RIVER VALLEY FLOOD CONTROL INVESTIGATION REPORT

Prepared For:

Town of Spring Green, Wisconsin

In cooperation with:

Village of Spring Green, Wisconsin

Sauk County, Wisconsin

Prepared By:

April 2, 2009

JEWELL associates engineers, inc.
Engineers - Planners - Surveyors

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Prepared by:

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April 2, 2009

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Cover Photo: Richland County, WI Emergency Management Website

Abstract

In June 2008 multiple severe rainfall events caused widespread flooding and damage throughout southwest Wisconsin. Homes were damaged or even swept away, dams were breeched, crops were destroyed, roads were flooded, public works systems failed, and many residents were displaced. Although they received partial reimbursement from FEMA local governments spent substantial portions of their operating budgets and lost countless man-hours in response to the flooding.

The Town and Village of Spring Green Wisconsin were hit particularly hard by the flooding. These communities are located in Sauk County in the lower Wisconsin River valley. Although the Wisconsin River did not reach flood stage, nearly 4,400 acres were flooded by localized stormwater runoff. Due to the nature of the local terrain vast areas of the valley do not drain to the Wisconsin River or its tributaries. The floodwaters sat in the Spring Green area for several months while other communities were afforded the opportunity to start rebuilding. All told, the Spring Green area suffered millions of dollars in agricultural, business and personal losses. Numerous businesses and homes were damaged, many beyond repair. As of the date of this report many residents are still displaced by the flooding.

Jewell Associates Engineers Inc. was contracted by the Town of Spring Green, with financial assistance provided by the Village of Spring Green and Sauk County Wisconsin, to investigate means of alleviating localized flooding. The purpose of this report is to describe the findings of this study and provide recommended options, cost benefit evaluations, and potential avenues of funding and governance for drainage systems within the region.

Executive Summary

In June 2008 multiple severe rainfall events caused widespread flooding throughout southwest Wisconsin. The flooding caused damage throughout the region. Homes were damaged or even swept away, dams were breeched, crops were destroyed, roads were flooded, public works systems failed, and many residents were displaced. Although they received partial reimbursement from FEMA, local governments spent substantial portions of their operating budgets and lost countless man-hours in response to the resulting flooding.

The Town and Village of Spring Green Wisconsin were hit particularly hard by the flooding. These communities are located in Sauk County in the lower Wisconsin River valley, approximately 35 miles west of Madison, Wisconsin. Although the Wisconsin River did not reach flood stage, nearly 4,400 acres were flooded by localized stormwater runoff. Due to the nature of the local terrain vast areas of the valley do not drain to the Wisconsin River or its tributaries. The floodwaters sat in the Spring Green area for several months while other communities were afforded the opportunity to start rebuilding. All told, the Spring Green area suffered millions of dollars in agricultural, business and personal losses. Numerous businesses and homes were damaged, many beyond repair. As of the date of this report many residents are still displaced by the flooding.

The Spring Green area is located within Wisconsin's Driftless Area, a region untouched by glaciers in the Paleozoic age. Characterized by steep sandstone cliffs and deep river valleys, the Driftless Area encompasses much of southwest Wisconsin and parts of Illinois, Iowa and Minnesota. In this locale the river valley between the base of the bluffs and the Wisconsin River is poorly drained with much of the region without a path of discharge to the Wisconsin River or its tributaries. Under normal conditions most of the runoff from the bluffs comes to rest in the River Valley and evaporates or infiltrates into the soils at the base of the bluffs. Historically, silts have deposited at the base of the bluffs, further complicating the lack of natural drainage throughout the River Valley. This is the case at an important region in this study, the area referred to as Big Hollow. The silts slow infiltration of rain water at the base of Big Hollow, and during intense storms localized flooding can occur. Runoff problems in the Big Hollow region have been described by Exo and Gotkowitz as follows: "During smaller storms, this runoff can infiltrate the permeable sand and gravel terrace deposits at the base of Big Hollow, which raises the elevation of groundwater levels in localized areas. During the June [2008] storms events, this excess of "over-land flow" of storm water from Big Hollow raised the water table to such an extent that low spots in the landscape have been flooded." Source: Exo and Gotkowitz, 2008

"Similarly, the bedrock escarpment north of the valley is an area of elevated runoff during intense rainfalls because the rainfall may exceed the rate at which the limestone and sandstone can absorb water. This causes a high volume of runoff from the bedrock slope to the water table in the sand and gravel along the base of the slope. This raises the water table (and in extreme cases, floods) areas from west to east along the north side of the valley." Source: Exo and Gotkowitz, 2008

Historic Flood Events

2008 was not the first time the River Valley suffered flooding of the prairie lowlands. Anecdotal evidence suggests some of the areas flooded in 2008 were more wetland or even lake-like prior to conversion to agricultural and residential use. Known historic floods inundated the region in 1938 and again in 1993. There is unverified information severe flooding also occurred near the turn of the century. Local newspaper accounts of 1938 and 1993 events suggest the flooding occurred in much of the same areas affected by the 2008 flooding. Information submitted for disaster assistance related to the 1993 flood suggests flooding occurred on a much smaller scale once in the mid seventies and again once in the mid 1980's.

The Prairie View subdivision, northwest of the Village of Spring Green, was significantly affected by flooding in 1993. At that time the Big Hollow watershed was suggested as a major contributing factor to the flooding. In 1993 the homes in Prairie View were also inundated by floodwater. As it was in 2008, but to a lesser extent, basements were flooded and foundations damaged. By continuously pumping their basements, most residents were able to stay in their homes. A June 1994 Wisconsin Department of Development report notes 36 homes in the Prairie View subdivision and surrounding area were damaged in 1993. The report states similar conditions to the 2008 flooding in that the homes were flooded, not by high river water but by saturated ground coupled with flash flooding. The report also references some homes having 18-25 inches of water in basements nearly a year after the event.

In 1993 efforts were made to pump the floodwaters to the river. Plans to construct a Big Hollow drainage ditch were also explored. Both efforts failed, and eventually the floodwaters receded.

2008 Flood Events

In spring 2008 groundwater elevations were high due to heavy rainfall in August, 2007 and runoff and infiltration of melting snow from the record snowfall of the winter of 2007-2008. Two severe storm events, the first on June 7th and 8th and another on June 12, 2008 hit the region and caused massive flooding. The resultant flooding eventually led to a Presidential Disaster Declaration for Public Assistance submitted and granted for 30 Wisconsin counties including Sauk County. Montgomery Associates Resource Solutions, LCC (Montgomery), a subconsultant on this study, estimated the June 7th/8th event to be 5.1 inches and the June 12th event produced 5.0 inches of rainfall. This rainfall data appears to be supported by a WisDOT commissioned study titled "Assessment and Documentation of Flooding Locations for Select State Highway Facilities and Drainage Crossings Work Order Contract No 0656-13-52", 2008." The report lists the June 7th/8th event at 5.035 inches and the June 4-13, 2009 10-day rainfall at 10.82 inches as shown in figure 1.4-2. According to Montgomery the June 7th & 8th and June 12th events also exceeded the 5-day 100-year rainfall depth for this region. Individually the events were comparable to the local 50-year 24-hour rainfall and approached the 100-year event of 6.1 inches.

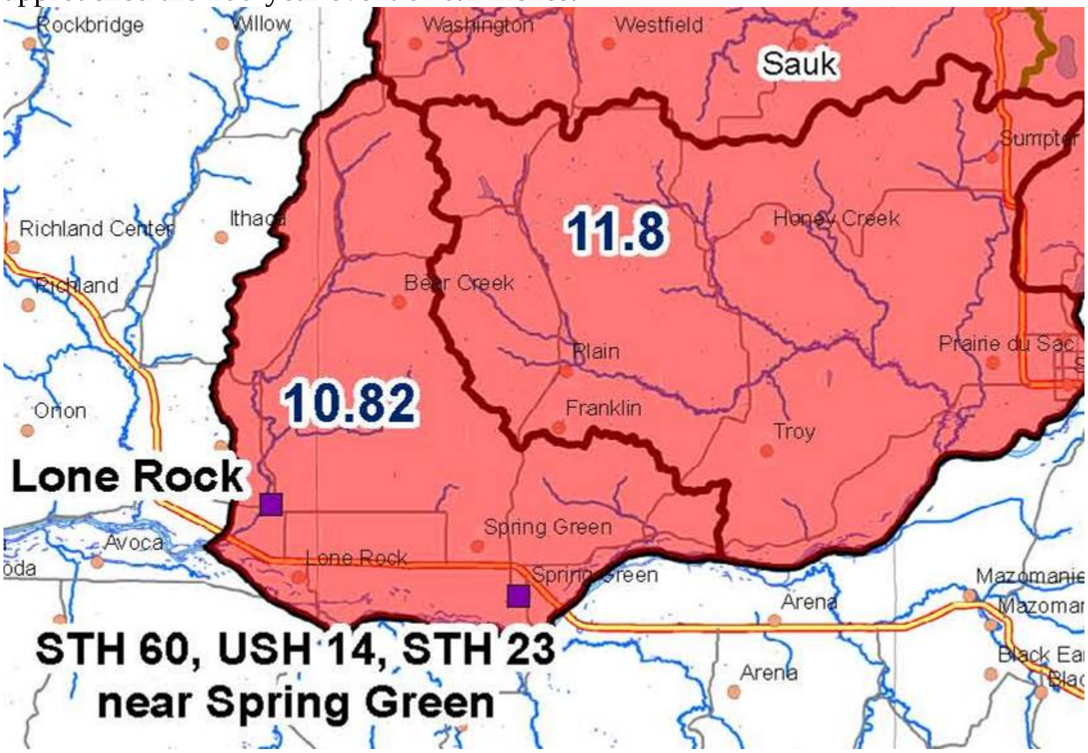


Figure ES-1. June 4-13, 2009 10-day precipitation
Source: "Assessment and Documentation of Flooding Locations for Select State Highway Facilities and Drainage Crossings Work Order Contract No 0656-13-52", 2008."

The flooding covered nearly 4,400 acres of land. Although not as dramatic as the sudden draining of Lake Delton, the impact of the flooding on the River Valley area was devastating. Crop losses were catastrophic. Groundwater and surface water poured into homes in the Prairie View subdivision and elsewhere. Flood control walls and structures installed in response to the 1993 flooding failed; displaced residents were relocated to evacuation centers; and sandbagging operations were initiated in an effort to reduce further damage in Prairie View and elsewhere. Many residents within the Prairie View subdivision as of the date of this report have not returned to their homes.

The financial effects of the flood were staggering especially when considering the small size of the communities involved. A report prepared by Denise Brusveen, Sauk County UW Extension Agriculture Agent estimates over $9 million in agricultural losses were suffered by area farmers. A survey conducted by Jewell Associates in September 2008 indicates local businesses in the Town of Spring Green suffered up to $1.4 million in property and inventory damages and $850,000 in lost revenue. The report did not account for loss of business in the Village. A survey of private losses was not conducted for the purposed of this report, however FEMA data gives an indication of the magnitude of the damage to private residences. Data obtained from the Wisconsin Department of Military Affairs for the period through February 2009, shows under the FEMA Individuals &

Households Program (IHP) used for home damage 270 households applied for assistance and 191 claims were paid totaling $1,068,136.46. The Housing Assistance (HA) program paid another $1,056,540.08 in assistance. FEMA also paid $27,573.36 in assistance classified as “other needs” (ON).

The Village of Spring Green incurred an estimated $139,938.26 in flood response costs submitted to FEMA and an additional $10,314 in ineligible costs. The Village anticipated receiving $126,184.32 in payments from FEMA. Of the $139,938.26, $7,125.50 was for roadway repairs, and $58,942.68 in sewer and water system repairs, with the remainder for general flood response needs, labor and equipment, and contracted services such as dumpsters and portable sanitary facilities.

The Town incurred over $178,794.90 in roadway repairs and $114,551 in flood response costs. Compensation from FEMA and the state for the roadway repairs totaling $126,324.63 is anticipated along with $79,471.53 for the response costs.

Study Scope and Approach

In September 2008, Jewell Associates Engineers Inc. was contracted by the Town of Spring Green, with financial assistance provided by the Village of Spring Green and Sauk County Wisconsin, to investigate means of alleviating localized flooding. The purpose of the study was to provide the Town of Spring Green with the necessary information to aid a decision on what, if any, construction projects should take place to deal with future flooding. The areas of study included: investigating the creation of a retention area south of the Village of Spring Green for collection of stormwater discharged from the Village of Spring Green onto lands owned by Terry Shifflet; draining areas east of STH 23 and north of USH 14 east to the Wisconsin River; draining lands near the Tri-County Airport to the Wisconsin River and/or Bear Creek; and exploring options to control stormwater in the principle area of concern, the Big Hollow watershed.

For each of these areas the investigation was to study the impacts, costs, and benefits of the alternatives. Based on the study preferred alternatives were to be recommended and potential avenues of funding and governance for the alternatives researched.

In developing the scope of this study, Jewell worked with Madeline Gotkowitz, a hydrogeologist at the Wisconsin Geological and Natural History Survey (WGNHS), to learn about the influence of groundwater on the 2008 flooding. Gotkowitz through WGNHS had previously studied the region and developed a computer model to simulate groundwater flow. Because of her responsibilities at WGNHS, Gotkowitz was not available to further refine the model to meet the needs of this study. One of the firms Jewell and the Town were referred to was Montgomery Associates Resource Solutions in Cottage Grove, Wisconsin. In the fall of 2008 Jewell contracted Montgomery as a subconsultant and soon after worked with Montgomery to refine the study approach.

It was determined Montgomery would provide support for the groundwater portion of the study. Because of the interaction of surface water and groundwater Montgomery was to also provide to surface water flow data and hydrologic modeling for the study areas in the Town. Jewell staff was to conduct the hydrologic modeling in the Village and meet the remainder of the study requirements: providing survey and gathering available survey data, developing computer surface models for the Town; providing preliminary engineering and opinions of probable cost for drainage solutions; meeting with affected landowners; providing a cost-benefit analysis for proposed flood control projects; and researching funding opportunities.

For the surface water study Jewell provided surface model data to Montgomery for use in developing hydrologic models for the three study areas in the Town. Montgomery studied the rainfall events from June for use in the model and gathered data for regional 10-year and 100-year rainfall events. Montgomery then delineated the subwatersheds (areas draining to a similar point) for the township. The township was divided into several basins.

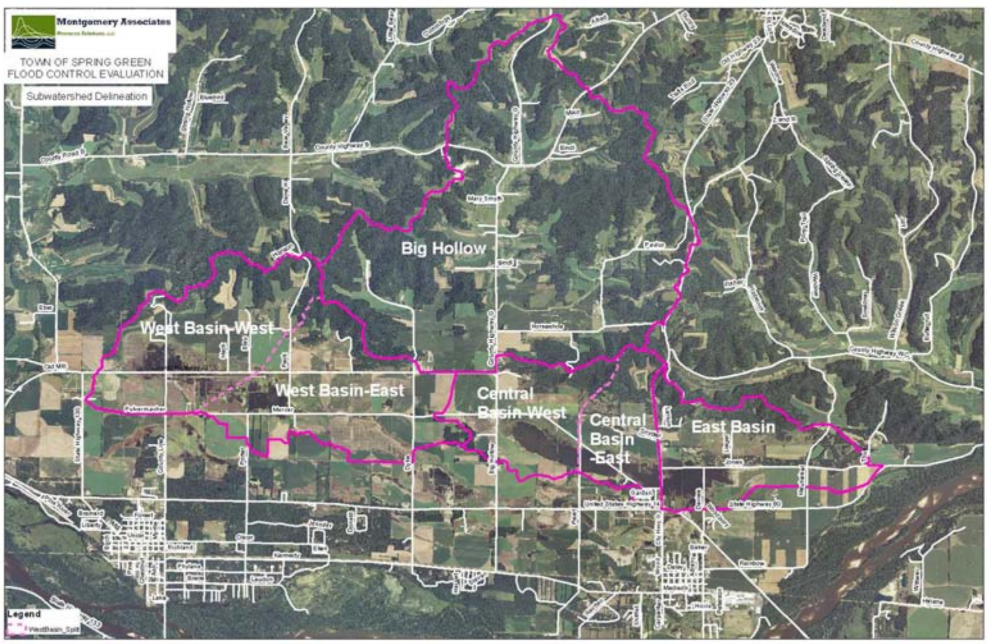


Figure ES-2. River Valley Flood Control Study Subwatershed Map
Source: Montgomery, 2009.

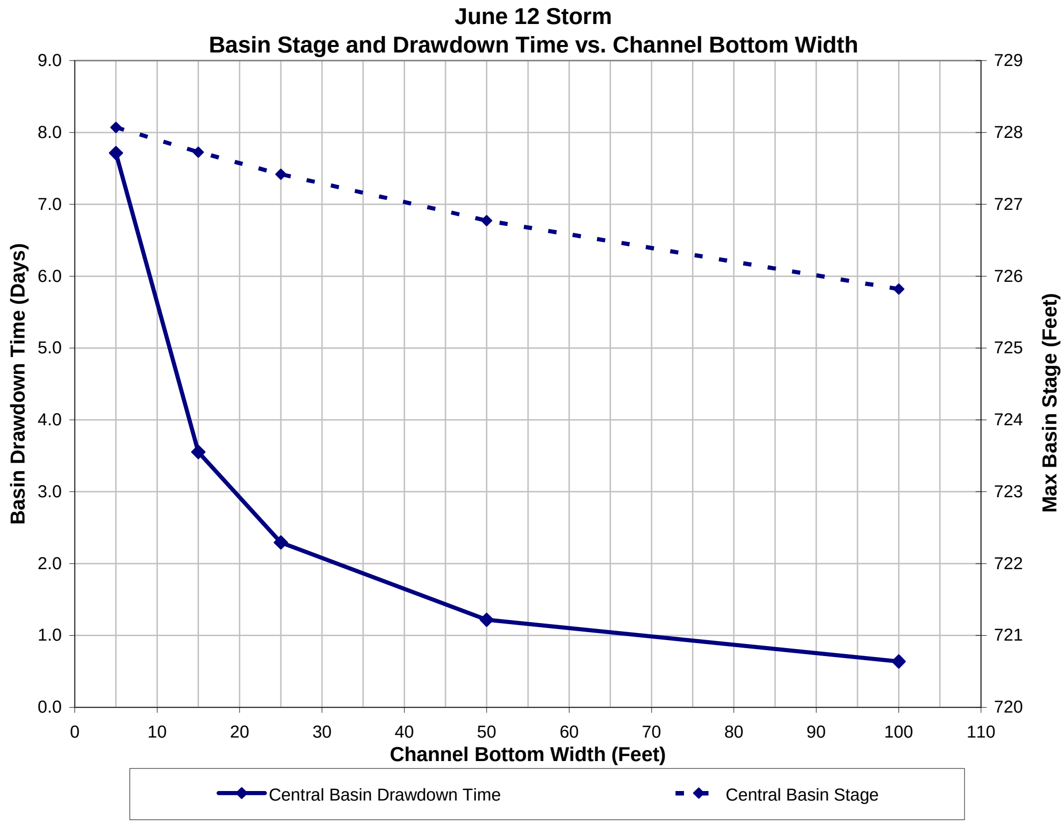
The models developed for the study yielded baseline flows for further study. For example the June 2008 events the modeling yielded the following results:

Runoff Volumes (Acre-Feet)			
Subwatershed	**June 7-8**	**June 12**	**100-year Storm**
Big Hollow – 7,345 acres	1,013	1,740	1,442
Central Basin – 2,105 acres	548	533	709
East Basin – 1,660 acres	360	350	479
West Basin – 4,273 acres	1,182	1,152	1,516
Total Volume	**3,103**	**3,775**	**4,146**

Table ES-1. Runoff Volumes for River Valley Subwatersheds
Source: Montgomery, 2009.

