Agency Advisory Board (AAB) Meeting Minutes
Energy & Environmental Research Center (EERC)
June 24, 2004

AAB Members Present

Rick Bowering
Don Elston
Randy Gjestvang
Damon Gravow
Scott Jutila
Scott Kroeber
Nick Ludowese
G. Padmanabhan
Bill Schuh
Jeffrey Volk
Dean Wieland

EERC Participants and Attendees

Beth Bolles
Barry Botnen
Lisa Botnen
Doug Davidson
Lynette de Silva
Sheila Hanson
Jim Johnson
Marc Kurz
Corey Maki
Stephanie Nielson
Sarita Pachhai
Troy Simonsen
Xixi Wang
Kirk Williams

Beth Bolles called the meeting to order and provided an update on the Waffle progress and activities.

Light Detection and Ranging (LIDAR) Collection

LIDAR is being collected in the Forest River Watershed and Walsh County, for a total of 1627 sq. mi; the goals are to:

- Compare the determination of storage volumes using the National Elevation Dataset (NED) and LIDAR on a watershed scale.
- Compare the modeling results using NED and LIDAR for an entire subbasin or portion of a subbasin.

- Determine potential shortcomings of using NED for this study.

Sanborn Mapping Company is conducting the LIDAR collection at a rate of $101/sq. mi. for a total cost of $164,327. The EERC leveraged this expense by forming a partnership with the Natural Resources Conservation Service's (NRCS's) National Cartography and Geospatial Center, Texas, which contributed $74,000 to this effort.

The products will consist of:

- Bare-earth digital elevation model (DEM) as ESRI grid (floating point); this provides ease of storage and data manipulation, easier integration with raster databases, and results in a smoother, more natural appearance of derived terrain features. The main drawback to the product is the inability to use various grid sizes to reflect areas of different complexity of relief.

- Bare-earth TIN (triangulated irregular network), provides the ability to describe the surface at different levels of resolution and efficiency in storing data. However, bare-earth TIN in many cases requires visual inspection and manual control of the network.

- First-return DEM as ESRI grid (floating point).

- 1.35 meter post spacing.

- Extremely large data set (~20 GB for the bare-earth DEM).

The final products will be delivered at the end of August, with sample datasets delivered in mid-July. For manageability the DEMs will be tiled by quarter quadrangle area, and data will be delivered on DVD and an external 200-gigabyte (GB) hard drive.

Soil and Water Assessment Tool (SWAT) Modeling

Bethany explained that existing-condition SWAT models have been developed and calibrated for 17 of the 27 watersheds in the basin, and that the remaining existing-conditions models will be developed by the end of 2004. She said that later this summer, we will begin evaluating Waffle storage scenarios using the models.

Bethany explained the rationale for selecting the SWAT, why it is the most appropriate model for this study and why its functions are deemed the most flexible and the strongest to evaluate the Waffle approach.

Rationale for Using SWAT (instead of HEC-HMS):

- Waffle storage areas would be temporary and mostly offline.

- The U.S. Army Corps of Engineers' Hydrologic Engineering Center (HEC)-Hydrologic Modeling System (HMS) was designed primarily to model online reservoir storage, not distributed, offline storage, such as the Waffle or wetlands.

- SWAT provides three storage options: reservoir, pond, and wetland. Pond storage closely mimics the Waffle approach. The wetland function can be used to simulate the effects of wetland storage on flood mitigation.

- The Waffle approach was proposed to help deal with spring snowmelt flooding.

  — SWAT simulates snow accumulation and thaw, and takes into account the dynamic effects of soil moisture and temperature on the simulated runoff. SWAT can also simulate snowmelt and rainfall simultaneously.

  — HEC-HMS does not have these capabilities. A snow model is required to develop and execute the model.

- Whereas SWAT uses hydrologic response units (HRUs) to more accurately simulate watershed spatial variability, the basic unit in HEC-HMS is a subbasin, which is treated as a homogeneous unit.

- Soil conditions determine the partition of snowmelt water between infiltration, evapotranspiration, and surface runoff.

