MINUTES OF THE
WAFFLE AGENCY ADVISORY BOARD MEETING
The Fort Garry Hotel, Winnipeg
January 15, 2003

ACTIVITIES SINCE THE LAST MEETING

First of all, under Proof of Concept, which is technically our Task 1 activity, we have continued to work on the identification of storage areas. We are currently focusing on fields and raised roads and trying to determine the methodology for calculating volumes in those fields.

□ **Methodology for Calculating Storage Volumes**

We believe we will be able to identify a method or a program in GIS that will automatically identify storage section volumes, based on the elevation of the roads and road intersections and using USGS data.

□ **What Is KLJ Doing?**

In addition, Kadrmas, Lee & Jackson (KLJ) would be surveying a couple of 6-mile sections for us. One is located in the Red River Valley area, and then another section that we are doing is the high land. We hope to get an idea of ditch volume and what it is going to take to do any surveying needed for Year 2. But right now, we do not have any idea how to calculate ditch volumes.

□ **Distributed Storage Volume**

Based on some of the modeling work of our modeler, Xixi Wang, using existing models—where he determined how much water was used and stored upstream of two points along the Red River—to have prevented major flooding in the 1997, Heith has taken those volumes and used GIS, then divided the volume over the land area and eliminated roads, lakes, rivers, towns, anything where you would not be able to store water. Some of the initial preliminary calculations that he came up with show that in some areas, only 1 inch of water or less distributed—1 inch of water per square mile—might have made a difference in the 1997 flood. Now granted, you are not going to get storage in every area, but if you had one out of 12 sections storing 12 inches of water, then I think it could be feasible. So those numbers are promising. I know the lowest number that we got was 0.3 inches per square mile and the highest which was up around the Red Lake Watershed at 1.9 inches. So, even there, with the large volume of water that comes out of the Red Lake River, it appears as though we are not talking about storing an insurmountable volume of water. And, of course, that was for the 1997 flood, and those are still preliminary calculations based upon the existing models. These are not our final numbers, but initially the results are promising. And we are not talking about storing floodwater on each section.

□ **Data Collection**

In your packets, there are a couple of articles. One article is by Andrew Manale of the EPA Environmental Economics Division. He has supposedly done some work at Devils Lake looking

at modeling or helping to model at Devils Lake back in 1996. In his paper, he investigates retention reimbursement scenarios for landowners. So while we are approaching it from the technical feasibility perspective, he is dealing with the economic feasibility of this type of study. On contacting him, we also found out that he had done a study of determining how potential storage areas in the Wild Rice might be identified, which is a subbasin we are focusing on as our first conceptual area. We learned that he is very interested in furthering his studies in this capacity and will be working with us on that aspect. To the best of our knowledge, this study has not been published yet. In addition, he mentioned that he was familiar with some potential studies or potential areas in Europe where the Waffle approach may have already been implemented. He is going to get us some information on that.

□ **Elevation Data**

We have also been investigating LIDAR (light detention and ranging); it is a methodology for collecting very detailed elevation data, down to resolutions of 6 centimeters. It is very accurate but also very expensive. I know, ideally, it would be nice to have LIDAR for the entire Red River Basin, but it would cost a lot of money. I know it has gone down in price a little bit, but I know it generally costs about $1000 per square mile. With 40,000 miles in the Red River Basin, it would cost $40,000,000, so we decided to compare LIDAR versus the free USGS data that are out there and the national elevation data set to see, if we use the existing free data, how they compare to LIDAR and whether there is any way we could get by using the free data. There have been a few areas around Wahpeton, Fargo, Pembina, and also the Sheyenne River Valley that have been surveyed using LIDAR, so Heith took those areas and compared the elevation data for each pixel to see what the difference was (I will pass these around). I did not make handouts because, again, we do not want to distribute this publicly just yet. However, what he found basically is that in most of the areas, at least 70% of the values were within that of the free data values—within 1 meter agreement to the very detailed LIDAR data. It is a lot for the flat area, but we found that most of the errors occurred in river valleys. The LIDAR does not get a return off of water. It is like a dead zone, so it does not even get a return value.

Basically, what we want to see is whether there is some type of commonality between the NED and LIDAR data being off at a certain point. We can look at Fargo, Devils Lake, Pembina, the Sheyenne River, the Wahpeton data—those are some pretty different areas with a lot of different topography and some of the same. If we can find a commonality between all of them, we should be able to use the NED data with some success.

