating more instances when drawdown/interference/surface water impacts/quality impacts are occurring. To protect surface and ground water resources and avoid the inconvenience and cost of a water shortage, current policy/procedure must be expanded to look past drawdown and interference concerns.
- Three ways that water quality data could be helpful in managing an aquifer and understanding the effects pumping are: 1) providing a baseline characterization of the age and quality of the water that will be allocated. DNR already collects this water quality data for the County Atlases to provide an indication of human influence on water and how recently the ground water has been recharged (read below). For example, the ground water might be 20 yrs old, more than 50 or 100 yrs old, or more than 1000 years old. 2) providing an indication of if, and how much, ground water quality or age is changing with pumping. If it is changing, why? Quality information can provide important clues that may not be discernable with water level information. An example: I am aware of a metro area suburb that has seen the quality of the ground water it pumps decline as it and its neighboring communities, which all pump from the same buried bedrock valley, grow and expand their water use. Last I knew, this community was planning to install a treatment system to reduce the concentrations of iron and manganese in the water. It was presumed that water with a higher dissolved mineral content in the adjacent bedrock aquifer was recharging the buried bedrock valley aquifer and lowering its quality. 3)

providing an indication of flow and water quality changes near important hydrogeologic boundaries that may be impacted by high volume pumping. For example, monitoring wells could be installed to monitor water levels and quality changes near important surface water features or across aquifers.

- For sustainability issue it could be done by gradual elimination of pollution and eventually pollution veto as I described in Survey 2. Polluted water in whatever quantity is not usable and manifests unsustainable supply. Shift toward the water sustainability will take time and the water must be in usable quality. Thus, the only way is the elimination of pollution if our goal is sustainable supply for indefinite period.
- These issues are absolutely linked--again, I suggest a 'triage' approach, with areas of concern identified in models (for example, Dave Mulla's work on atrazine and acetochlor leaching to groundwater) being selected for further monitoring and potential intervention. The same approach could be applied to runoff contamination of surface waters.
- We must take the step of defining quality degradations as the equivalent of removing water from the system.
- There is a great deal of water quality information that has been collected, but cannot be easily accessed. The water quality information from the many remedial investigation reports at the PCA should be put into an electronic database and made more accessible. Met Council and Dakota Co are attempting to do this with plume mapping. We could expand this type of mapping to wellhead protection areas and then state-wide.
- I believe the return of water should be evaluated as part of the decision. That is, what is the ultimate fate of the water withdrawn? Part of this evaluation would be the quality of the return water. Users that return a large portion of the withdrawal water in a high quality state would be considered more favorably. As an example, what percentage of the water pumped for ethanol is returned (discharged) and what is the quality of that water compared to its original quality? How does that compare to a municipal system?
- We first need basic water quality data, no point in attempting to talk about it if we do not know the actual issues. We would then need to determine potential impacts to water quality by water uses and develop the standards that would be used to determine if a water quality issue has been triggered.
- Link the collection and reporting of data on an aquifer basis. Manage the resource more locally with rule making on a state level.

**The MPCA Board requested a framework for evaluating high water-using industries. In Survey #2 we asked you to share your thoughts on a framework: what elements it would contain, how it would be applied, and how it should be maintained. After our discussions in meeting #3, do you have any additional thoughts to offer the project?**

- The framework should make use of existing information and identify areas where information is lacking to inform decisions. As we discussed, the County Atlases, particularly the newer ones, are full of very relevant information, but only a handful of counties have access to this work. There are the County Water Plans which provide a nice set of background information, as well. In cases where critical information is lacking, it would seem reasonable to ask the applicant to expend a certain level of effort/\$ to add to that information for the purposes of making a permit decision and to assess effects over time.