  – HEC-HMS uses only an infiltration rate.

  – SWAT simulates the hydrology dynamics between the vadose zone and water drainage courses based on soil conditions. (For example, SWAT takes into account both the infiltration into and seepage out of the vadose zone.)

- SWAT is capable of automatically extracting many model parameters from the input databases, such as curve number and infiltration rates. These parameters must be entered manually when using HEC-HMS.

- SWAT can simulate the cumulative effects of both structural measures, such as reservoirs, and non-structural measures, such as Waffles, wetlands, and conservation practices. HEC-HMS does not have this simulation mechanism.

- SWAT can be used to further evaluate the effects of water storage on crops, soils, and water quality.

Field Trial

Marc gave a presentation on the field trial and the most recent activities. To date, the EERC has done the following:

- Completed the 14-day storage period and then drained the land.
- Processed flow velocity and volume calculations for each culvert.
- Calculated evaporation losses based on corresponding meteorological data.
- Performed water quality sampling and analysis and performed a preliminary evaluation of the results.

- Downloaded soil temperature and moisture data and evaluated the results
- Performed soil analysis for nutrient quantification (Centrol Consulting)
- Performed infiltrometer tests
- Evaluated soil physical characteristics (Interstate Testing)

Bill Schuh asked if the water was still flowing or was it backed up in the field. Was the standing water flowing when the standpipe was put in? Marc indicated that it was 5 ft deep right near the culvert. Rick Bowering asked whether the overflows and control structure could both be used as a means of draining. Marc said they are connected and that both will be opened. He also added that it took 22 hours to drain the site.

Marc displayed the results. He explained that flow rates were calculated for each culvert to determine storage volumes. The total volume of water on the site at one time totaled 174.6 acre-ft; however, actual storage after overflow was approximately 85 acre-ft. Approximately 90 acre ft of water exited through the overflow standpipe and evaporation losses were calculated to be approximately 29 acre-ft. Marc indicated that both the wet and dry areas increased in soil temperature at the same time. However, the water-covered sensors exhibit less diurnal fluctuation. He added that the water quality data doesn't appear to change. Bill inquired whether this was after flooding in April and whether the results were from multiple samples. Marc commented that there were 20 samples collected from different areas in the field.

Also, samples in the ditch upgradient of the site were taken after 8 days of storage and again at 14 days of storage. A packet of water quality and nutrient data is being assembled for comments. The results indicate no apparent negative impacts to water quality have been observed. Water quality data and soil analyses are being compared to understand potential interactions.

Modeling Component of Field Trial

Kirk Williams gave a presentation on the modeling aspects of the field trial. He spoke about the development of the predicted modeling, conducted prior to water on this section. Below are some of the highlights from that presentation.

The west conveyance ditch feeds the main north–south outfalls. All of the surface water flow from the section was expected to enter the west ditch and flow either toward the north or south outfalls. An initial concept of the overall potential storage within the section was developed based on the contoured elevation profile. This profile is roughly 878 ft in the northeast quarter to about 874 ft in the southwest quarter. The drainage points are located in the southwest and northwest corners. The lowest point was determined to be along the west perimeter road, approaching the southwest corner at an elevation of 877.2 ft. Considering the perimeter road would be used to contain the stored water, it was determined that between the targeted water surface and the lowest point in the west perimeter road, a freeboard of 1.2 ft would be provided.

A water surface elevation of 875.0 ft above mean sea level would potentially represent a storage capacity of approximately 85 acre-ft, provided all of the quarter sections are hydrologically connected. If the elevation of the stored water were uniformly increased to 876.0 feet across the section, a sectional storage capacity of about 320 acre-ft would be possible. Before the first snowmelt occurred, the section had approximately 2.2 to 3.0 inches of water already on-site.

Assuming no infiltration nor evaporation, this represents about 120 to 170 acre-ft of stored water already on the section. This amount of stored water is roughly equivalent to an elevation of 875.5 ft. As a result, there was the capacity for another 160 acre-ft, or 3 inches, of precipitation before the 1.2 ft of freeboard would to be compromised.