About 40%–50% of those values were within half a meter agreement. Granted, it would not be a perfect estimate if we used those values to determine volume, but considering it is free, right now we think that might be good for a start. Especially if—well it is more a question of when—we develop a program that will do it automatically for us—go through and calculate these volumes.

- What is important here is not absolute elevations but relative elevations, and there are different types of errors that you can have that would be more influential than others. I am concerned that when you are looking at a storage problem that involves inches—inches to a quarter cell—we are looking at elevation differences in our method, measurement of a

meter, that the scale of what we are having is being optimistic. If, hypothetically, you were to find that we were having a 1- meter problem with absolute elevations, however, that it was much less with relative elevations, I think that your problem would be pretty well solved. I would just suggest that that is one thing to look at, because how can you simulate this?

Many of you know that the elevation data set that is put out by USGS for this project area has a pretty significant error bar, and that is associated with the absolute elevation. The relative elevation, one fits all one cell to the next, is, most of the time, less than that virtual error. Case in point, discussing this with somebody who is doing an IFSAR (Interferometric Synthetic Aperture Radar), a radar collected elevation data project in southern California, their absolute error was just under a meter. To do some testing, part of this area that they were surveying included a number of airports. They did cross sections down the runway using their collected information, which is supposedly going to contain this error and expecting to see this random distribution of hills down the runway that is flat, and when compared to absolute elevation, yes, the error shows up. You remove that and look at relative error, 1 pixel to the next, the runway in the digital expression of it, was just as flat as it is standing out there. So, looking at it maybe using the data for the hydrology in needing to know over a broader area the more precise elevation changes, the NED data might not be adequate, but looking within a smaller region and looking at the relative error from place to place, we are hoping that doing an analysis like we are doing now with the LIDAR and the NED we can come up with a fudge factor, how far off the NED data may be. And when we go out and do this across the whole basin, we are not going to be able to come down to some decimal point on the acres we need to store this on. There has got to be a pretty substantial error bar; if this analysis can assist in developing that error bar, that would be great. So if, hydrologically, in a model you only need 10,050 feet, then landwise, you are going to need plus or minus, or probably on the plus side, a number of percentage points higher than that. We are hoping that this study can help us with the extent of that error bar which would mean more storage potential.

- A couple more points on that came to mind as you were speaking. If the error is randomly distributed, either to the plus or to the minus, then the horizontal or aerial scale can offset.

- So with a little bit of modeling, again just looking at different sample sizes in different areas, you should be able to, if it is not being random, be able to find a unit that is workable.

There is a difference that does show up greater in the river areas. Based on the cell size, the USGS data are approximately 100 feet by 100 feet. It will not pick up the change in slopes when you get to the river valley area, so there is a relationship, and between the slope of the land and the amount of error that shows up in a study like this. One thing we do not have is LIDAR collected outside of the lake plain to look at what type of error associations we are going to see, like in the Page area of North Dakota. You get above the beach ridges and closer to the pothole region and you have a lot of variations in the slope of the land. If there was LIDAR collected from there, you could compare it to, say, the USGS National Elevation Dataset. Would you have the correlation percentage less than a meter or under a half meter like you see in the valley

floor? A hundred feet by a hundred feet in some areas cannot take up that drop. These data here are 5 meters by 5 meters in size, so it could very well pick up the changes in slope and go down to the stream valleys. But, other than having a lot of money to spend, there has to be the best approach to what is available. Apparently there are some IFSAR data that are available for Pembina Valley. We would like to be able to get a hold of them and do the same thing, since it is a fraction of the cost of the LIDAR data.

With respect to a comparison between LIDAR and IFSAR, I heavily quizzed one of the guys from the Aerospace Data Center of South Dakota. I actually got him interested in seeing if he could make his data work this way, so hopefully I planted the seed so he can have some of his guys give us a hand with this. He thought there may be something we could do with the dataset that is available. Certainly better than the old data that were integer values in whole meters, which certainly would not have been in any way usable. But the more recent stuff does have a decimal point value back in the information.