- It is very difficult to answer this question given its breadth, in spite of all the information assembled for focus group participants. There are two points that I think are very very important for the Work Group members to keep in mind as they address this issue in the next few weeks. 1) Our current system for evaluating water allocation permits works pretty well. It is a pretty straightforward process with clear markers for decisions, and has clear requirements for permit applicants. In general, there have been few problems. With the advent of ethanol, increasing population, and the uncertainty of climate change, we want more assurance that we are not draining our aquifers and harming our surface and ground water resources. More assurance requires more data and more evaluation, and takes more time and resources. 2) The new framework to be recommended by the work group will improve our ability to assess the potential effect of a new high volume user on an aquifer and provide (hopefully) a way to monitor potential effects of water use on valued resources. This data will be helpful in making management decisions and understanding the effects that are occurring. It will certainly be a big improvement. But we must caution against providing the impression that there is a surefire way to know whether our water use is sustainable or not. Significant uncertainty will remain.
- I have not participated at this discussion, so I do not know details. However, at the beginning of Survey 2 you asked about framework. In this framework I suggested that the focus should be on conservation and efficiency. The knowledge of sustainable supply could be starting point for evaluation. The comparison of sustainable supply with high-water using industries will provide the framework for evaluation and push industry either out or the industry must have to change toward efficiency and conservation.
- Whatever entity is the user, high or low user, the allocation of use needs to be based on an economic basis to maximize economic return on the use, with constraints that the capital stock not be reduced and maybe with some social constraints to protect those whom do not have economic might. Was there any economist involved in the discussions? I think not. This needs to be rectified, and we need to start to think of this in economic terms.
- Whatever entity is the user, high or low user, the allocation of use needs to be based on an economic basis to maximize economic return on the use, with constraints that the capital stock not be reduced and maybe with some social constraints to protect those whom do not have economic might.
- High water-using industries should always be evaluated in their proper context. For example, if they're situated in parts of the state with lots of water resources and few people, perhaps they don't need extra scrutiny. However, if they fall in one of the 'high concern' areas identified by large-scale analysis, I would suggest that rigorous water management plans be encouraged and implemented. Ideally, this would also be in concert with municipal and other water users taking steps to conserve and recycle water.
- I think the priority areas concept offers a good addition to the framework we discussed where sustainability is threatened and a more precise analysis is warranted.
- 1) Provide funding (equipment and staff) for putting available information in electronic formats and for maintaining databases. 2) Establish criteria for using the existing data to identify geographic areas where existing or increased water demand may adversely affect water resources sustainability. 3) Make sure that government units have the regulatory authority to protect these areas.

- I expect the framework to change as better data and aquifer characterization are completed. The first step is the ability to monitor and recognize the effects of current and newly proposed uses. Even this most basic step is limited by the available mapping and water usage data.
- No

### **Cumulative Potential Effects**

**In analyzing the environmental effects of a proposed project, the RGU must consider the cumulative potential effects as well as the direct effects of the project. To evaluate cumulative potential effects, the RGU should consider whether a proposed project that may not individually have the potential to cause significant environmental effects could have a significant effect when considered along with existing projects, as well as any future projects that have been planned or for which a basis of expectation has been laid.**

**The group has not spent much time discussing cumulative potential effects, but it is a core question to be addressed in the work group charge. How can we better quantify the cumulative potential effects of large water users?**

- This goes back to using the data framework to run future scenarios. We know estimates of future populations. In some cases we know expectations for future incoming industries. We can use the framework to evaluate what a future development scenario would look like.
- To gain a sense of cumulative effects, a model is needed. Modeling can be costly and time consuming, and in some cases it may not yield particularly helpful results. However, models are not all the same. Very simple models can be extremely helpful in resolving questions – it depends upon the particulars. It follows therefore that any requirement for modeling must be flexible and accompanied with clear guidelines for what is needed when. The appropriate choice is dependent upon the level of knowledge about the aquifer system and the types of questions that need to be answered. It might be necessary to gather some data for use in the model. If there are questions about whether one large user will cause significant effects and limit future withdrawals from the aquifer, there is probably sufficient cause to develop a model to evaluate the concern.
- It can only be quantified by the knowledge of water balance characteristics per parcel of land. That is the key! If we know how much on sustainable basis this parcel of land can handle we can compare existing and projected water use and deny the new project the permit if the sustainable supply is not available. Or another way to put it, the industry must be efficient in water use and practice conservation. Here is certainly the economic analysis and pricing of water would be very critical.
- The basis for the assessment is that we need to know what quantity of water can be allocated to all possible users for the present as well into the future. This needs to be established first and foremost. Then the assessment of potential effects from existing and potential users can be examined by comparing the needs of those users against the sustainable amount. Certainly this assessment will be straightforward for a region or area in which the users exist. Additional analysis might be needed if some of the users are close enough to each other to possible cause local