We examined the effects of infiltration and evaporation rates for typical water losses over the same period and how a combination of these events could affect this area. What kind of losses are we going to see? At the start of March and April, we determined total losses due to infiltration and evaporation of 0.83 inches and 2.25 inches, respectively. This is equivalent to 44 to 120 acre-ft of lost water. This is not considering water leakage.

Kirk explained that the EPA's Storm Water Management Model (SWMM) was selected for this project, because it has the following attributes:

- A comprehensive computer model for analysis of quantity and quality issues associated with urban runoff.
- Continuous simulations that can be performed on natural drainage conveyance for prediction of flows, stages, and pollutant concentrations.
- The Extended Transport (Extran) Module for solving complete dynamic flow-routing equations, simulation of backwater, surcharging, and pressure flow situations.
- The capacity to simulate all aspects of the urban hydrologic and quality cycles, including rainfall, snowmelt, surface and subsurface runoff, and flow routing through a drainage and storage network.
- Simple statistical analyses that can be performed on output from a continuous simulation exercise.

Kirk says he plans to use the SWMM model to demonstrate sections interconnected by a drainage network. Of course, this system will require more complex simulation scenarios to generate the stored water timing and release curves. These operational curves will be compared to those generated by the simulations from the next sections.

Estimation of Water Storage Potential with USGS Topography and Digital Elevation Data

Troy presented the estimation of water storage potential using statistical methods. They were used to determine approximate storage volumes on a watershed basis using NED data and topographic maps. The assumption was that existing roads would be used to store water. Troy pointed out that there are 38,000 sections in the Red River Basin (RRB).

With this method, we took 20 samples from each watershed to statistically determine how many sections would need to be evaluated to reasonably estimate storage capacity in a watershed. Once the number of sections per watershed was determined, that number of sections was randomly selected within each watershed for evaluation of storage volumes. Troy indicated that through this approach, we looked at a section and determined if it was going to be useable or not.

Sections were eliminated if they contained rivers, creeks, cemeteries, etc., or if they were part of a town. Sections that appeared to have storage and a minimum of three roads were still considered. Using elevation points on topographic maps, minimal road elevations surrounding a section were determined. Each grid cell was adjusted for discrepancies between the topographic maps and the DEM. The minimum elevation of the surrounding roads was considered the height of potential water storage. This minimum elevation was then compared to the DEM to determine the water storage capacity within the section below that elevation.

Beth commented that this kind of approach was used to suggest potential storage per watershed. We'll be dividing each watershed. She asked Troy how many sections were analyzed. Troy indicated that there are about 100 sections per watershed; because there are 28 watersheds, we are evaluating 2800 sections.

Randy asked if we are going to analyze how much volume has been flooded already. Beth commented that we have not really thought about that. Randy added that one can look at aerial photos of the area and make assumptions from those.

Rick added that storage is higher than the culvert level. If there is snow there, the water level is higher. This is going right to the top of the roads. Wouldn't you have to take a foot off? Troy indicated that this statement was correct. Rick added that there is no guarantee that the lowest point in the road indicated on the topographic maps was actually the lowest point. Beth commented that we realize this limitation. Jeff commented that you can only go down in storage, and that all of the estimations are high. Beth added we need to look at reducing these volumes, that it is better to be conservative, and that this is not the most conservative value right now.

Jeff wanted to know how part of a watershed can be used to make assumptions about an entire watershed, and how can that connection be made. Beth responded that we cannot analyze every section; it is not possible for this phase of the project. With the SWAT model we will have to designate some potential average storage volume and distribute the storage based upon the relief and/or slope of a section. The LIDAR that is being collected will give us a better estimate of errors in using this approach.

Bill commented that you need more detail and more resolution than the National Elevation Dataset (NED). Jeff commented that you're getting a huge number and your error is on the high side. Beth added that we might end up going back and redoing some examples and seeing how much it does affect storage. With the model it will evaluate how much you need at a certain point to prevent a large flood like 1997 and potentially see what you do have. The LIDAR will help in determining error with the NED.