LIDAR also gives the response in conjunction with or in contrast to the IFSAR data. The IFSAR data do not work well in areas that are heavily affected by vegetation, whereas the LIDAR data works around that. We have a large collection of IFSAR data in an area that is going to have a sort of canopy over it. The data values will have to be extrapolated underneath the canopy to get true volume estimates, but luckily most of the forests in North Dakota have been removed (general laughter). It will not probably be a huge issue if IFSAR data were to be the tool of choice.

- Was this just a demonstration?

No, the project in Cal that I talked to that fellow about, they are doing a riparian assessment project, and they are using IFSAR for their large data collection. From the numbers I have seen, that is like half the cost of LIDAR or less. And if the instruments are correctly adjusted, IFSAR is very good at water detection. Not only the surface water, but there are correlation estimates on using it to determine soil moisture also. Maybe there would be some by products from IFSAR data collected over certain areas.

□ **Constructing a Database**

We are also in the process of constructing a database as a repository for our data. Everything we collected is not necessarily going to be stored there, but this database will allow us to do queries by watershed, by county, and by type of data, such as elevation data or soil data. We will give the location of the data, and at some point we would like to make it available on the Web, so that if somebody wants to come in and look up all the data for the Maple River Watershed, then they can do that by watershed and see what is available. Or if they wanted to look up all the areas that had soil data, they could do that. That is in the process of being constructed. Right now, we are designing it more as an internal tool, to let us know where the data are. At some point, we will probably work with the RRBDIN since they are the ones that are set up for the role of distributing information.

□ **Public Outreach**

□ **Watershed Districts**

We are in the process of meetings with the Watershed Districts in Minnesota; we have met with four of them to date. So far, their attitude has been pretty open about the project. I was surprised because I know there have been a lot of comments from the North Dakota water resource boards, and I expected a similar attitude in Minnesota. So far, they have been fairly neutral, but the purpose of meeting with them—and we will be meeting with the water resource districts in North Dakota—is to let them know what we are doing specifically related to the subbasin modeling effort, to see what they would like to see in a model, and to see what would be of the most use to them. Basically, we are learning their concerns and the questions that they might have regarding the project, not just related to modeling. We are going out and trying to make sure that we develop a product that has the most use for them.

□ **Meetings with Other Water-Related Groups**

We have not met with any of the water resource boards yet. We are scheduling those meetings, and Lynette did speak at the North Dakota Association of Water Resource Board's annual meeting a couple of months ago. In addition, we have been to a couple of area meetings. The Red River Basin Commission had a modeling kickoff meeting to discuss the modeling efforts that it is doing. We are going to work to make sure that we are not duplicating efforts with the Red River Basin Commission. They also had a meeting to discuss a collaborative effort to obtain detailed elevation data. They are looking at LIDAR collection and are trying to get everybody in the Red River Basin to join efforts so they can get funding

□ **Citizen's Advisory Board Meeting**

We had our first Citizen's Advisory Board Meeting. We have fourteen members on the Board The meeting went very well, almost too well. We did not get a lot of constructive criticism from them, and I am not sure if that was because it was the first meeting and they did not want to speak out. The next meeting of that group will probably be in about two to three months. They also agreed that they would like to meet more frequently than what we had initially planned. That is good, and as long as they are willing to put in the time, then we are happy to accommodate that.

□ **The Conceptual Model and the Demonstration**

Xixi has developed the conceptual model for the project, and right now, preliminarily, for the subbasin model, he has been looking at using SWAT (Soil and Water Assessment Tool). That model incorporates land use, soil types, and tillage practices, so it would allow us to look in really great detail at some of the factors that may contribute to or affect our storage scenario; so, initially, this is very promising. In order to help develop the conceptual model for the subbasins, he is right now just playing around with the Minnesota Wild Rice Watershed; previously that watershed was divided into 50 hydrologic units, e.g., 50 subbasins within that watershed. Based on land use and soil type in the Wild Rice Watershed, Xixi has now divided it into 600 units. The detail of this model would be a lot greater than what was previously available.

- The term "conceptual model" implies a broad scope model; this is not detailed, you are not looking at crop effects. You are looking in a general way, is that correct?

Correct. We are not actually utilizing the model yet. We are designing how we want our model to look, how we would partition the model.

He has also done that for the entire modeling effort. Ultimately, at the end of the project, we would take all of those subbasins, and based on the hydrologic models that we have used, generate a hydrograph that we would use as input into a hydrologic model which then computes water surface elevations and flows. So, ideally, at the end of the day, all these subbasin models would be tied together with the main submodel into one comprehensive model that would allow us to look at small-scale storage and trace the effects of that all the way back.