- I don't see how you could do this without modeling. Ideally, a tool would be developed for the RGU to identify whether the activity is in a 'high concern' area, or a 'low concern' area, and this could determine the level of detail required for the evaluation of cumulative effects. A specific timeline for reassessing the water situation every five years or so should be developed, if it's not already. I would suggest a dynamic modeling tool to assist this process.
- We need an information system that includes short and long term sustainability factors, and estimates of system capacities. This would make the reasonable assessment of cumulative potential effects routine. It doesn't have to be scary. It should not have to produce the same rigor of data as one gets from analyzing an aquifer test to add real value to environmental review.
- The basis for the assessment is that we need to know what quantity of water can be allocated to all possible users for the present as well into the future. This needs to be established first and foremost. Then the assessment of potential effects from existing and potential users can be examined by comparing the needs of those users against the sustainable amount. Certainly this assessment will be straightforward for a region or area in which the users exist. Additional analysis might be needed if some of the users are close enough to each other to possibly cause local strains on the water resource.
- A first step seems to be able to know where all the large water users are and to ensure that they are permitted. Permittees should understand that their ability to pump water in the future is not guaranteed and will depend on future economic, social, and environmental needs.
- We must also consider the effects of many small uses. Potential effects (future) must be modeled, as they cannot be measured. Modeling also makes it possible to overcome the long time frames associated with ground water response to change.
- The basis for the assessment is that we need to know what quantity of water can be allocated to all possible users for the present as well into the future. This needs to be established first and foremost. Then the assessment of potential effects from existing and potential users can be examined by comparing the needs of those users against the sustainable amount. Certainly this assessment will be straightforward for a region or area in which the users exist. Additional analysis (such as well interference analysis) might be needed if some of the users are close enough to each other to possibly cause local strains on the water resource.
- We need to understand the systems used by large water users (e.g. understand the hydrogeology) and to have as accurate data we can obtain regarding the users (e.g., pumping rates and water levels). Modeling the cumulative potential effects is only practical when the input data is available and accurate. Otherwise, the predictive ability of the model is limited by the range of estimated values resulting in a model that is only a model of estimated guesses. I cannot stress the importance of obtaining good data and having fundamental tools like aquifers maps and parameters to predict the effects of users.
- Have a better understanding of aquifer/watershed dynamics prior to allowing additional large users to become established. Set up rules to curb/replace existing large uses if additional large users are added to the benefit of the community/state (Marxist water law?).

## Conclusion

### **What are the priority actions and next steps state agencies should address with existing staff, assuming no new funding? What are the priority actions and next steps state agencies should address with additional funding?**

- Define availability and sustainability standards and come up with a method to evaluate these with the resources available
- The state agency should gradually move toward water sustainability paradigm and compile water appropriation in addition to current practice using the new method as per parcel of lands where the information is available. Develop the Water resources sustainability atlas program where state agencies and University of Minnesota are working together. The sustainable supply should be compared with the appropriations and ecological services. Surface water and ground water should be unified. The water sustainability atlas program should be joint effort of all state agencies dealing both with surface and ground water. Ecological services should be a part of the Water Resources sustainability atlas. The program should address water quantity, water quality, ecological services, land use and others. It is premature to have additional funding for agencies. First, it is critical to build the team, then have a pilot project and have results. Only then the question of additional funding must be considered.
- With existing staff: coordinate with ongoing research projects to come up with a scheme for determining the areas of highest concern in Minnesota. Also, rather than distributing resources evenly over the whole state, concentrate them on areas where there is a demonstrated concern over water use (e.g. Ramsey county, central Minnesota irrigation belt). Assist local/regional authorities in coming up with a water management plan. With additional funding: invest more staff and resources in the above.
- We clearly need a "phase 2" to keep the discussions going and evolving as our information and understanding evolves. We also need to engage others outside the work group, beyond the technical expertise we've already tapped. We might want to consider a two-year process with various ad hoc stakeholder groups to refine elements of the framework and to begin to bring together the needed data, information management system, methods, criteria and indicator, and
- With no funding, work will continue as it is currently, with staff making the best decisions they can. With additional funding, staff will have access to more information for making better-informed decisions.
- It is my intention to undertake the activities that my agency can best supply in a prioritized fashion. These activities don't change with funding levels, only the rate at which they are accomplished changes. My priority is to define aquifer boundaries and properties and relate these aquifers to the wells that withdraw water from them (geologic mapping, CWI development). This enables meaningful monitoring of water levels, water quality, and aquifer usage. Permits should be modified or rescinded based on outcomes. The next step is to construct models that allow simulation of the effects of proposed uses.
- I will not separate this out by what funding is available or not. - establish maps of water resource sustainability for the entire state down to the scale of counties, and even to smaller scale when higher resolution water resource data are developed. - develop an economic model for quantifying the economic value of the water resource. This

economic model should be able to put economic value on water and ecological services. Developed a decision support system for allocation of sustainable supply between potential human and ecological needs; this system should be economic with built-in constraints to protect the economically disadvantaged (human and ecological?). - develop relations for water resource needs of all ecological services. - develop assessments of the impact of potential climate changes on future water resources.