Once the flow data was modeled, several alternatives for handling floodwater were explored. Alternatives like creating local flood control ponds in Big Hollow or constructing a single large channel from Big Hollow to the Wisconsin River were found to be unfeasible and/or cost prohibitive.

The option of temporarily ponding water at the base of Big Hollow and channeling the discharge to the River was then explored. To facilitate temporary ponding and reduce the likelihood of an overflow of Pearl Road east towards Prairie View subdivision and the Village of Spring Green it was assumed sections of Pearl Road and CTH G would need to be elevated to prevent overtopping. Taking this assumption and utilizing Jewell surface model data and preliminary channel geometry, Montgomery was able to develop comparisons of channel sizes to required pond size and pond drawdown, the time required to empty. The data was graphed and used by Jewell and Montgomery to determine a preferred channel size as designs were refined.



Figures ES-3. Graph of Big Hollow/Central Basin Channel Width vs. Downdown and Stage
Source: Montgomery, 2009.

Using this figure ES-3 it can be found that for the June 12th events a channel with a 10-foot bottom would require 5.5 days to draw down (solid line) and reach a ponded elevation of 727.9 feet (dashed line). Similarly, a 50-foot bottom channel would require approximately 1.2 days to draw down from the maximum flooded elevation of 726.8 feet. The graph can then be used to determine acceptable time of flooding of cropland in the controlled flood storage area near CTH G and give an indication of the potential flood risk to roadways and neighboring properties. It was also important to consider the time of drawdown when considering back to back events like those in June 2008.

Flood Control Alternatives

After selecting a preferred channel geometry, Jewell staff further refined the channel designs and routes. Potential channel routes and preliminary designs were developed for the Big Hollow/Central Basin, the East Basin, and the West Basin.

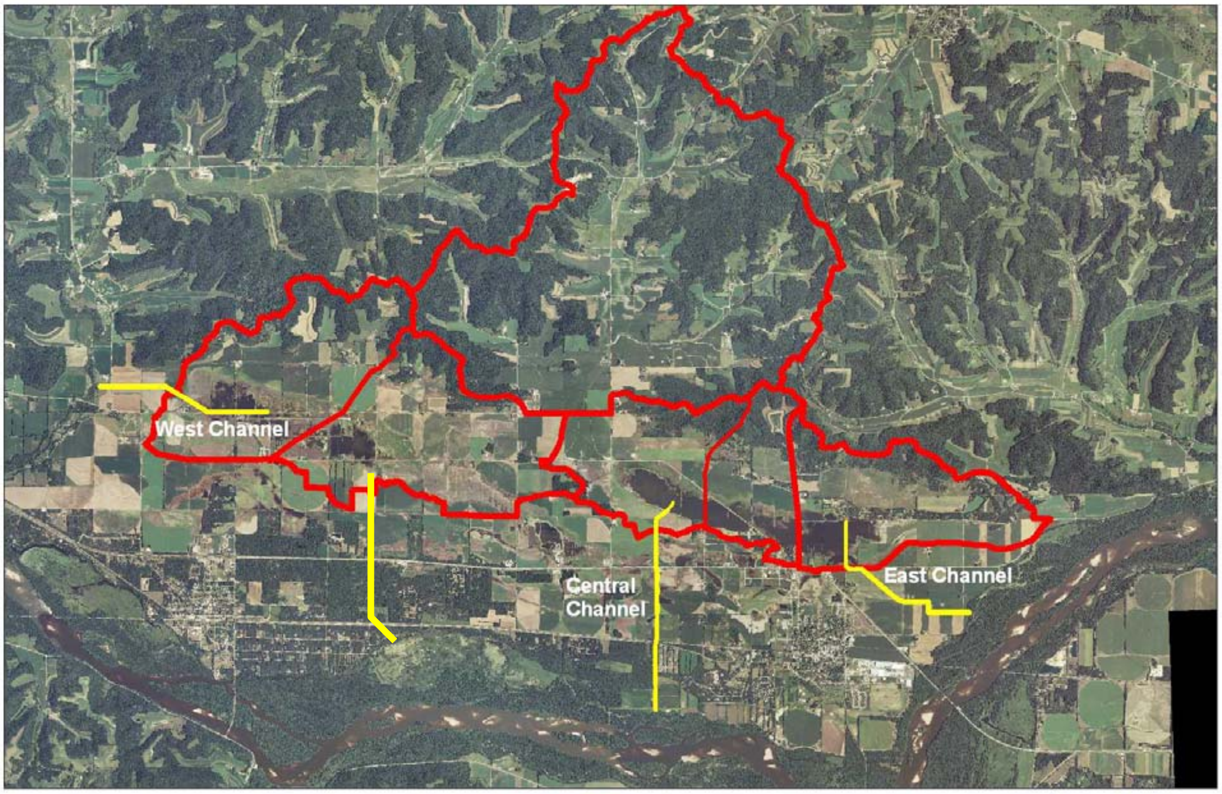


Figure ES-4- Potential Channel Routes
Source: Montgomery 2009

Preliminary alignments and profiles were set and computer software was used to determine the required earthwork and the required construction limits of the various proposals. As the alternatives were refined, estimates of construction material quantities were developed, hydraulic sizing computations for roadway and railroad crossings were calculated, and costs were developed for various alternatives.

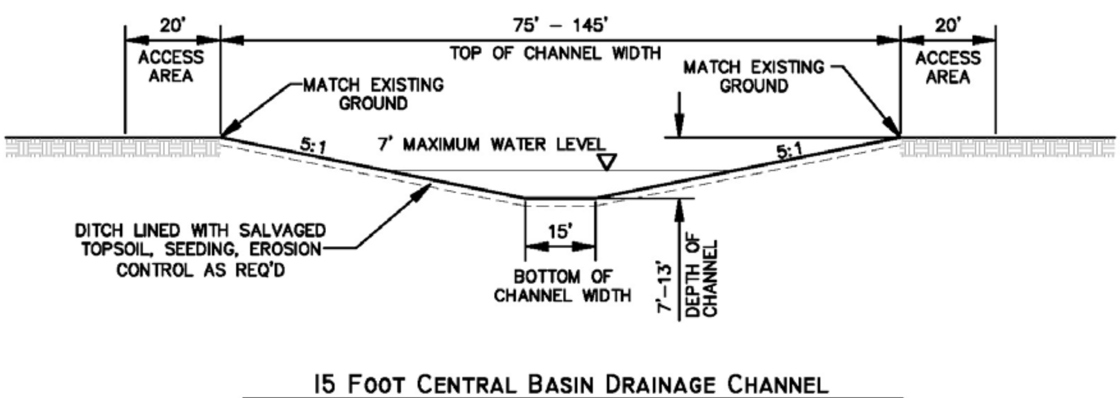


Figure ES-5- Typical Section of Big Hollow/Central Basin Channel

For the Big Hollow/Central Basin it was determined a channel with a 15-foot bottom with a water level up to 7 feet deep was required to convey the floodwaters stored on 400 acres of land. Various route options were explored with costs ranging from $2.6 million to $3.4 million with 50 to 65 acres of land taken from agricultural production. A recommended route for the Big Hollow Channel was selected essentially running north-south from CTH G between Big Hollow and Pearl Road to a Wisconsin River slough. As with all the alternatives, there is concern for wetlands, habitat and water quality from the Wisconsin Department of Natural Resources.

For the East Basin both a channel option and an alternate with a series of stormwater ponds in the Village of Spring Green was explored. It was determined that even if the Big Hollow flows were redirected, significant flooding could still occur in the East Basin. The solution proposed was again a small channel allowing temporary flooding. In this case a 10-foot bottom channel from the Davies Road & Jones Road area to the Wisconsin River was proposed. This option would cost $1.5 million to $1.75 million with more than 30 acres of land taken from agricultural production.

Under the alternate east basin scenario, the interconnected ponds would cost around $2 million with both public and private lands used to store and convey floodwater. The alternative offers a feasible solution to addressing some existing Village stormwater issues and may also offer solutions for future growth north and east of the Village.

For the West Basin, multiple routes to both the Wisconsin River and Bear Creek were explored, one of which is being proposed by a group of landowners trying to form a drainage district. It was determined that even if the Big Hollow flows were redirected significant flooding could still occur in the West Basin. The channel solution again proposed temporary flooding and a 20-foot bottom channel from either the northwest or southeast side of the airport running south to the Bakken's Pond area or west to Bear Creek. The options would cost $1.5 million to $ 2.4 million with 35 to 50 acres of land taken from agricultural production.

Village Flooding

Independent of the West, Central and East Basin studies Jewell evaluated an existing flooding condition at the outfall of two of the Village storm sewers. Over 200 acres of Village and Town property drain through these two pipes or overland to the farm fields between Shifflet and Carpenter Roads. In times of normal precipitation, flooding and crop damage are persistent at this location. This damage is a continuing source of potential liability for the Village. This area does not naturally discharge to the Wisconsin River. In June 2008 the water at this location ponded to the point of crossing Shifflet Road and traveling southwest. It only reached the river after local residents dug a trench to release the floodwater. This trench was subsequently refilled. Through the summer of 2008 the Town pumped water to the Village stormsewer system, adding to the flooding problem in this area.

As part of this study Jewell Associates studied means of controlling stormwater at this location through the use of a detention area. The detention area would be a means of controlling the stormwater discharging by allowing it to pond temporarily in a dry pond or artificial wetland area and slowly discharge to the river. Two pond alternatives were evaluated for this location.

Option 1 – Create an 18-acre detention pond or artificial wetland through the creation of berms. The detention pond would discharge to the River via an excavated channel with a 15-foot bottom.

Option 2 – Create a 27-acre detention pond or artificial wetland with a 2,700 LF 36-inch diameter pipe outlet discharging to the Wisconsin River.

Alternately, the Village could choose a “No Build” alternative but this approach would not address flooding across Shifflet Road towards nearby homes.

Options 1 and 2 cost roughly the same, being in the $500,000-$600,000 range with 27 acres required for pond or channel construction. The land owner in this case has a preference for option 1.

<u>Groundwater</u>

During the study the effects of groundwater were also investigated. In terms of groundwater several objectives were outlined:

- Monitor existing water table elevations at various locations and identify the trend in water levels

- Evaluate how groundwater levels may be impacted by changes in recharge

- Estimate the average linear velocity of groundwater movement

- Determine potential influence of the Wisconsin River on water table elevations

Groundwater data was collected from monitoring wells installed during the project and this data was used to further refine a groundwater computer model developed by Madeline Gotkowitz, hydrogeologist, at the Wisconsin Geological and Natural History Survey (WGNHS). The refined model was used to predict the impact of proposed drainage alternatives on groundwater levels and recharge.

From their study Montgomery then was able to determine the effects of a Big Hollow drainage channel on groundwater recharge. Montgomery found, “We believe that it is unlikely that the selected flooding alternative will result in the reduction or increase in overall area recharge rates exceeding a few inches per year. The groundwater model simulations indicate that with a 1 inch increase/decrease in the recharge rate, the water table elevation may rise/drop up to approximately 0.5 ft near the river to 1.5 ft in the upper valley. With a 3 inch increase/decrease in the recharge rate, the water table elevation may rise/drop up to about six feet. Therefore, considering the level of detail of these analyses, we believe that it would be unlikely that long-term water table decreases in areas of the East, Central and West basins with improved drainage would exceed a few feet. Similarly, we believe that it is unlikely that increases in the water table elevation in the vicinity of the temporarily flooded areas and drainage swales near the Wisconsin River would exceed a few feet, which is within the range of 'typical' annual water table fluctuations." Source: Montgomery, 2009.

Project Coordination and Funding

The study involved two final areas which were project coordination and funding. Project coordination involved research and contacting various Federal, State, and local agencies to discuss requirements for the project and in some cases solicit assistance. Coordination with the local railroad and local utilities was also examined. Each agency will require some level of coordination. Two important agencies were determined to be the Wisconsin Department of Natural Resources and the Wisconsin Department of Transportation. The DNR has many concerns regarding the projects and their potential impact to the environment and WisDOT coordination will be required for highway and railroad drainage structures. It was determined WisDOT could be an important potential partner in a project, both for ease of utility coordination and potential cost sharing in drainage improvements associated with the highways.

Within the scope of this study Jewell was to explore avenues for funding of potential flood control projects. Government agency grants and sources of borrowing and bonding were explored. In addition to exploring the options listed in the study, Jewell, at the direction of the Town, is actively pursuing several of these options. In particular, a Big Hollow drainage project has drawn the interest of the US Department of Commerce Economic Development Administration (EDA) via the Economic Adjustment Assistance program. The project has passed the initial phases of EDA review and Jewell will continue to pursue this option past the completion of this study as directed by the Town.

Conclusions and Recommendations

The study draws several conclusions and recommendations listed in section 13. Most importantly it was found:

1. The magnitude and the nature of the River Valley flooding is unique and offers challenges in terms of determining patterns of drainage and ultimately predicting and controlling the movement of floodwaters.
2. The installation of drainage channels with bottom widths of 10-20 wide and allowing land to temporarily flood in a controlled manner can be employed to address flooding in the River Valley area.
3. "Installation of the drainage channels will reduce recharge in the northern portion of the valley, producing a reduction in the water table elevation. There will

probably be some increase in recharge produced by runoff flows in the temporary flood storage areas and drainage swales near the Wisconsin River, which could result in localized increases in groundwater levels.“ Montgomery 2009.

4. The installation of a drainage channel for the Big Hollow and Central Basin Watersheds will not eliminate all flooding in the East Basin near the Village of Spring Green or the West Basin near the Tri-County Airport.
5. Environmental issues related to Bakken’s Pond and the Wisconsin River sloughs will be a design and political challenge for any flooding project to go forward.
6. WisDOT involvement in a project can offer cost savings in terms of utility relocations and cost sharing.
7. The involvement of State, Federal and local agencies, utilities, and the Wisconsin Southern Railroad is critical to the success of any River Valley flood control project.

As a first priority, Jewell Associates Engineers recommends to the Town the construction of a Big Hollow drainage channel and temporary flood storage area. Implementation of Town drainage projects for the East Basin and West Basin may be postponed until the effectiveness and performance of the Big Hollow project for flood mitigation over a wide area can be evaluated. For the Big Hollow project, option 1 as described in section 6.3 is the recommended alternative. Further consideration of option 2 may be warranted if WisDOT participation can be garnered.

It is also recommended that the Town continue to pursue outside funding for the project as the financial burden of this project will be significant if local tax dollars are the sole source of funding.

Another important recommendation is to proceed with the buyout of homes in the Prairie View subdivision and other flooded locations to reduce the likelihood of future flood damage, especially considering the postponement of any East Basin project.

If drainage districts are formed in the Town of Spring Green as a means of constructing and financing additional drainage improvements, the Town Board may share the findings of this study with the drainage board and their engineer.

Acronyms and Abbreviations

AIS	Agricultural Impact Statement
AMC	Antecedent Moisture Condition
cfs	cubic feet per second
BMP	Best Management Practice
Corps	U.S Army Corps of Engineers
CN	Curve Number
CTH	County Trunk Highway
DATCP	Wisconsin Department of Agriculture, Trade and Consumer Protection
DNR	Wisconsin Department of Natural Resources
EDA	US Department of Commerce Economic Development Administration
EWP	NRCS Emergency Watershed Program
FEMA	Federal Emergency Management Agency
FPPA	Federal Farm Land Protection Policy Act
FIRM	Flood Insurance Rate Map
GIS	geographical information system
Jewell	Jewell Associates Engineers, Inc.
MM	WisDOT State Highway Maintenance Manual
MARS	Montgomery Associates Resource Solutions, LLC
Montgomery	Montgomery Associates Resource Solutions, LLC
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OHWM	Ordinary High Water Mark
ROW	Right of Way
SHRM	State Highway Rehabilitation-Maintenance projects.
STH	State Trunk Highway
TC	Time of Concentration
Town	Town of Spring Green, Wisconsin
USCOE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geographical Survey
USH	United States Highway
UWEX	University of Wisconsin Extension
WEM	Wisconsin Emergency Management
WDNR	Wisconsin Department of Natural Resources
WGNHS	Wisconsin Geological and Natural History Survey
WISDOT	Wisconsin Department of Transportation
WSOR	Wisconsin and Southern Railroad
WWTP	Waste Water Treatment Plant

Glossary

100-year recurrence event – 100-year event – an event, in this case rainfall or flooding, with a 1% or 0.01 probability of occurring in any given year. The occurrence of a 100 year event does not decrease the chance of a second 100 year event occurring later that year or any year to follow.

Acre-foot – the amount of water it would take to cover one acre of land one foot deep (43,560 cubic feet or 325,851 gallons).

Anecdotal – based on or consisting of reports or observations usually by unscientific observers and/or second- or third-hand observations.

Antecedent Moisture Condition (AMC) - A measure of soil moisture at the onset of a rainfall event. The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service (SCS), defines AMC in terms of total rainfall during the 5 days immediately preceding the rainfall event. In hydrology calculations AMC ranges from 1 to 4 defined as: 1 - I Dry; 2 - II Normal; 3 - III Wet; 4 - IV Frozen or Saturated. AMC 2 is commonly used for most design work. AMC 3 can be used to study wet conditions such as spring rains after winter snowmelt.

Backwater - Backwater is the increase in the upstream water surface level resulting from an obstruction in flow, such as a roadway with a bridge or culvert opening.

Basin – see drainage basin

BMP – Best Management Practices – Term used to describe accepted activities, prohibitions of practices, maintenance procedures, and or other management practices to prevent of reduce pollution of stormwater runoff.