Year 1 was slated for broad activities; hence, our focus on that. Definitely, we had planned in the Year 2 effort to pick two subbasins. Right now, since we have been looking at the Wild Rice Watershed to develop the conceptual model, that would be one of the test subbasins. We have also mentioned the Maple River Watershed on the North Dakota side, which we have considered using as an example. But we have not selected a second test subbasin. We will go out to look in more detail at the data, such as culvert data, and things that we will need to collect for that.

We plan to conduct a demonstration where we are going out and actually having someone store water on their land and look at differences, comparing our test plot to existing plots in terms of crop yield and soil moisture. For the demonstration aspects of the project, Ed Steadman, who is no longer working in Grand Forks as an Associate Director but has moved to Pennsylvania and is now a Senior Research Advisor for the EERC, is going to be putting together the plan for a demonstration and also looking into the agricultural economics and what we would need to evaluate. Down the road, I think the whole demonstration of the project would probably have to be coordinated with NDSU to get some input from them. To be honest, that is the least clear aspect of the project right now. I think one of the most important, but probably the least clear, just because it was slated for much later in the project.

□ **Agronomic**

- I sent Beth a memorandum on the agronomics, and I see with Manale that this is an important step in the right direction. You are looking at the compensation aspects of it and at the potential damage. I think some of the initial thinking on the thing was that it was likely to be a "win—win" because of water gains by farmers. My personal opinion is that it is very unlikely that will be the case. The Red River Valley has a situation that is rather specific and unique. We have very, very high-clay soils. The warming aspects of the soils are so critical, to get things rolling and moving and in many of these areas, if you did flood a person's land for a period of time, you are virtually looking at taking them out of production. Several aspects that I think you need to consider are that not only are we taking them out of production, we are taking high-value crops out of production. We are not taking only wheat, but a lot of times sugar beets, potatoes, and other things of that nature. Now Ed is looking at this, and you are starting to look at that part of it, but I would urge

you, as you do this, to make sure that you avail yourself of the experts in the field. This is not something that should be modeled by a hydrologist. We have some agricultural economists at North Dakota State University. Jim Leach has worked with these things a lot. I do not know if he is involved with this at all. But there is a tremendous amount of research that has been done over the years that relate to tillage effects, warming of the soils, drying of soils, and temperatures. There is a whole massive body of literature on this issue. Engage the agricultural economists at North Dakota State University immediately and plan on a subcomponent of your study that just involves that. It would be the specific problems of the Red River and how it is related to agriculture. The second aspect of this, which I think you are going to have to look at, is not only the compensation of the farmers, but when you look at your economic analysis, you have to also consider the trickle-down effects in the towns, the communities, the implement dealers, the fertilizer people, everybody.

Absolutely. We never intended to conduct any of the economic analysis ourselves. I would not want to personally. That would be very difficult, and obviously, especially in that field, it is going to require experience and knowledge in that area.

In terms of the effects to agriculture, that is going to vary so much depending on where you are in the basin. In the Red River Valley, you have a high clay content and poor drainage. I think as you start to get out of the valley and you get to the sandier soils, the effects are going to be vastly different.

- Although the number of sandy areas is small relative to the clay, and also, even there, being familiar with Larimore and doing some work on the old valley aquifer, even there we have drain ditches everywhere. I have seen, not only in 1997 but in other years as well, they are running around on their tractors trying to open up temporary drainage ditches to help move the water off the other drainage ditches. There is a very extensive network of county drains there. I believe that much of the water table, even in those areas, right now is 3 or 4 feet from the surface.

- Yes. It is surprising that even in some of these sandy areas, when there is a wet cycle as we are in now, the water tables tend to rise, even in the sands. So I think there would be substantial parts in even that area. I know that up north in Northhome, I stopped in at a house, and they were pumping water out of the basement onto the road.

Along those same lines, it was suggested at our last meeting that we evaluate storage spread based on land productivity or to focus on land that is not so productive or in areas that are state land or CRP. That is something that, using GIS, would certainly be easy enough to determine—where the productive areas are.