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- Existing staff should continue to manage the current programs and data collection efforts with no new funding. Additional funding should be prioritized on basic data needs in areas of most likely increasing water demand and usage.
- Compile existing data on an aquifer basis and determine data gaps. Map aquifer boundaries, fill in the data gap. Aquifer modeling for sensitivity and determine sustainability.

**What key bullet items would you like to see in the Executive Summary? That is, what three things are most important to include in responding to the EQB charge?**

- Define availability, define sustainability, come up with a method to evaluate them on a spatial basis
- 1. To succeed, this will need continued commitment from the state and strong interagency leadership and funding. 2. A policy and data framework is possible and can be accomplished in the short-term. We don't need to wait for all the answers to develop and implement a system/framework for informing part of decision making and planning. 3. Water sustainability needs dedicated funding for research and monitoring.
- 1. Information need on water resources sustainability at a multi-scale 2. Building an integrative team that involve physical science- social science- economic science on water resources sustainability 3. Initiating water resources sustainability program with state agencies and University
- --Need for regional prioritization. --Need for assessment of cumulative impacts --Need for tying modeling to monitoring to management (it seems to me that these efforts are currently disjointed)
- First, we must make sustainability the basis of our response. We should use the two-tiered definition suggested in the background paper for element 3b. This should also explicitly incorporate water quality, water quantity and ecosystem-needs factors. Second, we should argue for a basic shift from reactive management to prospective management. This will require the use of the best estimates we can muster with existing information, but provide for their refinement as decisions are made at all levels of government and at all scales (temporal, as well as spatial) of concern. Third, we should lay out a strategy for

refining the framework and institutionalizing it over a specified time frame. The strategy should include priorities for the collection of data on all aspects and scales of sustainability; development of the information system necessary to store, organize, present and aid in the routine analysis and application of this information; amendments to the legal guidance, authorities and procedures of the state and various agencies and levels of government; the use of indicators; the use of priority sustainability management zones; and a built-in evaluation function.

- Decisions can only be as good as the information on which they are based. Available information should be more accessible. There should be funding to support putting the current, available data into electronic formats and for sharing and maintaining the data. Additional funding will be necessary to characterize site-specific water resource conditions. Establish criteria and then identify priority areas. Provide regulatory authority for managing the priority areas.
- Data gathering- aquifer mapping, aquifer properties, hydrologic characterization. Monitoring- based on better resolution of aquifer boundaries. Model development- enable simulation of the effects of proposed uses.
- The emphasis on the need to: - developing maps of the sustainable resource at various scales - developing functions that quantify the water resource requirements for ecological services - developing an economic model for allocation of sustainable water resource between competing users.
- Basic data is of utmost importance in managing our water resources. We do not have the data or resources (personnel and budgets) to adequately manage water resources.
- All industry, including agriculture have an impact on aquifer resources. Ethanol is not unique. A large database for evaluating aquifer resources exists, the data is not (to my knowledge) compiled and readily available. Groundwater/surface water systems are integratable and nonpolitical. They need to be defined and managed on that basis.

**In responding to the charge, we can propose recommendations to address today's decision-making needs, as well as propose a plan for moving forward. What do you propose we can say or recommend now for evaluating the impacts of high water-using industries? What do you recommend we suggest as mid-term and long-term strategies to establish a broad framework to answer questions about water sustainability and the impacts of high water-using industries?**

- Define availability, define sustainability, come up with a method to evaluate them
- Now we can use only a rough estimate that EQB done. About the broad framework please see Survey 2: in short information motivation -capacity. The intelligent response to the charge requires all three, but it must start with information.
- High water-using industries: Scrutiny of their activities should be proportional to the vulnerability of the area they intend to enter. Keep in mind that there is little/no \*economic\* incentive for industries (or individuals) to conserve water in most cases. Should we consider a 'water credit' scheme similar to 'carbon credits'? The critical thing to keep in mind around long-term strategy is that it should be adaptive, rather than fixed. Energy production, climate change, and water use are evolving so rapidly in Minnesota that any strategy or framework developed today will probably be outdated in 10 years. The state needs a mechanism for reevaluating its water management periodically. Mid-

term, the state might consider some of the actions described above (making an effort to 'triage' regions of the state and develop more in-depth monitoring and planning where water resources are scarce). I do think the high-water-use industries are justified in asking that water conservation be considered holistically. Citizens and municipalities may need to conserve water as well.