Big Hollow – the geographical region of the Town of Spring located north of USH 14 along CTH G. Big Hollow is mapped along an intermittent stream on USGS topographic maps. The mouth of the Big Hollow watershed lies within the general location of Sections 26, 27, 34 and 35; T9N; R3E; Town of Spring Green and northern portions are in the Town of Franklin and the Town of Bear Creek..

Bluff(s) – in his report generally refers to the dolomite and sandstone formations north of the dry prairie regions of the Village and Town of Spring Green Wisconsin.

Curve Number - (also called CN) is factor used in hydrology calculations for predicting runoff or infiltration from rainfall. The curve number method was developed by the USDA Natural Resources Conservation Service (formerly SCS). The runoff curve number is based on the area's hydrologic soil group (HSG), land use, land treatment and hydrologic condition (wet or dry). The higher the curve number the greater the anticipated runoff.

Cfs – cubic feet per second, a unit of measure of flow (448.8 gallons per minute).

Drainage – stormwater runoff

Drainage Basin – an extent of land within which water flows down into a specified body, such as a river, or lake. (see watershed)

Driftless Area – the region, consisting of primarily southwest Wisconsin, that escaped glaciation in the last glacial period. The term "driftless" indicates a lack of glacial drift, the material left behind by retreating continental glaciers.

Dry Pond - A term used in stormwater management to describe depressions created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Dry ponds are designed to dry out between storm events, in contrast with wet ponds, which contain standing water permanently.

Escarpment – bedrock escarpment – for the purpose of this report bedrock escarpment refers to the geographical area along the steep face of the local dolomite and sandstone bluffs transitioning to the flat terraces at the base of the bluffs.

Forebay - an area at the inlet of a stormwater pond used to settle out larger sediments so that sediment removal will be easier

Groundwater Recharge – the process of surface water infiltrating into the soil and influencing groundwater levels and groundwater quality

Hydraulic grade line – for open-channel flow (flow with a free surface), a line corresponding with the water surface; under pressure (such as pipes flowing full), the hydraulic grade line is at the level water would rise to in a small vertical tube connected to the pipe.

Ordinary High Water Mark - In 1914, the Wisconsin Supreme Court defined the OHWM as "the point on the bank or shore up to which the presence and action of the water is so continuous as to leave a distinct mark either by erosion, destruction of terrestrial vegetation or other easily recognized characteristic." The Ordinary High Water Mark determines the extent of public water and activities below or near the OHWM often requires DNR permitting.

Outfall – A point of discharge of stormwater or wastewater. Generally the end of a pipe or swale.

Prairie View – Generally referring to the Prairie View residential development located in the Town of Spring Green northwest of the west intersection of USH 14 and STH 23. This area suffered the worst damage to residential homes in the 2008 and 1993 flooding.

River Valley - a local reference to the geographical region along the Wisconsin River in the area of the communities of Arena, Spring Green, Plain, and Lone Rock. For the purpose of this report it generally refers to lands within the Town and Village of Spring Green Wisconsin consisting of the areas west and north of the Wisconsin River from Spring Green to the Sauk/Richland County Line extending north to the local dolomite and sandstone bluffs.

Sanitary sewer – a pipe that conveys sewage (wastewater from homes and businesses).

Storm Event – a rainfall event of a specific duration, intensity, and frequency. (see 100-year event).

Stormwater – water produced by precipitation.

Surcharge – in a gravity-flow piping system, when a pipe is flowing full, surcharge is the height to which the water backs up.

Time of Concentration (Tc) - The Tc is generally defined as the time required for a drop of water to travel from the most hydrologically remote point in the Subbasin or watershed to the point of collection. Depending on the hydrologic methods employed Tc is calculated differently. The most common approach, and what was employed in this study, is to follow USDA Natural Resources Conservation Service (formerly SCS) methodology.

Wastewater – water (usually non-potable) discharged by domestic and industrial water users and/or stormwater.

Watershed - an extent of land within which water flows down into a specified body, such as a river, or lake. (also see drainage basin)

Wetland Pond – A term used in stormwater management to describe a stormwater control feature that contains a permanent pool of water in addition to a volume of stormwater storage that fluctuates with rainfall. The permanent pond of water is intended to provide water treatment by allowing the settling of sediment.

Section 1 - Introduction

1.1 Purpose of this Investigation

In June 2008 multiple severe rainfall events caused widespread flooding throughout southwest Wisconsin. The flooding caused damage throughout the region. Homes were damaged or even swept away, dams were breeched, crops were destroyed, roads were flooded, public works systems failed, and residents were displaced. Although they received partial reimbursement from FEMA, local governments spent substantial portions of their operating budgets and lost countless man-hours in response to the flooding.

The Town and Village of Spring Green Wisconsin were hit particularly hard by the flooding. These communities are located in Sauk County in the lower Wisconsin River valley. Although the Wisconsin River did not reach flood stage, nearly 4,400 acres were flooded by localized stormwater runoff. Due to the nature of the local terrain vast areas of the valley do not drain to the Wisconsin River or its tributaries. The floodwaters sat in the Spring Green area for several months while other communities were afforded the opportunity to start rebuilding. All told, the Spring Green area suffered millions of dollars in agricultural, business and personal losses. Numerous businesses and homes were damaged, many beyond repair. As of the date of this report many residents are still displaced by the flooding.

In September 2008, Jewell Associates Engineers Inc. was contracted by the Town of Spring Green, with financial assistance provided by the Village of Spring Green and Sauk County Wisconsin, to investigate means of alleviating localized flooding. The purpose of the study was to provide the Town of Spring Green with the necessary information to aid a decision on what, if any, construction projects should take place to deal with future flooding. The areas of study included: investigating the creation of a retention area south of the Village of Spring Green for collection of stormwater discharged from the Village of Spring Green onto lands owned by Terry Shifflet; draining areas east of STH 23 and north of USH 14 east to the Wisconsin River; draining lands near the Tri-County Airport to the Wisconsin River and/or Bear Creek; and exploring options to control stormwater in the principle area of concern, the Big Hollow watershed.

For each of these areas the investigation was to study the impacts, costs, and benefits of the alternatives. Based on the study preferred alternatives were to be recommended and potential avenues of funding and governance for alternatives researched.

This report summarizes the findings of the River Valley Flood Control Investigation.

1.2 Background on Area of Investigation

The Village and Town of Spring Green are located in southwest Wisconsin approximately 35 miles west of Madison, Wisconsin. This area is within Wisconsin's Driftless Area, which was untouched by glaciers in the Paleozoic age. Characterized by steep sandstone cliffs and deep river valleys, the Driftless Area encompasses much of southwest Wisconsin and parts of Illinois, Iowa and Minnesota. The area of this investigation is what is locally referred to as the River Valley Area, a local reference to the geographical region along the Wisconsin River in the area of the communities of Arena, Spring Green, Plain, and Lone Rock. For the purpose of this report it generally refers to lands within the Town and Village of Spring Green, Wisconsin consisting of the area west and north of the Wisconsin River from Spring Green to the Sauk/Richland County Line extending north to the local dolomite and sandstone bluffs.

The area at the base of the local bluffs extending to the Wisconsin River is also characterized as Wisconsin Desert because of the vast sandy plains and windblown dunes. The "desert" in the valley bottom between the sandstone bluffs and Wisconsin River is relatively flat and poorly drained. The valley bottom is primarily sand and gravel which allows for water infiltration under normal conditions while the limestone top layer of the bluffs resists rainfall infiltration. Under normal conditions most of the runoff from the bluffs comes to rest in the River Valley and evaporates or infiltrates into the soils at the base of the bluffs.

Historically, silts have deposited at the base of the bluffs further complicating the lack of natural drainage throughout the River Valley. This is the case at an important region in this study, the area referred to as Big Hollow. The silts slow infiltration of rain water at the base of Big Hollow, and during intense storms localized flooding can occur. The runoff problems in the Big Hollow region have been described by Exo and Gotkowitz as follows: "During smaller storms, this runoff can infiltrate the permeable sand and gravel terrace deposits at the base of Big Hollow, which raises the elevation of groundwater levels in localized areas. During the June [2008] storms events, this excess of "over-land flow" of storm water from Big Hollow raised the water table to such an extent that low spots in the landscape have been flooded." Source: Exo and Gotkowitz, 2008

"Similarly, the bedrock escarpment north of the valley is an area of elevated runoff during intense rainfalls because the rainfall may exceed the rate at which the limestone and sandstone can absorb water. This causes a high volume of runoff from the bedrock slope to the water table in the sand and gravel along the base of the slope. This raises the water table (and in extreme cases, floods) areas from west to east along the north side of the valley " Source: Exo and Gotkowitz, 2008

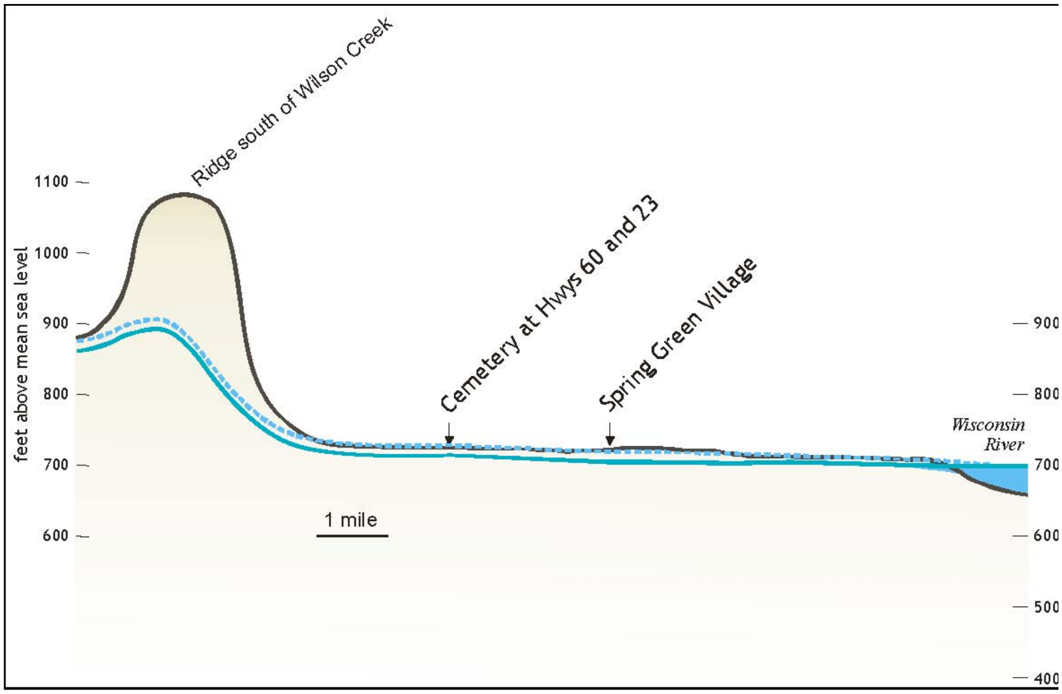


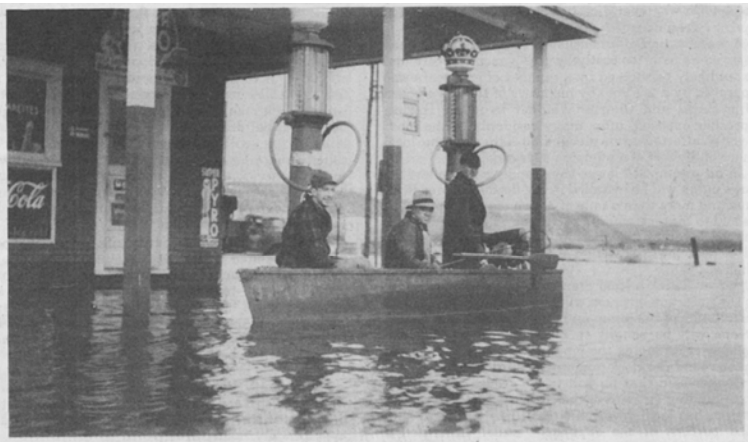
Figure 1.2-1. Cross section from north to south, from bedrock uplands to the Wisconsin River. The solid line is the normal water table and the dashed line shows 2008 conditions, with a higher-than-normal water table. Areas such as the cemetery, which are low in elevation, are more prone to flooding than areas where the water table is normally deeper, such as areas of the village. Source: Exo and Gotkowitz, 2008

Groundwater was an important factor in the 2008 flooding and therefore was subject to further study. As shown in Figure 1.2-1, the water table in the Spring Green river valley tilts and flows toward the Wisconsin River. In general the water table is several feet deep to tens of feet deep throughout the Valley. Soil borings and excavation throughout the Village of Spring Green from 2003 to 2007 showed a typical groundwater depth in the Village to be 15 feet deep. After record rainfalls in June 2008, the water table rose to the surface in several areas between the bluffs to the north and the Wisconsin River to the south.

Areas closer to the Wisconsin River within the Village of Spring Green primarily did not flood. The ground surface elevation is lower than north of the Village, however the normal depth to groundwater ranges from about 17 to 25 feet below ground surface in the Village and 4 or more feet deep in areas like the golf course. The 10-foot water table rise seen typically throughout the northern extent of the River Valley did not reach the ground surface in some of these areas.

1.3 Past Flood Events

2008 was not the first time the River Valley suffered flooding of the prairie lowlands. Anecdotal evidence suggests some of the areas flooded in 2008 were more wetland or even lake-like prior to conversation to agricultural and residential use. Known historic floods inundated the region in 1938 and again in 1993. There is unverified information severe flooding also occurred around 1900. Local newspaper accounts of 1938 and 1993 events suggest the flooding occurred in many of the same areas affected by the 2008 flooding. Information submitted for disaster assistance related to the 1993 flood suggests flooding occurred on a much smaller scale once in the mid-1970s and again once in the mid-1980s.



Water has been a problem in the area north of Spring Green during other eras. Above, Larry Larson, Herb Davis, and Cyril Weston filled up their boat motor at the gas station located at Highway 23 and the present County Highway G (then US 14) during high water in 1938. (contributed photo courtesy of Kaaren Larson)

Figure 1.3-1. 1938 flooding north of the Village of Spring Green
Source: August 4, 1993 Spring Green Home News contributed by Kaaren Larson

A slight difference in conditions in the 1993 flooding was that the Wisconsin River had reached a 25-year high at the dam in Prairie Du Sac on June 30, 1993 as areas throughout the upstream regions of the river basin had seen above normal rainfall. Elevated groundwater flooded basements in May and June rose to flood the valley in July and August. In 1993 the flooding in the River Valley apparently resulted from a series of small regular rainfall events that occurred throughout the spring. Conversely in 2008 the river was not at such levels and the contributing June storms were very significant in nature. A FEMA memorandum from July 28, 1993 reports 2,600 acres were flooded as of that date.

The Prairie View subdivision, northwest of the Village of Spring Green, was significantly affected in 1993 and the Big Hollow watershed was again suggested as a contributing factor. In 1993 the homes within the Prairie View subdivision were also inundated by floodwater. As it was in 2008 basements were flooded and foundations damaged. A June 1994 Wisconsin Department of Development report indicates at least 36 homes in the Prairie View subdivision and surrounding area were damaged in 1993. The report notes similar conditions to the 2008 flooding in that the homes were flooded, not by high river water but by saturated ground coupled with flash flooding. The report also references homes having 18-25 inches of water in basements nearly a year after the event.

The Wisconsin National guard brought a 1,000 gpm pump in, and from August 5, 1993 to August 25, 1993 an estimated 25.5 million gallons of water were pumped from the Davies Road/Jones Road area east to the Wisconsin River. The water level dropped a few inches during the pumping, however thunderstorms soon returned the flooding to its original level. The pumping was thought to not have more effect than the natural infiltration and evaporation and was halted on August 25, 2008. An estimated 25.5 million gallons of floodwaters was pumped through assistance from FEMA. FEMA provided $23,000 to fund the pumping experiment.

Figure 1.3-2. 1993 pumping operation.
Source: Home News photo

Throughout the summer of 1993 discussions of digging a ditch from Big Hollow to the Wisconsin River and extending stormsewer from the reconstruction of Wood Street in the Village of Spring Green took place. Likely due to the substantial cost and undetermined benefit, these plans were not executed.

A point relevant to this study was information related to a 1994 drainage feasibility study conducted by Westbrook Engineers for Hartung Farms in response to the 1993 flooding. This Westbrook report is often referenced locally, but a complete copy has not been located to date. Based on some of the mapping located the proposed drainage route passes through multiple areas that area now developed. A January 1994 DNR memorandum discusses the findings of this study. The DNR memorandum suggests issues of note:

> The DNR memorandum points out an observation not made in the Westbrook study, that the area at the base of the bluffs is a significant contributor to stormwater runoff in addition to the Big Hollow flows.
>
> The Westbrook study proposed swales of similar sizing and slope to those proposed by this study. The 1993 proposal called for swales up to 80 feet across at the top and at slopes as flat as 5 feet per mile (0.00095 ft/ft).

The DNR suggested a flatter and smaller ditch with a 5-foot bottom and a 2.5 ft/mile slope (0.00047 ft/ft) would carry an equivalent volume of water to the 1993 report. Based on calculations using Manning's equation at the suggested design flow depth of 3 feet, this ditch was sized to accommodate 100 cfs. This is significantly less design flow than suggested by this 2009 investigation.

Finally, the memorandum suggested eliminating the Big Hollow floodwaters will not eliminate groundwater issues throughout the region.

Town records indicate the estimated costs of the Westbrook proposal for ditching Big Hollow to the River with a connector ditch along USH 14 from the Prairie View subdivision were $735,000. Adjusting this estimate based on the consumer price index (CPI) data studied by the US Department of Labor this translates to $1.05 million in 2009 dollars. As a comparison based on an estimated 3% annual inflation, the estimate is $1.18 million in 2009.

Figure 1.3-3. 1993 Flooding in the Prairie View Subdivision.
Photo is facing southwest at the intersection of STH 23 and CTH G. This same area flooded in 2008.
Source: July 28, 1993 Spring Green Home News courtesy of Wisconsin River Aviation

The costs of the 1993 flooding were not completely explored for the purposes of this report. Available town and local records of the event were reviewed. From all indications FEMA monies were secured for disaster relief by the town and individual homeowners were provided funds for flood proofing homes. Individual homeowner payments are not disclosed to the town so information was not readily available. In terms of the township, FEMA and state funds were granted for temporary levy construction and removal, road repair, and sediment removal for which the town was reimbursed over $28,000. The town's out of pocket cost for these projects was approximately $6,900. FEMA assistance was also provided via the Army Corps of Engineers for the three-week

August 1993 pumping operations. The cost of pumping alone in that period was an additional $23,000. Adjusting for inflation the cost of just these town repair projects would reach $85,000. It is assumed the Town's total cost related to the response was higher than this amount, but documentation was not readily available.