Wetlands Working Group Meeting Update

Lynette indicated that the purpose of the meeting was to investigate the role of wetlands in flood and drought mitigation with respect to the Waffle Project. The plan was to gain technical input and feedback from others with expertise in RRB wetlands and wildlife issues. Discussions began to see how the Waffle concept could be utilized within the wetlands. They addressed issues directly related to wetlands restoration and incorporating wetlands for flood mitigation. Representatives from the U.S. Geological Survey's Northern Prairie Wildlife Research Center,

State Water Commission, U.S. Fish and Wildlife Service, North Dakota State University, and the Audubon Society were in attendance, including some members from this advisory board.

Among the highlights were that storing water from 1–2 ½ weeks in most cases would not negatively affect wetlands nor their inhabitants, since this is considered temporary in a wetland timeframe. Of concern is sedimentation, and whether it would increase or decrease. Suggestions included a systematic restoration of grasslands first, if possible. It was suggested that land use and land cover should not be underestimated in the role they can play in mitigating flooding. Further, it was indicated that maximum use should be made of wetlands in upland areas to help distribute water storage throughout the basin.

Lynette added that within the model that is being designed, we'd have to know where restorations are occurring or proposed in the basin so we can include this in our model. Beth added that this approach incorporated the utilization of different strategies for storage throughout the basin. Randy commented that some people considered the wetland protection a high priority.

Jeff Volk added that wetlands do not significantly reduce flood water in the valley. Beth said that it depends on if the wetlands were restored compared to wetlands providing some additional storage. She indicated that the meeting was to determine the potential role of using wetlands for storage. Bill said that the variability of the wetlands is a major factor. It may be useful in some areas, but we would have a hard time determining their storage capacity.

Outreach Update

Sheila Hanson gave a presentation on outreach. She spoke of various meetings attended by Waffle staff where Waffle representations were given, including township officer associations, county commissions, and Kiwanis Clubs. She also discussed recent media coverage such as news articles and TV interviews. We also released the Waffle spring–summer newsletter and developments related to the Waffle Web site were made.

Regarding the 4706 landowner surveys mailed to landowners in Wild Rice Watershed, Sheila said that she has received 542 completed surveys, representing an overall response rate of 11.5%. She added that we still have a lot of comments to analyze. Jeff asked if there was a definition provided for overland flooding. Sheila answered no, that it was whatever the landowner thought overland flooding represented.

Jeff asked if the survey went to farmers or property owners. Sheila commented it went out to a variety of people. Jeff wondered whether Sheila planned on separating farmers and property owners surveys from towns people. She said she planned to separate them. Bill commented that you have to be very careful how you interpret the responses. Sheila agreed and indicated that more pointed questions in a further survey may be necessary.

Beth mentioned some of the problems with understanding the Waffle concept, adding that there is still some confusion among the public; when the Waffle is touted as "volunteer," some people assume that landowners would be donating their land. This is incorrect, but there is a further misconception that landowners will not be compensated for the use of there land.

The SWMM & the SWAT Models

Rick asked how do the SWMM and the SWAT interface? Kirk said SWMM is being used to determine the routing of the water through the section that will interface with the SWAT. Rick asked if we are going to do the SWMM model on every section. Beth said that it was mainly for the timing of water release. Bill added that eventually this will be done in every section.

Multiple Sites

Bethany said that there is a possibility that in the Hallock area there may be an opportunity to have multiple Waffle sites because John Younggren is on the watershed district for Two Rivers. The watershed district is interested in this approach and might utilize the Waffle plan in the future. Jeff suggested that it would help him if one of our watersheds was expedited to show physically how the concept would work. He indicated that he is still confused, and didn't see how this off-channel storage would work, or how buildings would be missed. He suggested taking one of the watersheds and working it through to the end. Beth added as soon as we get the LIDAR back we will be able to start a more-detailed analysis of the Forest River Watershed. Randy agreed that we need to concentrate on one subbasin.

The meeting was adjourned.