- We should both work with the information we have now, and identify the improvements we need in information, tools and standards to operationalize "sustainability."
- Use modeling where possible, permit without modeling if it is not feasible, monitor in all cases, make the ultimate fate of the water part of the consideration.
- For the present we need to recommend that the industries cannot use more water than what is estimated to be available, and in fact I would say we need to build a factor of safety into that so that we say that only some fraction of what is estimated to be sustainable can be allocated. That fraction might be 0.90, 0.80, etc. In the mid-term and long-term we need to work on developing the information for allowing the planning, and we need to develop the tools for making the decision of how to allocate sustainable water supply.
- We do not have the means to evaluate the impacts of high water-using industries and can only estimate the impacts of these uses. Mid-term strategies should focus on critical areas and the users located in those critical areas (e.g., ethanol users in buried unconsolidated aquifers in western MN or all users along the Mississippi River north of and including the Twin Cities. Long-term strategies should focus on developing a more comprehensive understanding of the water resources in areas with high water using industries.
- All industry has equal right to water. No industry has the right to permanently degrade that resource on a quantity/quality basis or interfere with the rights of other parties to utilize the resource now or in the future. The industry can operate if they can demonstrate they can comply with these restraints. Mid-term: Prioritize aquifers in the state based on current knowledge of their susceptibility and use. Refine the databases on these aquifers to validate their status and apply special conditions for their use based on this knowledge. Long-term: Establish mapping programs for aquifers state-wide. Prioritize their use similar to surface water classifications. Set up conservation credits (similar to wetland credits) for industries that conserve water.

**Please use this final box to outline any of your remaining thoughts, comments or suggestions.**

- I have run out of time. If still open tomorrow I may continue.
- I was pleased to participate in this process. Still, the volume of information provided and the questions asked are very comprehensive and most required more thought than I was able to give them. Thanks for the opportunity.
- Whereas it was once axiomatic that economic growth would continue indefinitely, questions of sustainability now becoming a grand challenge. Policymakers need to figure out how address this challenge and science and technology are the keys to provide the information needed to meet this challenge. The widespread thinking that we can use old framework of rules and standards and the old information is in error. To address the problem of sustainability in general, and water resources sustainability in particular, requires teams that are interdisciplinary, intersectoral, integrative, and intergenerational

(as the problems are). That proposition of integrative cross-disciplinarity is a prerequisite to address the challenge of water resources sustainability.

- Our team at the U. (Sangwon, Yiwen, and myself) would be happy to work with EQB and state water modelers from various agencies to develop appropriate tools for water monitoring and management.
- This is just the beginning of what should be a multi-year effort.
- It is interesting to look at the MDH Water and Wells Focus Group Report to see if the EQB work group's recommendations are consistent with the recommendations of that group. Since it appears that the County Well Index (CWI) is important to both technical groups, funding for maintaining, improving the CWI, and making the information more accessible should be a high priority.
- Overall we need to change the way in which water resources are assessed and the way in which those resources are used or allocated for use. First, we cannot continue to use what is available, but we need to use what is sustainable. And the use of what is sustainable would be use by humans as well as by ecological services. We need to take seriously what are the needs of the ecological services and we need to give true value to those services. The only practical way to make the assessments of how to allocate water is to put economic value onto water as a commodity, and to maximize the return on the capital stock. All of this will require that there is input from a coalition of persons with expertise in the physical (including chemical), biological, social (including economic), legal, and political disciplines. The time is now to work on this; let us not relax under the false impression that everything is okay. The earth is under too much strain already.
- This is a start and should not be the end. This dialogue must continue. I have arrived at this point with more questions than answers, more concerns than certainty, and more half-baked ideas than concrete recommendations than I had at the onset. I have been asking myself questions that I have not asked in the years I have been working in groundwater. My conclusion is this must continue and I would welcome the opportunity to continue my involvement. This last month I have not had the time I would liked to have had to respond to your questions and believe I have not provided the attention this deserves (doing this in the winter is better than the spring and summer). Thank you for the opportunity to respond, I'll be watching this effort.