In terms of grants, the Town also applied for Wisconsin Disaster Recovery Assistance for $385,000 in public facilities assistance and $604,000 in housing funds. There were also submissions to government agencies for constructing ditches ranging from $485,000 to $735,000. These requests were mostly denied.

By all appearances, the Town's effort to secure Wisconsin Disaster Recovery Assistance funds ended in June 1994 after being formally denied that spring. It is assumed by summer of 1994 floodwaters and groundwater had receded and so did the plans to dig a ditch to drain the Big Hollow watershed.

1.4 2008 Event

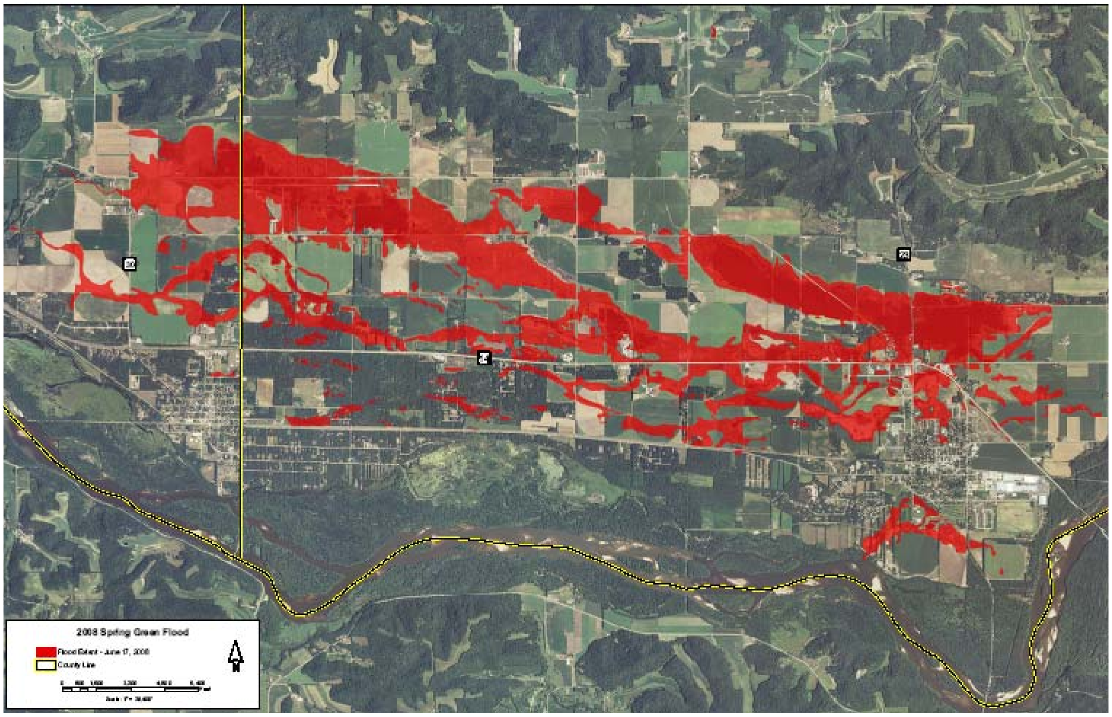


Figure 1.4-1. Extent of June 2008 Floods.
Flooded area shown in red. Roughly 4,400 acres
Source: Developed by Fred Iausly, Town of Spring Green, from field work, and data and June 17, 2008 imagery provided by Sauk County, the Wisconsin Department of Military Affairs, and the US Farm Service Agency.

It is not critical to or within the scope of this study to chronicle all the events leading up to and resulting from the June 2008 rain events that affected the River Valley area. It is important however to provide some information on the flooding to express the magnitude and unique nature of the event and the resulting losses. Additional information can be found in the references listed in this study, from local records and officials, and newspaper accounts.

In spring 2008 groundwater elevations were high due to heavy rainfall in August, 2007 and runoff and infiltration of melting snow from the record snowfall of the previous winter. Two severe storm events, the first on June 7th and 8th and a second on June 12, 2008 hit the region and caused massive flooding. The resultant flooding eventually led to a Presidential Disaster Declaration for Public Assistance submitted and granted for 30 Wisconsin counties, including Sauk County. Montgomery Associates Resource Solutions, LCC (Montgomery), a subconsultant on this study, reported the June 7th/8th rain event to be 5.1 inches and estimated the June 12th event produced 5.0 inches of rainfall. This rainfall data appears to be supported by a WisDOT commissioned study titled “Assessment and Documentation of Flooding Locations for Select State Highway

Facilities and Drainage Crossings, Work Order Contract No 0656-13-52", 2008." The report lists the June 7th/8th event at 5.035 inches and the June 4-13, 2009 10-day rainfall at 10.82 inches as shown in figure 1.4-2. According to Montgomery the June 7th & 8th and June 12th events also exceeded the 5-day 100-year rainfall depth for this region. Individually the events were comparable to the local 50-year 24-hour rainfall and approached the 100-year event of 6.1 inches.

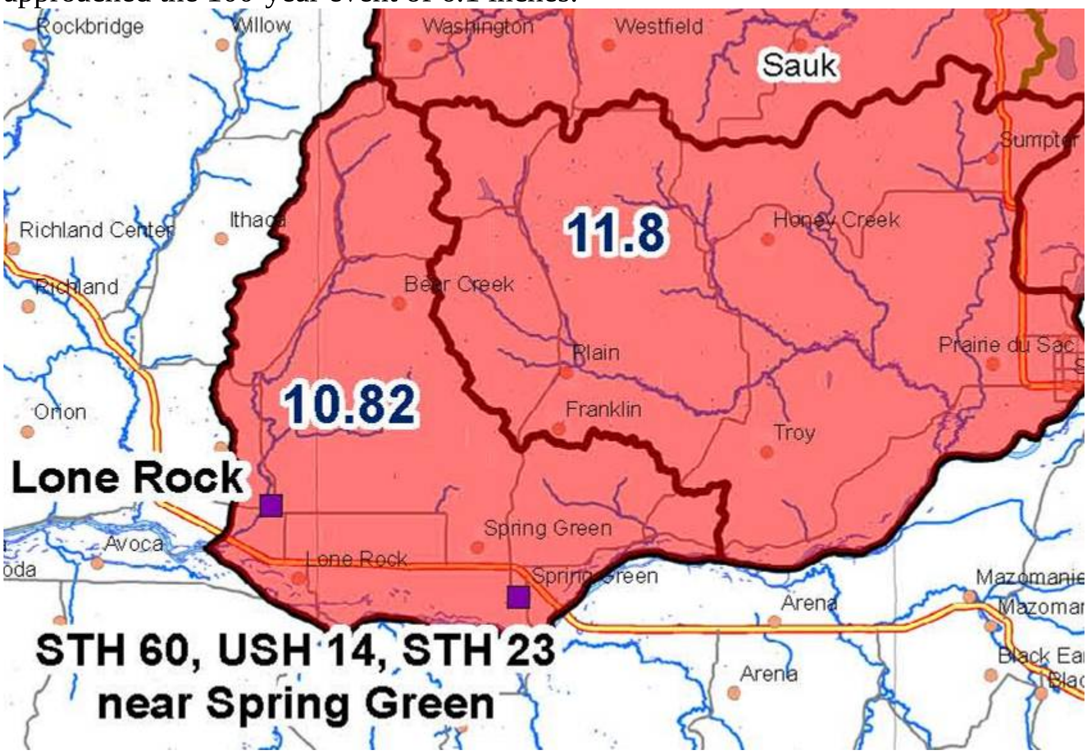


Figure 1.4-2. June 4-13, 2009 10-day precipitation
Source: "Assessment and Documentation of Flooding Locations for Select State Highway Facilities and Drainage Crossings Work Order Contract No 0656-13-52", 2008."

The storms in June fell on soils that were largely saturated with a much higher than normal water table elevation. At many locations these conditions caused groundwater to breach the ground surface and pond. The June 7th and 8th event caused flooding throughout the township but had yet to largely affect the Village of Spring Green except for areas along the northeast side of Winsted Street in the Cross Lanes Estates area and other localized incidents. By the evening of June 8th the Prairie View Subdivision northwest of the intersection of STH 23 and USH 14 started to show signs of flooding. By 3 a.m. June 9th, local emergency responders started to evacuate residents from their homes and cut power to the area. In some cases homeowners were evacuated by boat even though their homes were several miles from navigable water. Homeowners and volunteers began sandbagging operations soon thereafter and continued for many days.

By the morning of June 9th the extent of the flooding throughout the valley became apparent. Although not as dramatic as the sudden draining of Lake Delton, the impact of the flooding on the River Valley area was devastating. Several square miles of farmland were inundated. Groundwater and surface water was pouring into homes in the Prairie View subdivision and elsewhere. Flood control walls and structures installed in response to the 1993 flooding had failed. Displaced residents were relocated to evacuation centers and sandbagging operations continued in an effort to reduce damage in Prairie View and elsewhere.

Figure 1.4-3. Sandbag operations at the Village of Spring Green Public Works Shops
Source: Undetermined internet photo.

On June 12, 2008 the second significant storm hit the region. In addition to the township the Village of Spring Green started to feel the effects of the flooding. Groundwater ponded in farmland immediately north of the Village and entered a sanitary sewer line in this area. Coupled with floodwaters entering the Prairie Sanitary District in the township, the flows started to overtax the Village sanitary sewer system resulting in bypassing of the wastewater treatment plant and sewer backups in homes. Groundwater was also entering basements of homes throughout the northern extent of the Village. The township began pumping operations at the intersection of Wood and Somerset Streets discharging the follow to the storm sewer on Wood Street. This operation continued for weeks. 24-hour police patrols of flooded areas continued. By 7 p.m. the Town closed several roads due to washouts, the Prairie View subdivision and The Prairie House Motel were submerged, and sandbagging efforts were increased. It was later determined nearly 4,400 acres were flooded by localized stormwater runoff.

On and after June 12th temporary sanitary facilities were brought into the Village and Town as the sanitary sewer systems were overtaxed with ground and floodwater and failing. The Village eventually advised all users of the system to cease discharge from homes to the system and use the temporary facilities. Dumpsters were brought in to allow residents to dispose of flood damaged materials.

In the days following the June flood events, the Village and Town discovered and worked to correct flood damage throughout the valley. In the Village several area of sanitary sewer pipe were damaged and in need of replacement. Village well #1 was damaged and required repair. Village stormwater retention facilities at the golf course flooded, causing damage to aeration equipment and flooding neighboring cropland. It was later determined the ponds had been modified after construction and the cropland flooding may not have occurred otherwise. The Village also dealt with the repair of damage to several streets and lost undetermined hours of public works and police employees for attending to flood issues that otherwise would have been directed to everyday operations. Within the township similar public losses were realized mainly involving damaged roads and drainage structures and continued pumping operations. Again local officials and the town patrolman directed all their efforts at flood response and away from normal operations.

Although in part eventually compensated by FEMA, the Town and Village of Spring Green spent substantial portions of their 2008 operating budgets and lost countless man-hours in response to the flooding.

Throughout June the Village and Town worked to address the impact of the floods and the water started to recede. Then on July 9th and 10th, 2008 heavy rains brought the flooding back to near June levels. Sandbagging and flood response was again initiated however it did not require the effort of the June events. Unfortunately, the damage from flooding was already done, and the communities were already well versed in the means of response.

Figure 1.4-4. Flooding in the Prairie View Subdivision
Source: FEMA photo.

There are several anecdotal theories as to what may have contributed to the flooding of 2008. Changes to the local state highways and groundwater impacts due to a state owned natural area called Bakken's Pond were both blamed. In 2008 Exo and Gotkowitz explained "The various highways and roads in the area have a minimal effect on groundwater flow patterns. The impediment to groundwater flow probably only extends 25 to 50 feet from the roadside ditch. There is more ponding of water north of Highway 14 than directly south of Highway 14 in areas where the land surface is lower to the north. In other words, the roadways have not caused the flooding present today. When groundwater elevations are high, depressions in the land surface elevation dictate where flooding occurs. Similarly, berms constructed around Bakken's Pond do not cause extensive flooding of the landscape; the berms are relatively small and affect only a small area adjacent to the pond and wetland". A June 3, 2008 press release indicates the DNR had drawn down Bakken's Pond for habitat management purposes prior to the flooding.

WisDOT sought to address the highway effects on surface water in a 2008 study. The study states: "The flooding for the Spring Green and Lone Rock areas are unique situations. There is a perception or belief by some people in the area that WisDOT had removed culverts that at one time crossed USH 14/STH 60 between Lone Rock and Spring Green. Roadway plans obtained for review under this assessment indicated that sections of USH 14 and STH 60 between West Sauk County line and Spring Green underwent improvements in 2003 and that the few cross culverts that were removed were replaced. The following is a summary of relevant findings from this review.

• An existing culvert crossing USH 14, located approximately one-third mile east of Porter Road, was left in place. No work was done on this culvert.
• An existing cattle pass crossing USH 14, located immediately west of Dyke Road, was removed and a 12-inch reinforced concrete pipe was installed.
• Other improvements took place on USH 14 including milling and relaying the existing asphalt and installing an additional layer of new asphalt which raised the profile about 4 inches. The minor profile change had little if any effect on flooding in the area."

The report ultimately concludes, and this study agrees, the state highways in the region did not lead to the flooding in 2008. It is possible highway drainage caused issues for landowners upstream of the highways, however additional drainage facilities would have only directed floodwaters to downstream neighbors because there is no outlet to the river. Ultimately local topography throughout the region is the primary cause of flooding.

One final misconception is that the Wisconsin River contributed to or caused the 2008 flooding. Although the Town and Village are located in proximity to the Wisconsin, the 2008 flooding occurred miles from river. Areas adjacent to the river may have suffered localized flooding, but the damage caused in the Village and Town of Spring Green and in particular the Prairie View subdivision was caused by localized stormwater runoff, elevated groundwater levels and the lack of effective drainage due to topography. This was the conclusion drawn by the Wisconsin Department of Development after the 1993 flooding, and stormwater runoff and elevated groundwater was again the cause of flooding in 2008. The areas inundated by floodwaters were miles from mapped floodplain and from navigable water for that matter. This fact is supported by many of the references listed in this study including Exo and Gotkowitz, 2008 and WisDOT 2008. The uniqueness of this situation lends difficulty to finding a means to both address and correct the problem.

1.5 Cost of Flood Response and Relief

The financial effects of the flood were staggering especially when considering the small size of the communities involved. A report prepared by Denise Brusveen, Sauk County UW Extension Agriculture Agent estimates over $9 million in agricultural losses were suffered by area farmers. A survey conducted by Jewell Associates in September 2008 indicates local businesses in the Town of Spring Green suffered up to $1.4 million in property and inventory damages and $850,000 in lost revenue. The report did not account for loss of business in the Village. A survey of private losses was not conducted for the purposed of this report, however FEMA data gives an indication of the magnitude of the damage to private residences. Data obtained from the Wisconsin Department of Military Affairs for the period through February 2009, shows under the FEMA Individuals & Households Program (IHP) used for home damage 270 households applied for assistance and 191 claims were paid totaling $1,068,136.46. The Housing Assistance (HA) program paid another $1,056,540.08 in assistance. FEMA also paid $27,573.36 in assistance classified as “other needs” (ON).

The Village of Spring Green incurred an estimated $139,938.26 in flood response costs submitted to FEMA and an additional $10,314 in ineligible costs. The Village anticipated receiving $126,184.32 in payments from FEMA. Of the $139,938.26, $7,125.50 was for roadway repairs, and $58,942.68 for sewer and water system repairs, with the remainder for general flood response needs, labor and equipment, and contracted services such as dumpsters and portable sanitary facilities. Again this does not take into account loss of normal workday productivity. Over 1,700 hours of volunteer labor were accounted for by the Village and much more was likely contributed.

The Town incurred over $178,794.90 in roadway repairs and $114,551 in flood response costs. Compensation from FEMA and the state for the roadway repairs totaling $126,324.63 is anticipated and $79,471.53 for the response costs. Only a partial payment has been received to date.

Figure 1.5-1. Failure of Post 1993 Installed Flood Protection in the Prairie View Subdivision
Source: Jewell Associates – Taken July 2008.

Section 2 – Precipitation Trends and Flood Recurrence

2.1 Precipitation Trends

The floods in the Town of Spring Green are not typical floods where a stream or river overflows its banks and inundates floodplains and floodways. None of the flooded areas where significant damage occurred in the River Valley were located in a delineated floodplain on FEMA National Flood Insurance Program Flood Insurance Rate Maps (FIRMs) for the area. The nearby Wisconsin River did not overflow its banks at any time during these floods. River flow data was of no use to the project in determining the magnitude of the event and the probability of recurrence. Rainfall data did give some indication of the magnitude of the event. As discussed previously, Montgomery estimated the June 7th/8th event to be 5.1 inches and the June 12th event produced 5.0 inches of rainfall. The two events exceeded the 5-day 100-year rainfall depth for this region. Individually the events were comparable to the local 50-year 24-hour rainfall and approached the 100-year event of 6.1 inches. In terms of runoff the storms produced a volume of water that neared or exceeded 100-year events under unsaturated conditions. During the June events, elevated groundwater and saturated soils led to an increased magnitude of the flooding.

Typically, the water table in the flood prone areas of the River Valley is located several feet below the land surface. Soils are for the most part sandy and normally have ample capacity to absorb rainfall and snowmelt. However, groundwater monitoring in the region suggests a trend of recurrent high water table occurring every four to five years (figure 2.1-1). It is during these times of high water table, when the soils in the valley have little or no capacity to absorb additional moisture, that the region is vulnerable to flooding.