- That is the sort of thing you can do. Another aspect of the thing is in the planning process. For example, you may find that it is a very expensive thing, and there is a great deal lost, but if you are only looking for the catastrophic flood, if your plan is laid out so that you are not reacting to a lower mid-level loss. What we have here is an urban vs. rural loss; that is

basically what we are balancing off. If we have a relatively high urban loss threshold as our transference point where we start to ship this back to them, then I think it would be the cost of the 1997 flood that would justify large expenditures; the cost of many would not. I cannot say that because I do not know the economics. I do not know the facts. The other aspect of it, and I really want to stress this because we see this up in the Devils Lake area, is the rural/urban conflict. It is a sociological aspect, and I hope we don't see it here. What we see up there is an accusatory stance of urban areas to rural areas for draining, potential lawsuits back and forth. One speaker standing up on a platform claiming that you should never drain anything, because his house flooded in Grand Forks, but if some people had drained a little less upstream, and then somebody said, "Why don't you get your blankety-blank house out of the floodplain." You know, we have been arguing about people not building in the floodplain and floodplain management, so that we do not have these things, and on the other hand, we are telling him not to drain it. I think that everybody should have a reasonable right to protect their property. So, I guess my main point here is, as you are going forward with this, try to avoid that sort of conflict, pitting rural versus urban. There are valid concerns on both ends, and you need to really find a balance.

Some people near the Red River or near some of the tributaries will consistently get flooded year after year. So from that perspective, it is difficult to say or not to say that, sure, the urban areas would potentially benefit financially.

Right. I think if anything, I agree it is important to be careful to stress that we are not just focusing on the towns or the cities. I think that one of the problems that might come up is the downstream versus upstream. I know the Wild Rice/Minnesota Wild Rice Watershed District is having a problem. It is the East and the West and the people downstream, not just Ada, but some of the landowners that are consistently being flooded are very resentful of people upstream that release the water or are not storing water. The people upstream figure they do not have a problem, you know, they want to get that water off their land as soon as possible, especially during the summer. I know they are really divided there.

Out of curiosity, if there is a program that is willing to provide some incentives for farmers to get into the Waffle-type concept, like the CRP, and they are willing to, say, guarantee that even if farmers get in their crops later than they had originally planned, so that they end up getting maybe 60%–70% yield, rather than whatever they were previously getting, that could be the aspect that they are paid for, it would be that percentage where they do not benefit. That may be a win—win situation, because the farmers are then almost guaranteed that they would get paid more of their expected yield.

- As a farmer, when I got in early in the field this past spring, I had a 58-bushel wheat crop and made money on that wheat. The later I got in, the more I lost money. That has always been the case, year after year.

- There are so many factors. The cooling effect—just by keeping it cool, there is an exponential effect on the root growth of crops. There is timing, for example, when Gary

has a wheat crop, and if you get past a certain point in the season and it gets hot, it hurts the crop yield. There are all kinds of physiological things that enter into it. You have to go all into the season that certain wheats come in. For example, if you are in the cool part of the season, you get foxtails all over the place or some other weeds.

- A lot of effort could probably be reduced if you looked at soil capabilities and production first and used that as a qualifier to what areas ought to be studied further for elevations, because in all actuality, at least from our agency perspective, the biggest limiting factor to storage is going to be soil capability. I would not go into a huge elevation study on the whole watershed until I had looked at soils and production first. Use that as your first main layer, and then continue on, because there are some key factors that need to be considered.

- Then figure out from those soils the capability to store water physically with respect to roads and culverts or dams. The other thing that I have difficulty with is, there is upstream storage, off-stream storage, and within-stream storage, but, to me, any water that gets into the Red River Valley is already floodwater. Regardless of where it is, it is already floodwater. I think the major focus ought to be on upstream storage, and the second focus on off-stream storage.

- If you take a look there are 11 dams on the Tongue River, the impacts upon agricultural production are limited. Environmentally, there is a little bit more of an impact, but the recreational impacts are high. We are trying to renovate a dam out there, and the biggest factor in renovating the dam, because it is a high-hazard dam, is recreation. They are all over us on recreation value. There is very little focus on discussing agricultural production and environmental concerns; we are also looking at sediment and water quality. Those upstream storages, I think, are probably where I would focus first.

I agree. I think the upstream areas are going to be the key.

□ **Infrastructure Issues**

□ **Roads**

We are talking about using the existing roads that are elevated. We would not be raising the road. We would be using raised roads relative to the fields. Some people may have roads going down the section line, but they are not necessarily elevated.