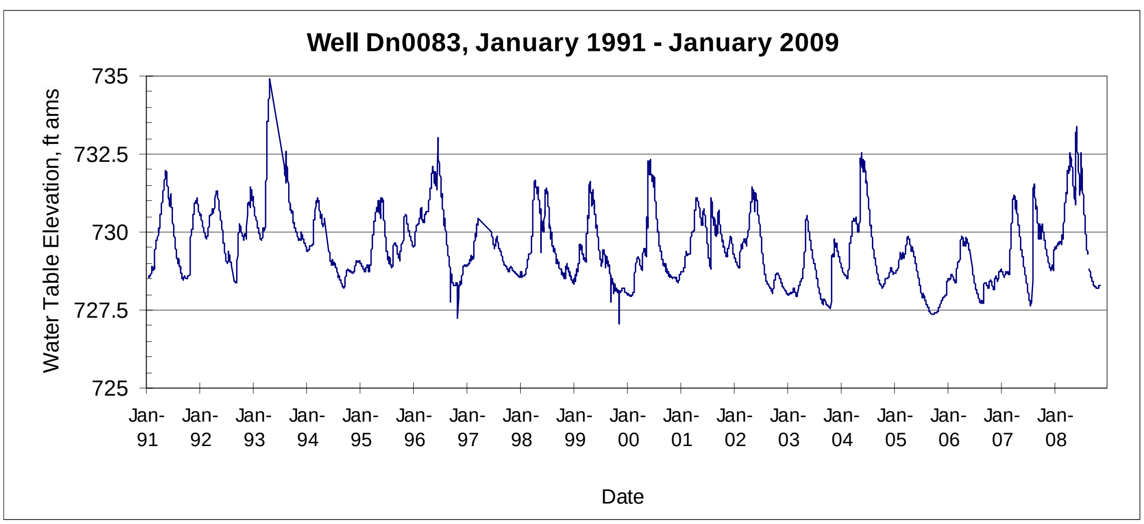


Figure 2.1-1. – USGS monitoring well DN0083 near Mazomanie Wisconsin

When considering the trends in regional high water table one must also consider trends in rainfall. Whatever the underlying causes, there has been indications of climate change spanning several decades. Whether the climate change is due to human actions and global warming or to variability in natural cycles can be debated, but data suggests an increase in average annual precipitation. Some predict a trend toward less frequent but more substantial rainfall events. At the time at least the trend towards more extreme events can be observed in the region. For example, National Weather Service records for nearby Madison show that six of the top ten 24-hour rain events since 1879 when recordkeeping began have occurred in the past 12 years. (Figure 2.1-2)

Amount	Date
1. 5.31 inches	9/7-8/1941
2. 5.27 inches	6/7-8/2008
3. 5.20 inches	9/12-13/1915
4. 5.00 inches	8/18-19/2007
5. 4.51 inches	6/17/1996
6. 4.38 inches	5/21-22/2004
7. 4.32 inches	7/21/1881
8. 4.21 inches	7/15-16/1950
9. 4.11 inches	6/8/2008
10. 4.11 inches	5/17-18/2000

Figure 2.1-2 Top Ten 24-hour Rain Events 1879-Present for Madison WI.
Source: National Weather Service, Sullivan /Milwaukee

Data from the University Wisconsin Center for Climatic Research shows in the 1990s Madison had 12 two-inch 24-hour rain events. Since 2000, there have been 25 two-inch rains reported. During the 1990s Madison had 2 three-inch 24-hour rain events. Since 2000, 8 three-inch rains have been logged.

The effects of trends in climate and rainfall on the River Valley are two-fold. First, increasing extreme rainfall events coupled with varying trends in high groundwater could lead to an increase in frequency of flooding in the River Valley area. Second, this rainfall trend suggests the designs for flood control in the River Valley should consider events of larger magnitude than conventional design standards may suggest. A trend toward at least checking designs against storms of larger magnitude is suggested in referenced engineering literature such as CE News (Barrett 2008) and WisDOT 2008.

2.1 Flood Recurrence

Based on the unique nature of the flooding in Spring Green the determination of flood frequency by traditional means is difficult. River gauging stations are of little use and even rainfall data can not be judged without considering the importance of groundwater levels.

In simple terms, based on the actual history of flood events in the Town of Spring Green being three significant flood events in the past 70 years an average recurrence interval of 23 years can be calculated. [T=N/n where the recurrence interval (T) is number of years in the record (N) divided by the number of events (n)]. This can not be compared to methods used to calculate river flood recurrence. River flood recurrence intervals are calculated based on the ranked magnitude of various flow events and is a slightly different and a little more complicated process.

With the aforementioned trends in precipitation and the decrease in years between events it is reasonable to assume the simple recurrence interval will decrease to below 20 years.

Section 3 – Study Scope and Approach

3.1 Scope of Study

Jewell Associates Engineers Inc. was contracted by the Town of Spring Green, with financial assistance provided by the Village of Spring Green and Sauk County Wisconsin, to investigate means of alleviating localized flooding. By contract the investigation was to focus on the following areas:

A. Big Hollow – including up to three alternatives for alleviating the flooding

B. Investigation of alternative routes to drain, by a waterway system, the lands near the airport to the Wisconsin River and/or Bear Creek.

C. Investigate available alternatives, if any, to provide relief by a drainage system of waters east of STH 23 and north of USH 14 east to the Wisconsin River.

D. Investigate the creation of a retention area south of the Village of Spring Green for collection of stormwater discharged from the Village of Spring Green onto lands owned by Terry Shifflet.

Each alternative was to be investigated for several criteria including: effects on groundwater; effectiveness in mitigating future flooding; natural resource impacts; impacts on roadways and railways; roadway and structure improvements; utility impacts; landowner impacts (land and farming operations); cost; maintenance; and life cost and cost-benefit analysis.

In addition Jewell was to: investigation required coordination with State and Federal Agencies, the railroad operator, and utilities; hold public informational meetings and other updates to keep the public informed; research funding opportunities; and finally provide a recommendation for the preferred alternative.

JEWELL associates engineers, inc. Engineers - Planners - Surveyors

3.2 Study Approach

In developing the scope of this study Jewell was working with Madeline Gotkowitz, hydrogeologist, at the Wisconsin Geological and Natural History Survey (WGNHS) to learn about the influence of groundwater on the 2008 flooding. Gotkowitz through WGNHS had studied the region and developed a computer model to simulate groundwater flow. Because of her responsibilities at WGNHS Gotkowitz was not available to further develop the model to meet the needs of this study. One of the firms Jewell and the Town were referred to was Montgomery Associates Resource Solutions in Cottage Grove, Wisconsin. In the fall of 2008 Jewell hired Montgomery as a subconsultant on the study and soon after worked to refine the approach to the study.

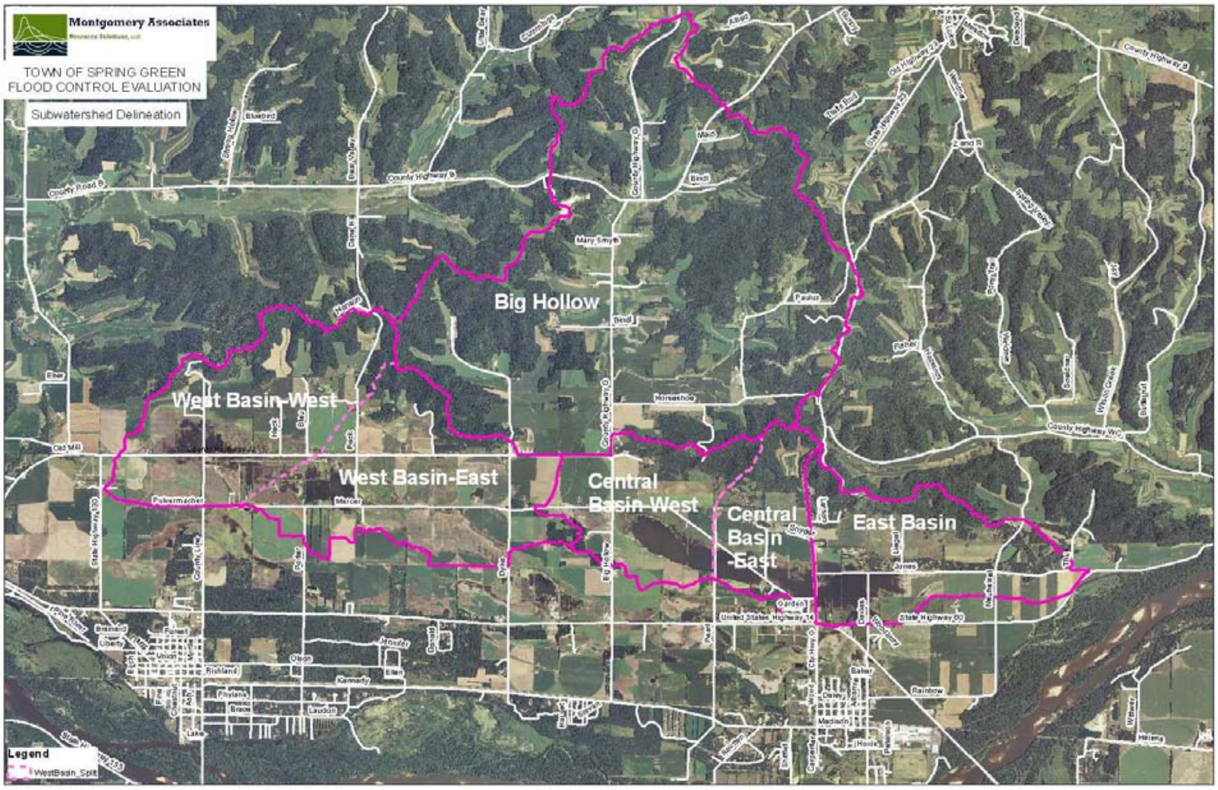
It was determined Montgomery would provide support for the groundwater portion of the study. Because of the interaction of surface water and groundwater Montgomery was to also provide to surface water flow data and hydrologic modeling for the study areas in the township. Jewell staff was to conduct the hydrologic modeling in the Village and meet the remainder of the study requirements; providing survey and gathering available survey data, developing computer surface models for the Town; providing preliminary engineering and opinions of probable cost for drainage solutions, and researching potential funding sources.

In terms of groundwater several objectives were determined:

- Monitor existing water table elevations at various locations and identify the trend in water levels
- Evaluate how groundwater levels may be impacted by changes in recharge
- Estimate the average linear velocity of groundwater movement
- Determine potential influence of the Wisconsin River on water table elevations

The groundwater study approach and findings are further discussed in Section 4 and Appendix A of this report.

For the surface water study, Jewell provided surface model data to Montgomery for use in developing hydrologic models for the three study areas in the township. Montgomery studied the rainfall events from June for use in the model and also gathered data for regional 10-year and 100-year rainfall events. Montgomery then delineated the subwatersheds (areas draining to a similar point) for the township. The Town was divided into several basins as shown in figures 3.2-1 and 5.1-1.



Figures 3.2-1. River Valley Flood Control Study Subwatershed Map
Source: Montgomery, 2009.

The primary subwatersheds were; Big Hollow, the Central Basin at the base of Big Hollow, the East Basin north of the Village of Spring Green, and the West Basin near the Tri-County Airport. The West and East Basins were further divided to reflect actual or modeled conditions. The West Basin was divided to reflect the ponded conditions on the southeast and northwest side of the airport. The East Basin was divided at Pearl Road for the purposes of modeling storage areas at the base of Big Hollow. The land use characteristics of each basin were then determined for the purpose of modeling runoff.

The hydrologic models were then used to calculate anticipated runoff from various storm events. It is important to note the models were designed to reflect the conditions encountered during the June 2008 storm events. These conditions were high soil moisture conditions or high water table conditions in the Central, Eastern and West Basins. When modeling the June 12th event consideration was given to the Big Hollow basin becoming saturated by the June 7th and 8th rainfall events. This is a conservative estimate in terms of normal hydrologic modeling, however it reflects the conditions in the River Valley in June of 2008. Conventional modeling will result in less estimated flow.

As an example the June 2008 events the modeling yielded the following results

Runoff Volumes (Acre-Feet)			
Subwatershed	**June 7-8**	**June 12**	**100-year Storm**
Big Hollow – 7,345 acres	1,013	1,740	1,442
Central Basin – 2,105 acres	548	533	709
East Basin – 1,660 acres	360	350	479
West Basin – 4,273 acres	1,182	1,152	1,516
Total Volume	**3,103**	**3,775**	**4,146**

Table 3.2-1. Runoff Volumes for River Valley Subwatersheds
Source: Montgomery, 2009.

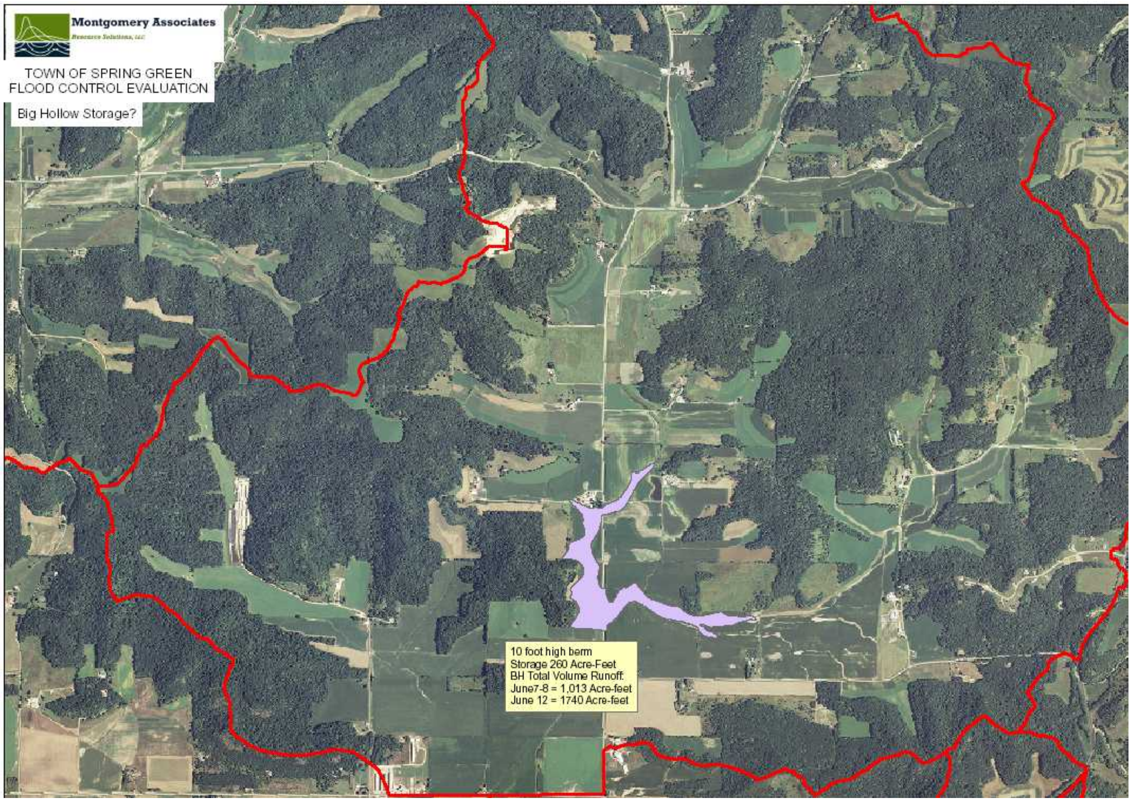
The models were then used to evaluate alternatives for managing stormwater runoff. The refinement of these alternatives will be discussed further in sections 6-9.

Some of the alternatives were eliminated early in the process, including collecting and pumping runoff through a series of pumping stations, creation of a lake at the base of Big Hollow, and retaining runoff in impoundments in Big Hollow.

Once the volume of runoff was calculated it was determined pumping stations could not effectively handle the scale of the June events. To create a system of pumps discharging to the Wisconsin River to handle even moderate rainfall events was felt to be unfeasible for both design and cost reasons. Even installing pumps to lower groundwater levels was shown to be of little value by Madeline Gotkowitz, hydrogeologist, at the Wisconsin Geological and Natural History Survey (WGNHS) in information presented to the Town in a 2008 presentation.

The concept of creating a lake at the base of Big Hollow was also evaluated. This alternative causes FFA regulatory issues at the airport in terms of creating a permanent waterfowl attractant. In addition, to avoid the risk of overtopping, a channel or pipe outlet would still be necessary to maintain water levels.

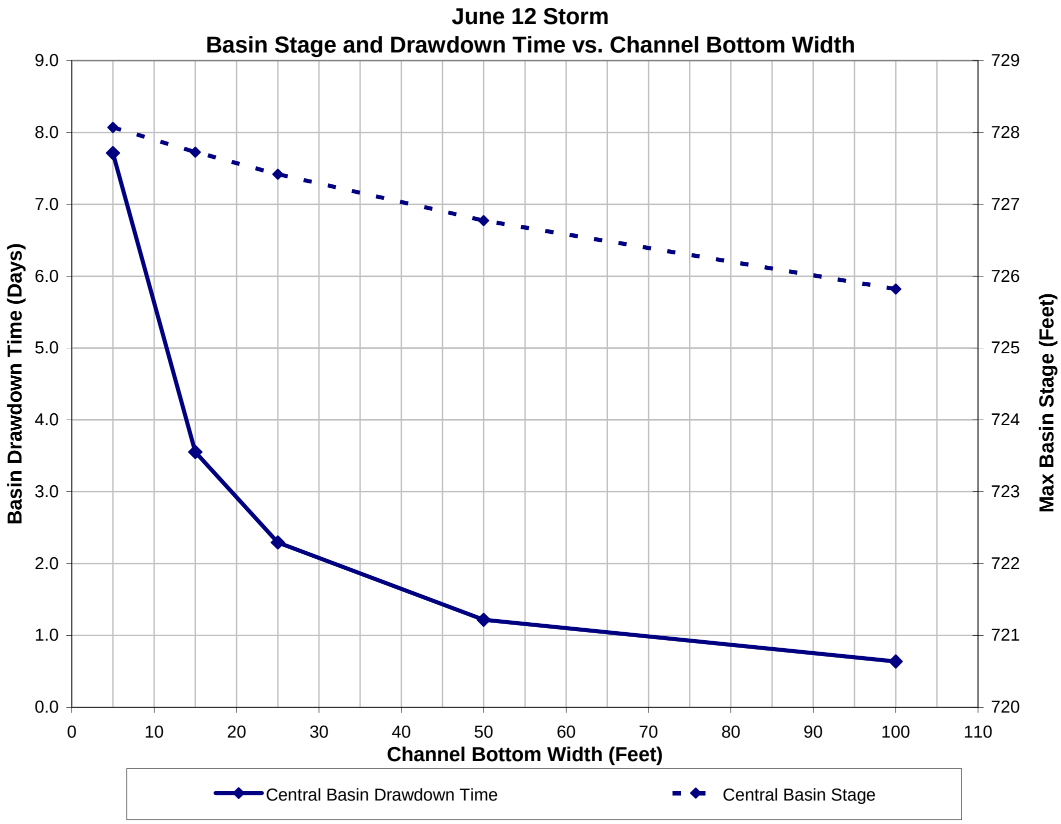
Finally, an alternative explored further was to essentially dam the water within the Big Hollow valleys. Figure 3.2-3 shows an example of one such structure. This structure would require approximately a 10-foot berm to retain 200 acre-feet of runoff. Based on the runoff shown in figure 3.2-2, five to eight of these structures would be required. The impact of this many structures on Big Hollow would be too great to further explore this option, and the structures will still need to be drained into the valley eventually, albeit at a slower rate, so a drainage route to the Wisconsin River would still need to be provided.



Figures 3.2-2. Big Hollow Local Flood Control Structures
Source: Montgomery, 2009.

It was then determined that channels or ditches to the Wisconsin River may be the most feasible way to drain the various subwatersheds. The Big Hollow and Central Basins were explored first. Through modeling Montgomery developed relationships for evaluating channel size. It was first determined that avoiding all flooding from the Big Hollow watershed would require a 100-foot wide channel bottom to direct water to the river. This channel would need to be 7 or more feet deep and over 200 feet wide at the top (See Figure 6.2-1). This option was explored further as described in section 6, however means of lessening the impacts of a channel were required.

The option of temporarily ponding water at the base of Big Hollow and channeling the discharge to the River was then explored. To facilitate ponding and reduce the likelihood of an overflow of Pearl Road east towards Prairie View Subdivision and the Village of Spring Green it was assumed Pearl Road and CTH G would need to be elevated to prevent overtopping. Taking this assumption and utilizing Jewell surface model data and preliminary channel geometry Montgomery was able to develop comparisons of channel sizes to required pond size and pond drawdown, the time required to empty. The data was graphed and used by Jewell and Montgomery to determine a preferred channel size as designs were refined. Figure 3.3-4 shows the graph for the Big Hollow/Central Basin relationships.



Figures 3.2-3. Graph of Big Hollow/Central Basin Channel Width vs. Downdown and Stage
Source: Montgomery, 2009.

Using this figure 3.2-3 it can be found that for the June 12th events a channel with a 10-foot bottom would require 5.5 days to draw down (solid line) from the maximum flooded elevation of 727.9 feet (dashed line). Similarly, a 50-foot bottom channel would require approximately 1.2 days to draw down from a maximum flooded elevation of 726.8 feet. The graph can then be used to determine acceptable time of flooding of cropland in the controlled flood storage area near CTH G and give an indication of the potential flood risk to roadways and neighboring properties. It was also important to consider the time of drawdown when considering back to back events like those that occurred in June 2008.

After selecting a preferred channel geometry Jewell staff further refined the channel designs and routes. Preliminary alignments and profiles were set and computer software was used to determine the required earthwork and the required construction limits of the various proposals. As the alternatives were refined, estimates of construction material quantities were developed, hydraulic sizing computations for roadway and railroad crossings were computed, and costs were developed for various alternatives.

Continued discussion of the refinement of the Big Hollow/Central Basin alternatives and the remaining basins can be found in sections 6-9.

For a complete discussion the methods of establishing rainfall data and runoff modeling refer to appendix A. - River Valley Flood Control Investigation: Surface Water and Groundwater Analysis By Montgomery Associates Resource Solutions, LLC, March 2009.

Section 4 – Groundwater Summary

4.1 Groundwater Findings

One of the goals of the study was to determine the existing groundwater levels and flow and the impact of the Wisconsin River on level and flow. Groundwater data was collected and this data was used to further refine a groundwater computer model developed by Madeline Gotkowitz, hydrogeologist, at the Wisconsin Geological and Natural History Survey (WGNHS). The refined model was used to predict the impact of proposed means of drainage on groundwater levels and recharge.

Montgomery states prior to this study WGNHS had drawn several conclusions regarding groundwater in the River Valley:

- Groundwater moves toward and discharges into the Wisconsin River
- Typically the water table is at least several feet below the ground surface in low lying areas and tens of feet in higher areas, but heavy rainfall in August 2007 and infiltration of record snowfall in spring 2008 led to a higher than 'normal' water table. In some areas, soils were saturated before the June 2008 storms.
- Excessive runoff during the June 2008 storm events raised the water table to above the surface in low lying areas in which the soils were already saturated and where the water table was only a few feet below the surface. Those areas flooded where the water table typically is within 10 feet of the surface.
- Enhanced groundwater recharge occurred along the bluffs and at the base of the fine-grained lake-basin sediments.
- The water table rose several feet, approximately 10 to 12 feet, at some locations on the upper terrace from December 2007 to June 2008.

Six groundwater modeling wells were installed at the locations shown in Figure 4.1-1. One additional well owned by a private individual was also utilized for the study. This well is referred to as the Peck Well. Wells SG-1, SG-2, SG-3 and Peck's well were located north of STH 14. Wells SG-4, SG-5, and SG-6 were south of STH 14, closer to the Wisconsin River. The locations of all monitoring wells are shown in figure 4.1-1. As a point of reference USH 14 and STH 60 are shown on the map in yellow. The wells were monitored from October 2008 to February 2009.

Figure 4.1-1. Location of Groundwater Monitoring Wells.
Source: Montgomery

In the short time the groundwater levels were monitored the wells along the northern extent of the River Valley area dropped 1.5 to 2.5 feet on average while the wells closer to the Wisconsin River maintained a steady level, rising slightly in January and February.

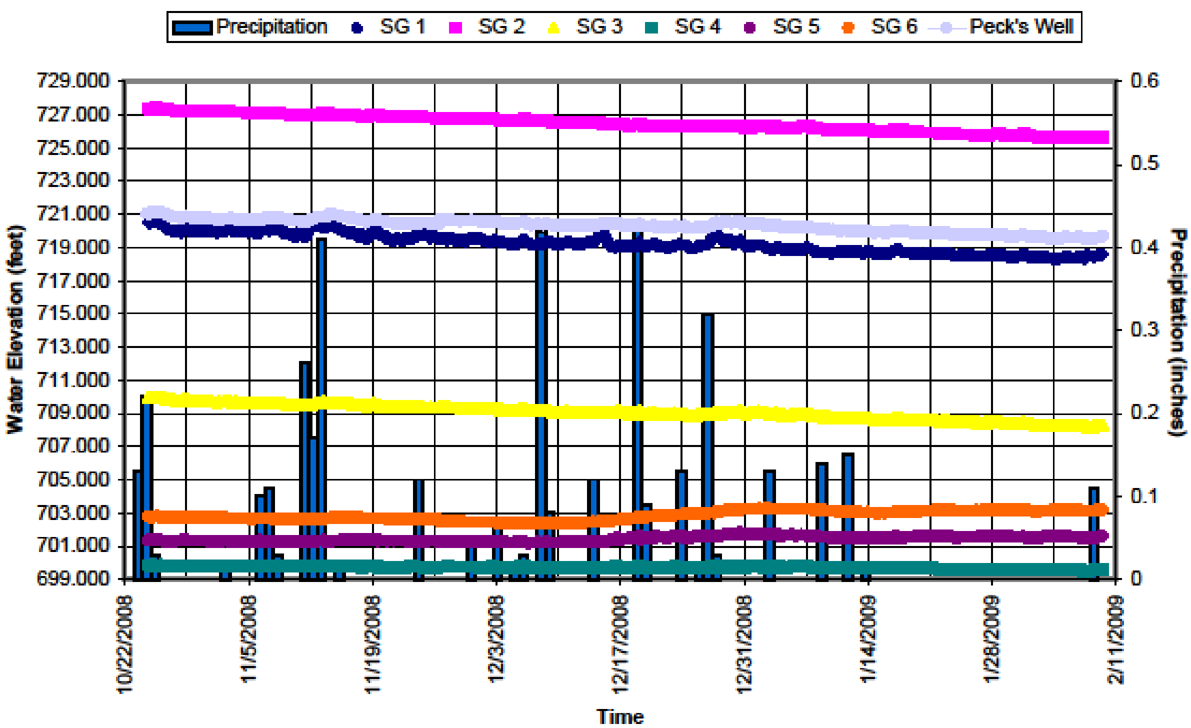


Figure 4.1-2. Groundwater Monitoring Wells levels October 2008 to February 2009
Source: Montgomery

Through the use of this data and refinement of the WGNHS model Montgomery was able to determine "groundwater flows from the upper valley (near CTH G) and discharges into the Wisconsin River in about 20 to 40 years. Thus the estimated average linear velocity of the groundwater flow ranges from approximately inches to a few feet per day. The upper end of the velocity estimate compares favorably to the velocity estimated from the monitoring data of approximately 2 feet per day. The values of hydraulic conductivity and specific yield of the sand and gravel aquifer in the model were 297 ft/day and 0.23 percent. Since these are average flows, groundwater movement may be faster or slower depending on local conditions." Source: Montgomery, 2009.

From their study Montgomery then was able to determine the effects of a Big Hollow drainage channel on groundwater recharge. Again Montgomery states "We believe that it is unlikely that the selected flooding alternative will result in the reduction or increase in overall area recharge rates exceeding a few inches per year. The groundwater model simulations indicate that with a 1 inch increase/decrease in the recharge rate, the water table elevation may rise/drop up to approximately 0.5 ft near the river to 1.5 ft in the upper valley. With a 3 inch increase/decrease in the recharge rate, the water table elevation may rise/drop up to about six feet. Therefore, considering the level of detail of these analyses, we believe that it would be unlikely that long-term water table decreases in areas of the East, Central and West basins with improved drainage would exceed a few feet. Similarly, we believe that it is unlikely that increases in the water table elevation in the vicinity of the temporarily flooded areas and drainage swales near the Wisconsin River would exceed a few feet, which is within the range of 'typical' annual water table fluctuations." Source: Montgomery, 2009.

From the groundwater study the following conclusions and recommendations were drawn by Montgomery:

- Flooding relief can be accomplished in the East, Central and West basins by installing drainage swales to discharge excess runoff from the temporary flood storage areas to the Wisconsin River or tributaries.

- Installation of the drainage swales will reduce recharge in the northern portion of the valley, producing a reduction in the water table elevation. There will probably be some increase in recharge produced by runoff flows in the temporary flood storage areas and drainage swales near the Wisconsin River, which could result in localized increases in groundwater levels.

- Detailed quantitative description of drainage performance at specific locations throughout the study area cannot be provided by the level of detail available for their study.

- Recommended continued water table monitoring at selected locations to further understand the spatial and temporal response of the groundwater system to recharge events and the influence of the river and other effects on water levels in the lower valley.

- During the preliminary design phase, a more detailed analysis of potential groundwater impacts of the alternative should be conducted to determine localized impacts.

As of the date of this study Montgomery has ended data collection from the six monitoring wells installed as part of the study. The wells are in place and WGNHS will take up monitoring several of the wells. Jewell recommends the Township support the WGNHS groundwater monitoring as needed. An option being explored by Jewell is to suggest WGNHS monitor more wells and Jewell, if directed by the Town, can collect and download monitoring well data.

For a complete discussion of the groundwater portion of the River Valley flood control study please refer to Appendix A. - River Valley Flood Control Investigation: Surface Water and Groundwater Analysis By Montgomery Associates Resource Solutions, LLC, March 2009.

Section 5 – Flood Flow Patterns

5.1 Flood Flow Patterns

Previous to this study, through both anecdotal evidence and studies by others, it has been suggested that significant contribution to flooding and elevated groundwater in the River Valley area originates as runoff from the Big Hollow watershed. This watershed north of CTH JJ is over 9,000 acres in size and consists of agricultural and wooded land spread over an expansive valley. The Big Hollow watershed discharges to sandy terraces and windblown dunes located at its base. As previously described for the purpose of this study this area has been referred to as the Central Basin. The topography of the Central Basin is such that no viable drainage outlet to the Wisconsin River is available. During normal precipitation, runoff events from Big Hollow flow to the Central Basin and cause temporary localized flooding of agricultural waterways and fields. This flooding normally dissipates in a short time via a combination of infiltration and evaporation without affecting the remainder of the River Valley. It has even been observed that waters flowing in the intermittent stream from Big Hollow infiltrate and "disappear" between CTH JJ and CTH G upon entering the Central Basin. In either case, this area serves as a point of groundwater recharge for the region.

During extreme rainfall events the Central Basin overflows Pearl Road and heads east toward the Prairie View subdivision and the Village of Spring Green. The basin can also overflow to the south and west depending on the severity of the flooding. The water flowing east can pass under STH 23 into the East Basin and cause additional flooding as there is no viable path of discharge. The water can also enter the Prairie View subdivision flooding multiple residential and commercial properties before turning west and essentially following the USH 14 corridor, joining the water that overflowed the central basin to the south, and continuing northwest toward the Tri-County Airport and at the peak of flooding flowing all the way to Bear Creek. Flow patterns are illustrated in figure 4.1-1. All this flow eventually settles in essentially three areas: in the East Basin between STH 60 and Jones Road, in the Central Basin south of CTH G and east of Pearl Road, and in the West Basin near the Tri-County Airport.

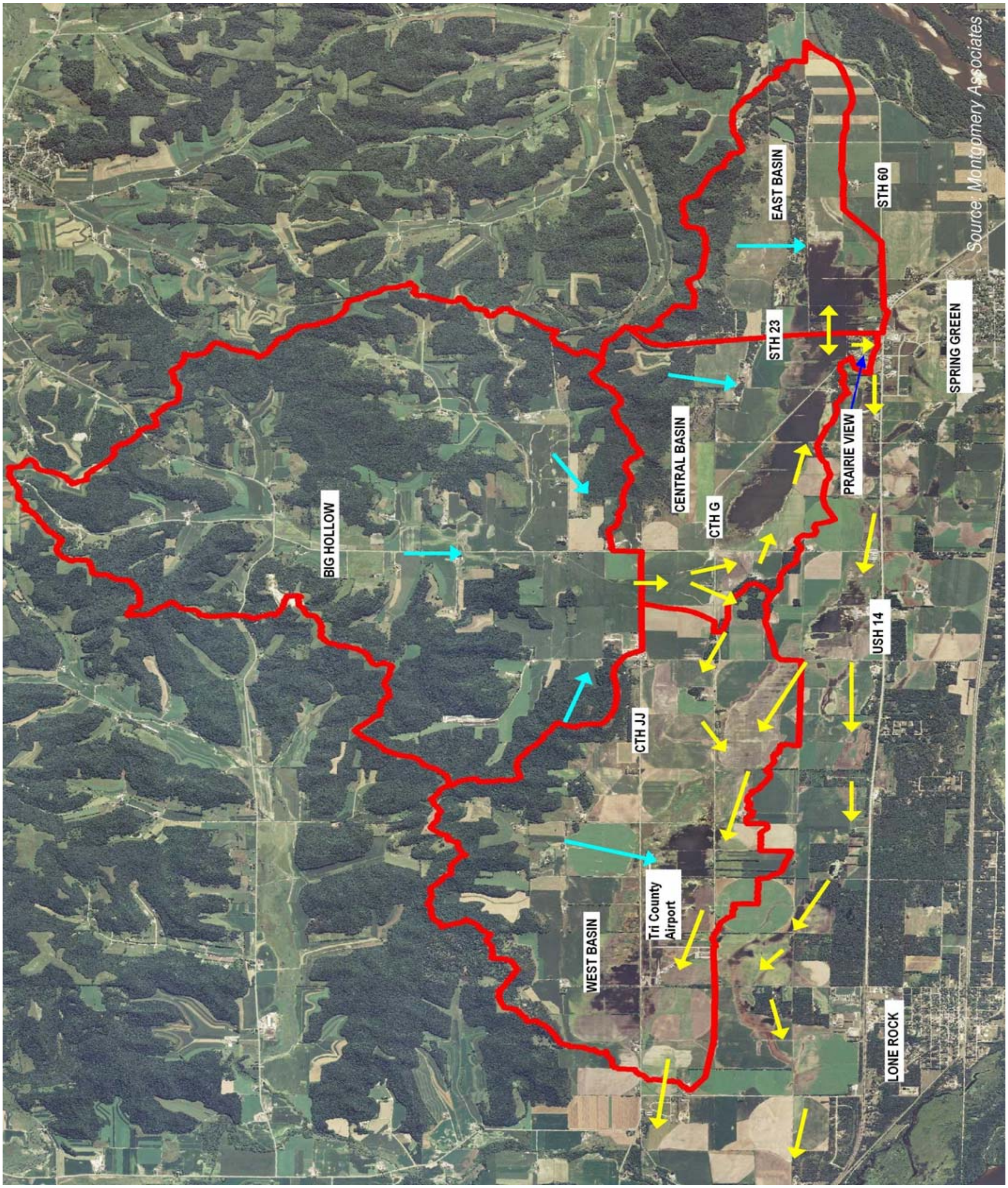


Figure 5.1-1 – Map of River Valley Flood Flows
Source: Montgomery Associates with additional data by Jewell

Section 6 - Big Hollow

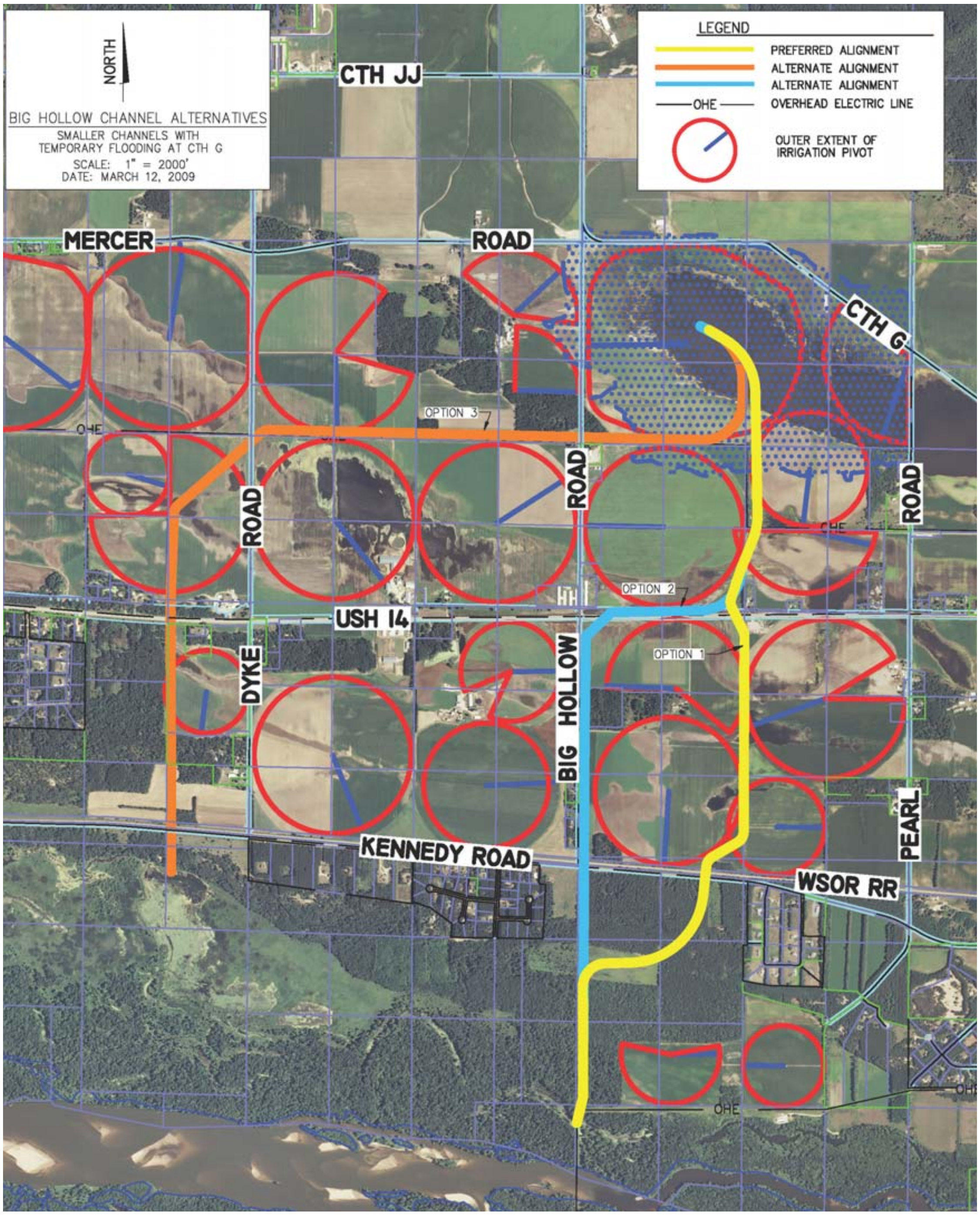


Figure 6.0-1 Optional Channel Routes for Big Hollow and Central Drainage Basins
(not to scale)

6.1 Big Hollow/Central Basin Study Background

The scope of the Big Hollow portion of the study was to investigate several alternatives including: to provide a swale or channel from approximately CTH JJ to the Wisconsin River, provide a retention pond (wetland or dry) near Big Hollow Road and CTH G with a conduit (pipe or ditch) to the Wisconsin River, and to provide a series of connected wetland areas to provide an outlet of storm water runoff from Big Hollow to the Wisconsin River. Alternatives reviewed and dismissed earlier in the study are described in section 3.2. Based on the work described in section 3.2, Jewell and Montgomery reviewed and refined several alternatives for the Big Hollow and Central Basin Drainage. A discussion of each alternative and its findings is described on the following pages.