- And some of those roads are not constructed to hold water.

That has been a big issue that has come up time and time again. It is difficult, I know Lynette has been trying to find information on how roads might be affected by flood waters. We have not found any studies that have been done on this issue as yet. But if you are topping the road, you are going to get problems that create washouts. A lot of those washouts that occur, the water is not controlled, there is no control, so it just washes out and you get one washout and water flows through. It is probably advisable to stay 2 feet below the road surface.

- **Culverts and Drainage Issues**
  - When runoff comes, it comes whether it is spring, summer, or fall. How are you going to create a system that only hydrates in the spring of the year and stores water on Gary's land, that now it is summer. How can you physically do that?

Well, I guess maybe I do not understand. What is the difference between having an open culvert or a gated, closed culvert? How does it affect how the water normally runs?

- But how can you physically manage the spring and not have any flooding in the summer on that land?

- Closed in the spring, open in the summer

- It is not that simple. In Grand Forks County, we have one guy who has the gates up, then they are down, they are up, then they are down. How do you control them? Are you going to have the Sheriff go out? It is impossible.

- It is done all the time in the West with irrigation projects. You have a drainage district or a water management district that has a centralized and highly informed system of gating and you basically have a staff and a structure to do this. But, I think an interesting aspect of your point is that you just cannot think of this in terms of the spring only. According to Osborne, one of the largest potential flood scenarios for the Red River Valley is the June flood. So you cannot discount late floods either.

I know the flooding that occurred in Ada caused two major flooding events this summer that were twice the volume that they got in 1997. So for them this was a much more devastating flood than 1997.

I think there is a very unique set of circumstances that results in the springtime flooding. As you all know, the variables that are involved there are numerous. We have to get a hold and get a better understanding of that. We are not saying that our study cannot contribute to a better understanding of a summertime flood, and in addition to that, I mean, the database that we are going to collect is going to enable us to understand summertime events even more, but at this stage, the focus is on the springtime. We do think that whatever we learn will contribute, and we may be able to help in the summertime event. Right now, we do have to place some limits on our study, and right now that is governed by the focus on the springtime events.

- Yes. When you talk about storing water on fields, you are not going to do that in summertime. A summer flood affects the farmer, so you have to look at different types of storage for the upstream. You have to have a much broader scope.

Right. In addition to that, we are providing a tool that can be utilized by the community and the policymakers, and it will be up to them what aspects of this they want to implement. Regardless of whether they use the Waffle-type approach in the summertime or at anytime, it

does provide a database and models that can be utilized to do whatever, even structural activity if they want.

Nobody can say right now that they have the Waffle because it is not controlled in any area. There is no planning in terms of the release for the water or who is going to store what where or what the effects are going to be. It is being stored, but that is not what we are proposing to do with this.

- I think somebody asked a question on the concept of where you put the storage. There are three parts to our watershed. You have the uplands, generally wetlands and flatter ground, a bunch of potholes. Then you have your slope. This cannot work on the slope, because there is too much slope. There are areas you have 20, 30, 40 feet in a mile. You cannot control that water, I do not care how good you built the road up. You cannot build it high enough; you are not going to control it. That is the beginning of the uncontrolled. By the time it gets to the bottom of the valley, it is all stored anyway, behind roads and outside the river. You have got to decide where in this system you are. It is not going to work on the bottom, because you have already got it flooded. It is not going to work on the side, because you physically cannot do it, because your topography is too steep, so you are left on top. I challenge you that the top water is not causing the flood on the bottom.

Where is the water on the bottom coming from? I mean eventually it all contributes.

- I understand, but it is a timing factor. I can tell you that land up on top is not on the bottom at the peak of the flood on the bottom. It is still up on top or trying to get through the middle. By and large, it is the middle water that is causing the flood on the bottom.

If it is too sloped, you cannot store it, but if you look at some of those areas of beach ridges, you will have your slope area, then behind that you have areas that are relatively flat and then you may get another beach ridge; go up another beach ridge which is pretty sloped. There could be areas, you are right, in general, that middle area probably may not have as much storage, but I would not eliminate it completely, because there might be storage areas within that area.

- I think you have to get into a test area and demonstrate and let the models try to tell you.