6.2 Big Hollow/Central Basin Direct Discharge

This design would consist of a single channel from Big Hollow starting near CTH JJ and extending south towards the Wisconsin River.

Through the design process between Jewell and Montgomery described previously, the following basic flow and channel characteristics were determined.

<u>Design Flows:</u>

	Storm Event		
	June 7-8	**June 12**	**100-year Storm**
Big Hollow	3,342 cfs	4,372 cfs	3,738 cfs

Source:Montgomery 2008.

<u>Potential Channel Geometry (see figure 6.2-1.)</u>:
Channel bottom width = >100 feet wide
Channel bottom depth = >7 feet deep minimum
Channel velocities = ~ 6 feet per second

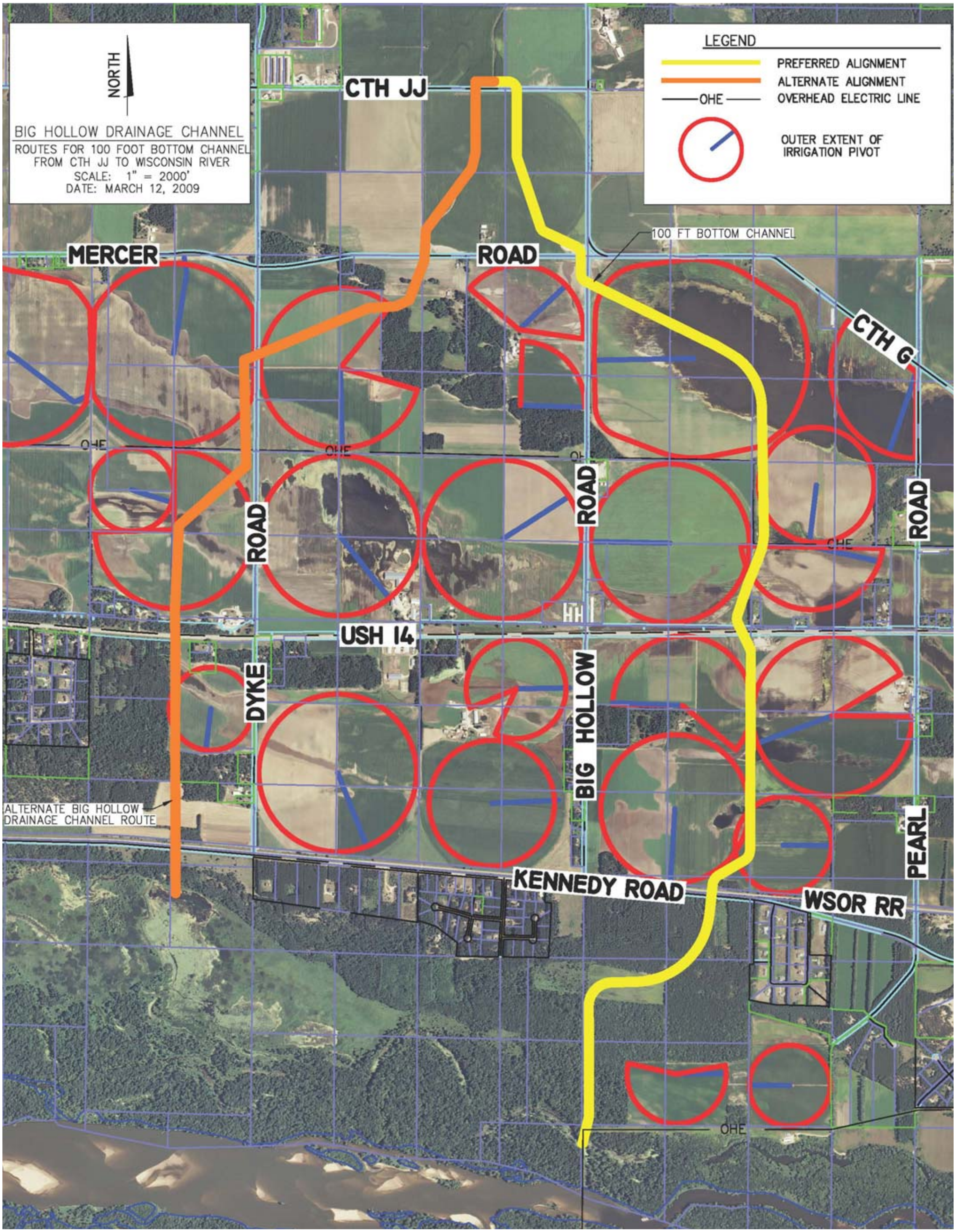


Figure 6.2-1. Big Hollow/Central Basin Direct Discharge 100-ft Channel Routes

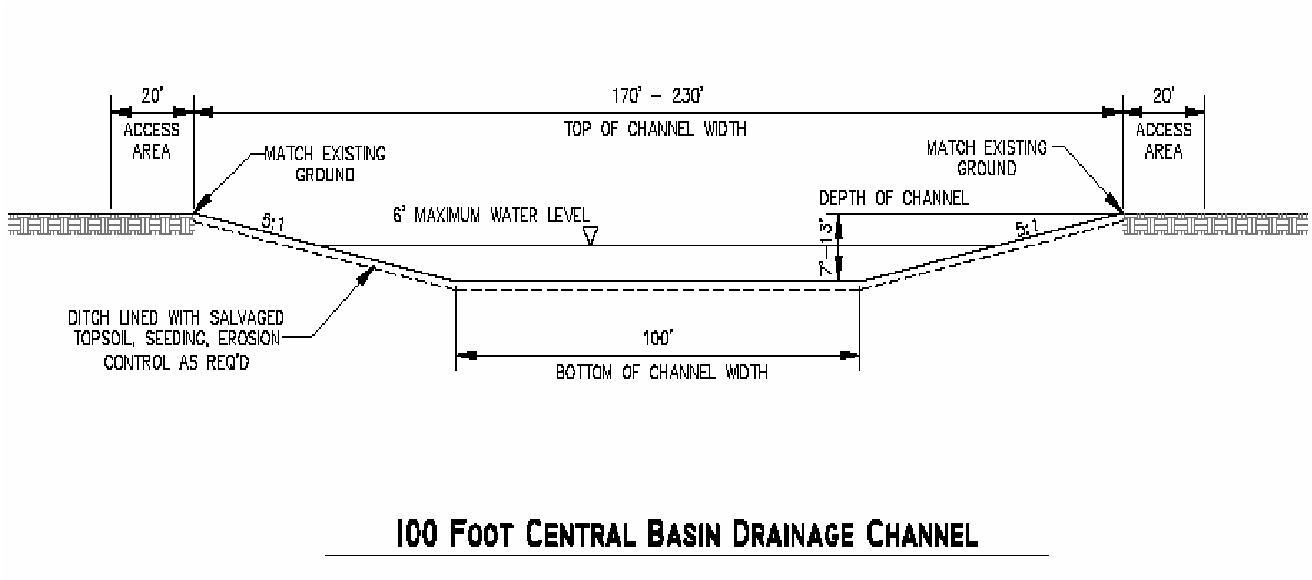


Figure 6.2-2 Typical Section of Big Hollow/Central Basin 100-ft Direct Discharge Channel

Several alternatives for routes to the south were explored based on both engineering design and suggestions from local residents and landowners. Two options were selected for further study as shown in Figure 6.2-1. The route findings are described below.

Option 1 – Western Route – Shown in Orange Fig 6.2-1.

This route would originate at CTH JJ and travel southwest to Dyke Road turning south approximately 1,200 feet west of Dyke Road and flowing to Bakken's Pond. Channel data is as follows:

Option 1 100-ft Channel
Design Characteristics

Bottom Width (ft)	100
Channel Length (lf)	14,044
Modeled Channel Slope (ft/ft)	0.0015
Min. Design Channel Slope (ft/ft)	0.0020
Side Slopes (H:V)	4:1
Mannings n (slope roughness)	0.03

Option 1 100-ft Channel
Major Construction Quantities

Earthwork (CY)	550,000
Structures – Bridges 100-150 foot clear span	5
Land Disturbance	> 60 acres
Land Acquisition – Drainage Easement	> 70 acres

Tables 6.2-1 & 2. Big Hollow/Central Basin Direct Discharge 100-ft Channel - Option 1 Channel Characteristics

Parcel Number	Parcel Acreage	Estimated Easement Acres	Property Owner
032-1287-00000	40	0.60	Kevin E Lins LC
032-1288-00000	40	6.70	Kevin E Lins LC
	Total =	7.30	
032-0096-00000	30.05	0.90	Jerome J and Carla E Carmody
032-0099-00000	34.41	5.50	Jerome J and Carla E Carmody
	Total =	6.40	
032-0116-00000	53.79	1.75	Alsum Farms LC
032-0120-00000	40	7.70	Alsum Farms LC
	Total =	9.45	
032-0133-00000	24	0.05	Richard F and Tamara J Peck
	Total =	0.05	
032-0131-00000	40	8.50	Gerald A and Margaret E Sprecher
032-0134-00000	32.9	1.50	Gerald A and Margaret E Sprecher
032-0140-00000	40	5.50	Gerald A and Margaret E Sprecher
032-0475-00000	12	0.40	Gerald A and Margaret E Sprecher
032-0479-00000	48.21	7.75	Gerald A and Margaret E Sprecher
	Total =	23.65	
032-0477-00000	38.4	1.50	Richard F and Lenore E. Taubert
032-0478-00000	40	2.25	Richard F and Lenore E. Taubert
	Total =	3.75	
032-0480-00000	12.12	2.50	James D and Rita K Strait Kline
	Total =	2.50	
032-1285-00000	40	0.60	Douglas Brander
032-0100-00000	19.39	4.00	Douglas Brander
032-0103-00000	70	6.75	Douglas Brander
032-0500-00000	25.42	1.00	Douglas Brander
032-0497-00000	26	4.25	Douglas Brander
	Total =	16.60	
BAKKEN'S			
032-0499-00000	9.76	0.10	Wisconsin Department of Natural Resources
032-0496-00000	7.89	1.30	Wisconsin Department of Natural Resources
032-0501-00000	39.9	0.10	Wisconsin Department of Natural Resources
032-0502-00000	39.9	1.50	Wisconsin Department of Natural Resources
	Total =	3.00	

Total Estimated Acres = 72.7

Table 6.2-3. Big Hollow/Central Basin Direct Discharge 100-ft Channel-Option 1–Landowner Impacts

Option 1 100-ft Channel
Utility Installations of Concern

American Transmission Co.	Overhead electric transmission 69kV
Alliant Energy	High Pressure Gas Main at USH 14
Charter	Fiber optic at USH 14 overhead
Verizon	Multiple underground locations at USH 14 Underground lines at Kennedy Road Underground Fiber Optic at Railroad

Table 6.2-4. Big Hollow/Central Basin Direct Discharge 100-ft Channel - Option 1 – Utility Impacts

Option 1 100-ft Channel
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$1265 - $1545
Structures – Bridges 100-150 foot clear span	$3240 - $3960
Erosion Control, Seeding & Restoration	$420 - $514
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Utility Adjustments (Estimated)	$18 - $22
Pavement Repairs and Bridge Approaches	$144 - $176
Land Acquisition	$207 - $253
Construction Contingencies, Project Development, Construction Management	$641 - $784

Total Cost $ 6.00 - $7.3 Million

Table 6.2-5. Big Hollow/Central Basin 100-ft Channel - Option 1 – Opinion of Probable Costs

Additional Findings

This route is a slightly shorter, more costly route compared to option 2. Discharging to Bakken's Pond may prove more difficult however. The channel would discharge close to a protected State Natural Area in Bakken's Pond but the Wisconsin Department of Natural Resources (DNR) has indicated the whole pond is an important natural resource. Disturbing wetlands will be an issue near Bakken's Pond. Additional environmental and public agency discussions can be found in section 10.

One disadvantage to the route is that slightly more impact on center pivot irrigation equipment is probable as shown by the highlighted circular areas on figure 6.2-1.

Option 2 – Eastern Route – Shown in Yellow Fig 6.2-1.

This route would originate at CTH JJ and travel southeast turning straight south between Big Hollow and Pearl Roads and extending to Hill Slough at the Wisconsin River. Channel data is as follows:

Option 2 100-ft Channel
Design Characteristics

Bottom Width (ft)	100
Channel Length (lf)	20,895
Modeled Channel Slope (ft/ft)	0.0015
Min. Design Channel Slope (ft/ft)	0.0010
Side Slopes (H:V)	4:1
Mannings n (slope roughness)	0.03

Option 2 100-ft Channel
Major Construction Quantities

Earthwork (CY)	650,000
Structures – Bridges 100-150 foot clear span	4
Land Disturbance	> 80 acres
Land Acquisition – Drainage Easement	> 100 acres

Tables 6.2-6 & 7. Big Hollow/Central Basin Direct Discharge-100-ft Channel - Option 2 Channel Characteristics

Parcel Number	Parcel Acreage	Estimated Easement Acres	Property Owner
032-1270-00000	40	0.75	James O and Carolyn Hackl
032-1271-00000	40	0.8	James O and Carolyn Hackl
	Total =	1.55	
032-1286-00000	40	6.4	Kevin E Lins LC
032-1289-00000	40	8	Kevin E Lins LC
	Total =	14.4	
032-0094-00000	56.81	1.6	Gerald M and Carol A Bindl JT Revoc Trust
	Total =	1.6	
032-0071-00000	57.5	6	Dale W and Judith F Clark
032-0070-00000	58.12	6.5	Dale W and Judith F Clark
032-0066-00000	56.5	0.25	Dale W and Judith F Clark
032-0073-00000	40	0.25	Dale W and Judith F Clark
032-0068-00000	40	6.5	Dale W and Judith F Clark
032-0084-00000	40	9	Dale W and Judith F Clark
	Total =	28.5	
032-0080-00000	40	4.6	James A Sprecher
	Total =	4.6	
032-0085-00000	37.33	3.25	James A and Caryl L Sprecher
032-0583-00000	40	2.75	James A and Caryl L Sprecher
032-0584-00000	40	3.75	James A and Caryl L Sprecher
	Total =	9.75	
032-0587-00000	40	3.5	Doug Brander
032-0584-00000	40	3.75	Doug Brander
032-0602-00000	40	2.75	Doug Brander
032-0593-00000	40	5.25	Doug Brander
032-0597-00000	4.6	1.25	Doug Brander
	Total =	16.5	
032-0598-00000	32.15	5.75	George A Jr. and Julie Fielder
	Total =	5.75	
032-0680-00000	40.1	2.25	Walter F Joost
032-0681-00000	40	8.5	Walter F Joost
	Total =	10.75	
032-0682-00000	40	6	
	Total =	6	
032-0688-00000	41.5	1	Wisconsin Department of Natural Resources
032-0696-00000	25.4	0.25	Wisconsin Department of Natural Resources
	Total =	1.25	
	Total Estimated Acres =	**100.65**	

Table 6.2-8. Big Hollow/Central Basin Direct Discharge 100-ft Channel-Option 2–Landowner Impacts

Option 2 100-ft Channel
Utility Installations of Concern

American Transmission Co.	Overhead electric transmission 69kV
Alliant Energy	High Pressure Gas Main at USH 14
Charter	Fiber optic at USH 14 overhead and underground
Verizon	Multiple underground locations at USH 14 Underground lines at Kennedy Road Underground Fiber Optic at Railroad

Table 6.2-9. Big Hollow/Central Basin Direct Discharge 100-ft Channel - Option 2 – Utility Impacts

Option 2 100-ft Channel
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$1365 - $1650
Structures – Bridges 100-150 foot clear span	$2727 - $3300
Erosion Control, Seeding & Restoration	$580 - $700
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Utility Adjustments (Estimated)	$18 - $22
Pavement Repairs and Bridge Approaches	$180 - $220
Land Acquisition	$227 - $275
Construction Contingencies, Project Development, Construction Management	$619 - $749

Total Cost $ 5.2 - $7.0 Million

Table 6.2-10. Big Hollow/Central Basin 100-ft Channel - Option 2 – Opinion of Probable Costs

Additional Findings

This route is a slightly longer route but is less costly when compared to option 1. The route discharges to Hill Slough as opposed to Bakken's Pond. Wetlands will be impacted. The slough is still a unique habitat the DNR would like to protect as it is classified as an Exceptional Resource Water (ERW) like Bakken's. With option one there is a possibility to discharge to the floodplain and avoid wetland and slough impacts. Additional environmental and public agency discussions can be found in section 10. The route appears to impact center pivot irrigation equipment less as shown by the highlighted circular areas on figure 6.2-1.