You see, initially, just to get an idea, we need to determine whether its even worth pursuing any further. By storing water, can we even make a dent in any of the major floods. I agree that now is the time to get down to the subbasin and the basin scale.

- Also, we need to see a demonstration in a model, not on the ground, on paper, physically bring something in and say this is what has to be done. This watershed, this culvert needs a gate, this culvert needs to be removed, this one needs to be made bigger.

See, you have to develop the model to do that.

- Another concern I keep having with the design of this thing is, what are you going to design it for? A 5-year flood, a 10-year flood, a 50-year flood, a hundred-year flood? The

answer to that question is going to dictate a lot of other things. What are you designing, what are you trying to prevent? The bigger the flood is, the more impractical it is. If you do design it for large floods, how will you address smaller floods?

We would be evaluating the large floods. I could say a hundred-year flood, I guess. With, say, a 500-year flood, we do not have 500 years worth of recorded data. What is a 500-year flood? You could get potentially a 500-year flood every hundred years. We have not collected enough flow data on rivers, flood data, to determine frequencies of floods. We are concerned with large volumes, such as occurred during the 1997 flood, the 1950 flood, and above and beyond 1997. If the people that implement this want to use it during smaller floods and look at the effects of storage during smaller flood events, that is fine. However, we are designing this for large floods.

- With this concept, you know, you have so much volume behind this structure, and if you are going for the catastrophic event, you had better have a damn big hole through that road, because you have a limit, the storage is capped. You are going to have to go in and make every culvert bigger to allow some water out because you are not going to find this scenario unless you are at the top of the watershed. You are not going to have enough storage to store all the water coming out of that section. As soon as you start to pull a couple sections together, now you have more water than that section can handle. You have to let some water out.

- The perfectly sized culvert for flood control is the one that just gets to the top of the road and does not spill. For that flood that was perfect, because you maximized the storage by letting enough water out. That is where I come back to you. You have to pick a standard that you are going to design the system to. That is where I come up with the frequency, call it what you want. You have to set a standard at which you are going to let the thing fall or make it work for you. If the standard is too low, it is not going to store water, and if the standard is too high, you are going to let more water out during your intermediate floods to try to micromanage the water.

- The concept in my mind is not nearly as complicated as I fear you are making it. The concept in my mind is that we already have culverts through those fields, through those roadways. They may or may not be sized right, but hopefully they have been sized right in Manitoba's case for summer rainfall events. What if we just put a gate on, whatever that thing is sized, that just holds the water that is standing there, that we see early in the flood. Just keep it standing there until the flood peak is gone, and then let that water out. That is not nearly as complicated. Just put a simple little gate on there so that the water does not go out until some later time. Now to me, that is a lot simpler than even thinking in terms of frequencies. You do not have to think in terms of frequencies.

We will have a better idea once we develop our subbasin model.

- Basically, I think the system only works when it is in parallel. It is just a theory that a failure cascades to the next failure and creates a failure all the way downstream.

- Somehow you have to find the prime place to store, as far as I am concerned, it is the fields or lands that do not have water flowing in, that are not connected to the current drainage systems.

- Look at the hassles township officers, county commissioners, and water boards have to put in a pipe, just a pipe, much less a whole series—well, we have to put a pipe here now, so they cannot put it there, and now this side is not big enough, we have to go down here and make this one a little bigger, and we make this one a little bigger to take it to the end. And you have to start at the beginning. That is why I am just struggling with this thing physically working. I cannot make it work logically in my mind at all.

- I think that the conclusion that I have come to is to take the land like we have done on flood control projects. You end up identifying what is best, and you buy that land out. So, now you have only one landowner that you have to talk to and that is yourself. You build the project that you are trying to build, and you maximize the storage behind it.

You were saying you would take it out of production. We do not even know how long we would have to store the water or the effects on crop fields. We think this concept is worth looking at because we spend billions of dollars in the Red River Basin, not just in towns, on land, on farmer's land that gets flooded year after year, and we think that it is smart to look at other solutions. I mean, do you want to just rely on flood protection measures after the water has become a problem? Because dikes and diversions are great—we do not want to replace those—but that is protection after that water has become a problem. You already have a flood at that point, and you are relying on those structures. What about all the areas that do not have any dikes or diversions? What about that land that year after year gets flooded?

Well, that is what we said at the last meeting. It came up that maybe we look at land based on productivity, so that is a potential scenario.