A 100-foot channel is not recommended, but if it were, option 2 would be the preferred option.

6.3 Big Hollow/Central Basin Channel with Temporary Flooding

It was obvious the alternatives discussed in section 6.2 were cost prohibitive so modeling was conducted to determine the feasibility of construction a temporary flood storage area at the base of the Big Hollow watershed. The area would be allowed to flood and floodwaters could be released at a more controlled rate reducing the required channel size. It was determined sections of Pearl Road and CTH G would need to be raised to provide a defined temporary flood storage area that would detain the runoff and protect properties to the east. Jewell and Montgomery again worked to determine design parameters. From the modeling it was determined a 15-foot bottom channel was most effective in controlling runoff while allowing a reasonable drawdown period.

	Central Channel			
Channel Flow	**June 7-8th**	**June 12th**	**10-year event**	**100-year event**
Max Flow (cfs)	550	861	325	675
Max Velocity (ft/s)	3.2	3.6	2.7	3.3
Normal Depth (ft)	4.7	5.7	3.6	5.1
Max Depth (ft)	5.3	6.4	4.1	5.8
Basin Stage				
Max Water Depth (ft)	5.3	6.4	4.1	5.8
Max Water Elevation (ft)	726.5	727.6	725.3	727.0
Drawdown time (days)	3.1	3.6	2.7	3.5
Conceptual Channel Geometry				
Bottom Width (ft)	15			
Channel Length	12,700			
Bottom Slope (ft/ft)	0.0012			
Side Slopes (H:V)	4:1			
Mannings n	0.03			
To meet Drainage District requirements and drain the floodwater in 48 hours for a 10 year storm a 20 foot wide bottom channel is required.				

Table 6.3-1. Big Hollow/Central Basin 15-ft Channel – Modeled Channel Data
Source: Montgomery 2009.

From this data Jewell refined the channel geometric design and calculated impacts and costs.

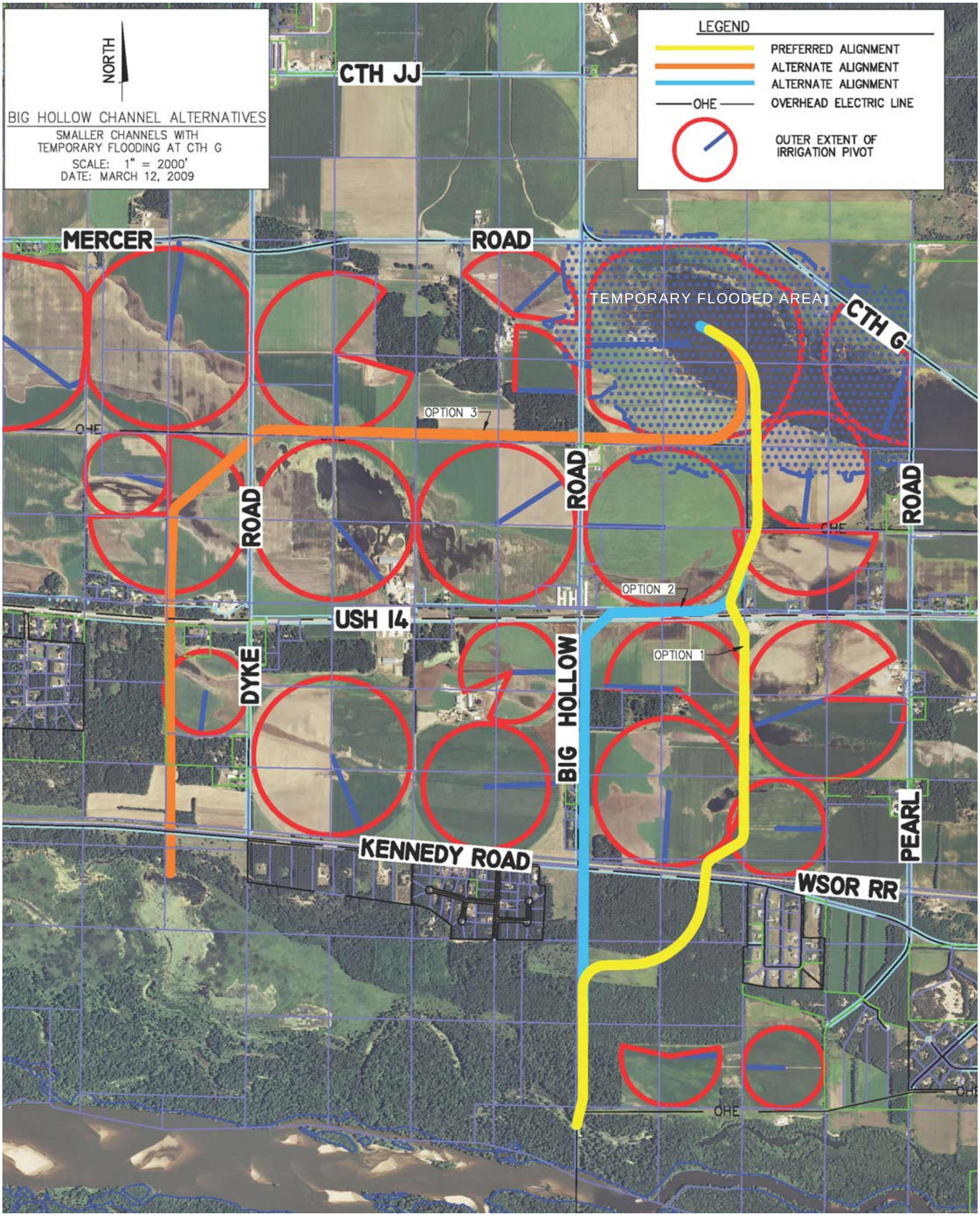


Figure 6.3-1. Big Hollow/Central Basin 15-ft Channel Routes

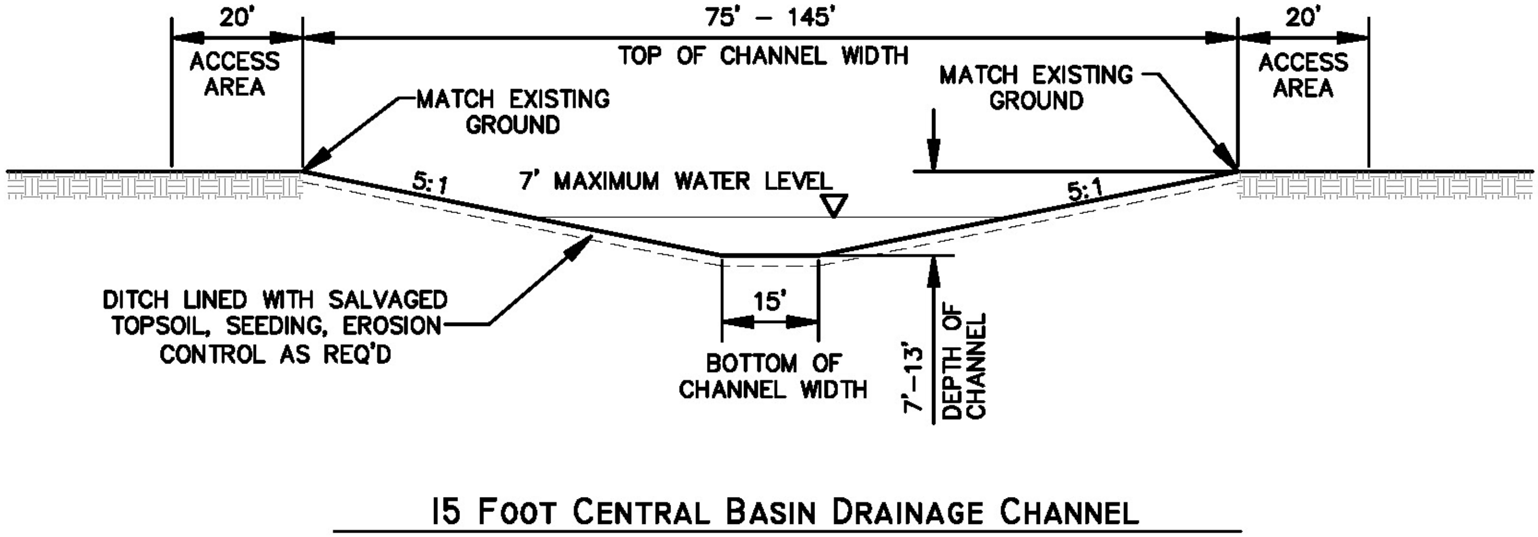


Figure 6.3-2. Typical Section Big Hollow/Central Basin 15-ft Channel

Several alternatives for routes to the south were explored based on both engineering design and suggestions from local residents and landowners. Three options were selected for further study as shown in Figure 6.3-1. The route findings are described below.

Option 3 – Western Route – Shown in Orange Figs 6.3-1 & 6.3-3.

This route would originate at a flood storage area near CTH G and Pearl Road (shown in blue on figure 6.3-3). It will run west to Dyke Road turning south approximately 1200 feet west of Dyke Road and flowing to Bakken's Pond. Channel data is as follows:

Option 3 – 15-ft Channel
Design Characteristics

Bottom Width (ft)	15
Channel Length (lf)	17,000
Modeled Channel Slope (ft/ft)	0.0012
Min. Design Channel Slope (ft/ft)	0.0008
Side Slopes (H:V)	4:1
Mannings n (slope roughness)	0.03

Option 3 – 15-ft Channel
Major Construction Quantities

Earthwork (CY)	400,000
Structures – 2 cell box culverts	3 – Combine Kennedy Rd and Railroad
Land Disturbance	> 45 Acres
Land Acquisition – Drainage Easement	> 65 Acres

Tables 6.3-2 & 3. Big Hollow/Central Basin 15-ft Channel - Option 3 Channel Characteristics

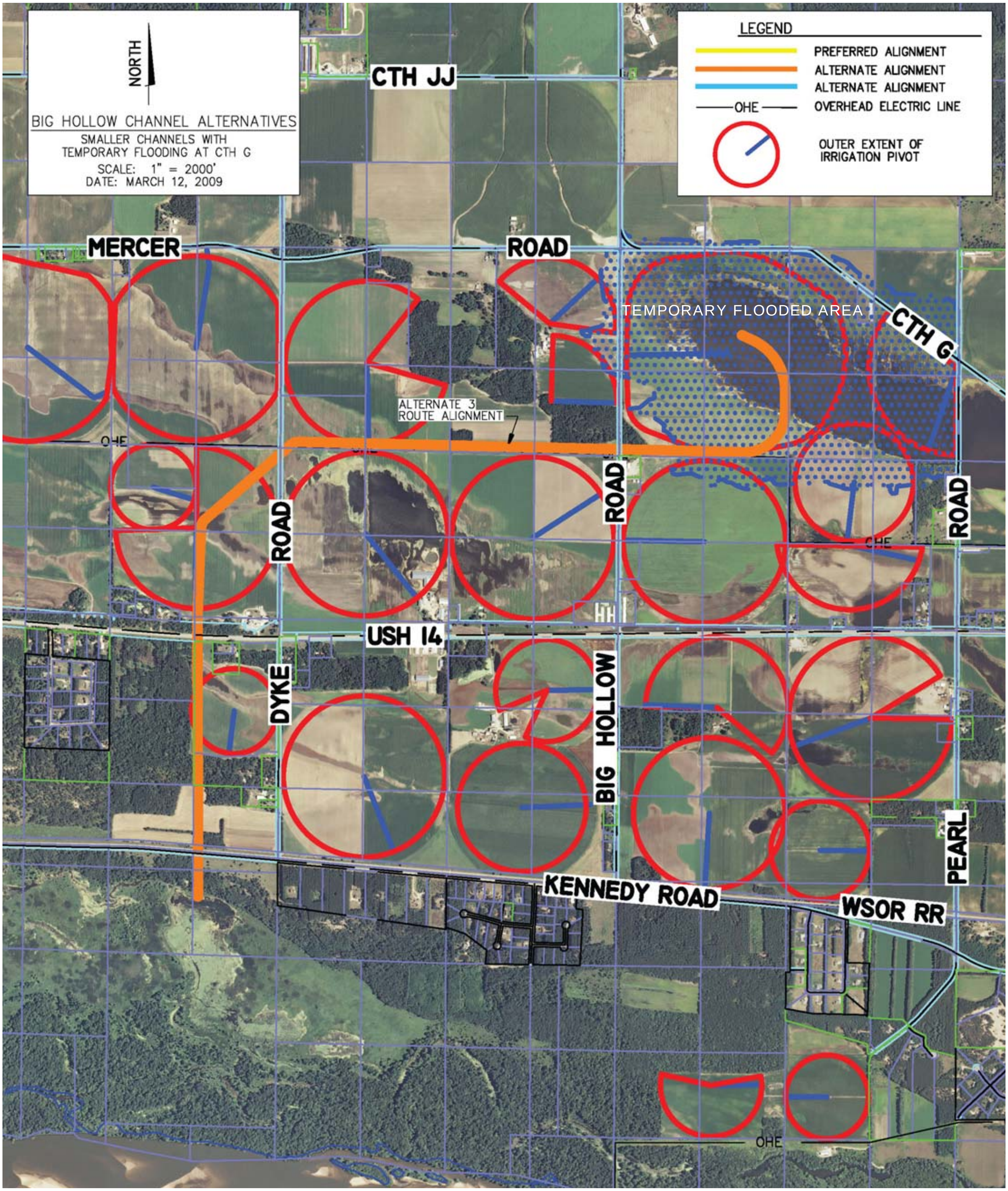


Figure 6.3-3. Big Hollow/Central Basin 15-ft Channel - Route Option 3

Parcel Number	Parcel Acreage	Estimated Easement Acres	Property Owner
032-0070-00000	58.12	1.50	Dale W and Judith F Clark
032-0073-00000	40	9.50	Dale W and Judith F Clark
032-0072-00000	40	6.25	Dale W and Judith F Clark
	Total =	17.25	
032-0075-00000	35.5	0.10	James A Sprecher
	Total =	0.10	
032-0076-00000	2.5	0.25	Fred Bindl LC
	Total =	0.25	
032-0110-00000	40	0.10	James O and Carolyn Hackl
	Total =	0.10	
032-0098-00000	40	6.50	Gerald M and Carol A Bindl JT Rev Trust
032-0097-00000	40	5.50	Gerald M and Carol A Bindl JT Rev Trust
	Total =	12.00	
032-0131-00000	40	5.25	Gerald A and Margaret E Sprecher
032-0134-00000	32.9	0.50	Gerald A and Margaret E Sprecher
032-0140-00000	40	4.25	Gerald A and Margaret E Sprecher
032-0475-00000	12	0.50	Gerald A and Margaret E Sprecher
032-0479-00000	48.21	7.00	Gerald A and Margaret E Sprecher
	Total =	17.50	
032-0477-00000	38.4	0.50	Richard F and Lenore E. Taubert
032-0478-00000	40	0.75	Richard F and Lenore E. Taubert
	Total =	1.25	
032-0480-00000	12.12	2.00	James D and Rita K Strait Kline
	Total =	2.00	
032-0105-00000	40	4.50	Douglas Brander
032-0104-00000	24.53	3.50	Douglas Brander
032-0107-00000	40	1.00	Douglas Brander
032-0500-00000	25.42	0.25	Douglas Brander
032-0497-00000	26	3.25	Douglas Brander
	Total =	12.50	
032-0496-00000	7.89	1.00	Wisconsin Department of Natural Resources
032-0502-00000	39.9	1.25	Wisconsin Department of Natural Resources
	Total =	2.25	

Total Estimated Acres = 65.20

Table 6.3-4. Big Hollow/Central Basin 15-ft Channel - Option 3 – Landowner Impacts

Option 3 15-ft Channel
Utility Installations of Concern

American Transmission Co.	Overhead electric transmission 69kV
Alliant Energy	High Pressure Gas Main at USH 14
Charter	Fiber optic at USH 14 overhead
Verizon	Multiple underground locations at USH 14 Underground lines at Kennedy Road Underground Fiber Optic at Railroad

Table 6.3-5. Big Hollow/Central Basin Direct Discharge 100-ft Channel - Option 2 – Utility Impacts

Option 3 15-ft Channel
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$1100 - $1300
Structures – 2 cell Box Culverts	$636 - $770
Erosion Control, Seeding & Restoration	$295 - $356
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Utility Adjustments (Estimated)	$18 - $22
Pavement Repairs	$36 - $44
Land Acquisition	$155 - $187
Roadway Improvements (geometric improvements to CTH G, Pearl Big Hollow and Mercer Roads)	$600- $740
Construction Contingencies, Project Development, Construction Management	$322 - $390

* Land Acquisition includes flooding easement for temporary flood storage

Total Cost $ 3.2 - $3.9 Million

Table 6.3-6. Big Hollow/Central Basin 15-ft Channel - Option – Opinion of Probable Costs

Additional Findings

This route is a slightly longer and more costly route compared to options 1 & 2. It requires one additional roadway crossing at Big Hollow Road. This crossing is over 20 feet deep and will present construction challenges. Discharging to Bakken’s Pond may prove more difficult however. The channel would discharge close to a protected State Natural Area in Bakken’s Pond but the Wisconsin Department of Natural Resources (DNR) has indicated the whole pond is an important natural resource. Disturbing wetlands will be an issue near Bakken’s Pond. Additional environmental and public agency discussions can be found in section 10.

The route has slightly more impact on center pivot irrigation equipment as shown by the highlighted circular areas on figure 6.3-3. One center pivot is impacted particularly hard. Property owner impacts are also the highest of the options.

Option 2 – Big Hollow Road Route – Shown in Blue Figs 6.3-2 & 6.3-4.

This route would originate at a flood storage area near CTH G and Pearl Road (shown in Blue on figure 6.3-4). It will run south to USH 14, turning west and following the north side of USH 14 to Big Hollow Road. The route then turns south down Big Hollow Road and extends to Hills Slough in the Wisconsin River. Channel data is as follows:

Option 2 - 15-ft Channel
Design Characteristics

Bottom Width (ft)	15
Channel Length (lf)	14,820
Modeled Channel Slope (ft/ft)	0.0012
Min. Design Channel Slope (ft/ft)	0.001
Side Slopes (H:V)	4:1
Mannings n (slope roughness)	0.03

Option 2 - 15-ft Channel
Major Construction Quantities

Earthwork (CY)	250,000
Structures – 2 cell box culverts	2 – Combine Kennedy Rd and Railroad
Land Disturbance	> 30 Acres
Land Acquisition – Drainage Easement	> 50 Acres

Tables 6.3-7 & 8. Big Hollow/Central Basin 15-ft Channel - Option 2 Channel Characteristics

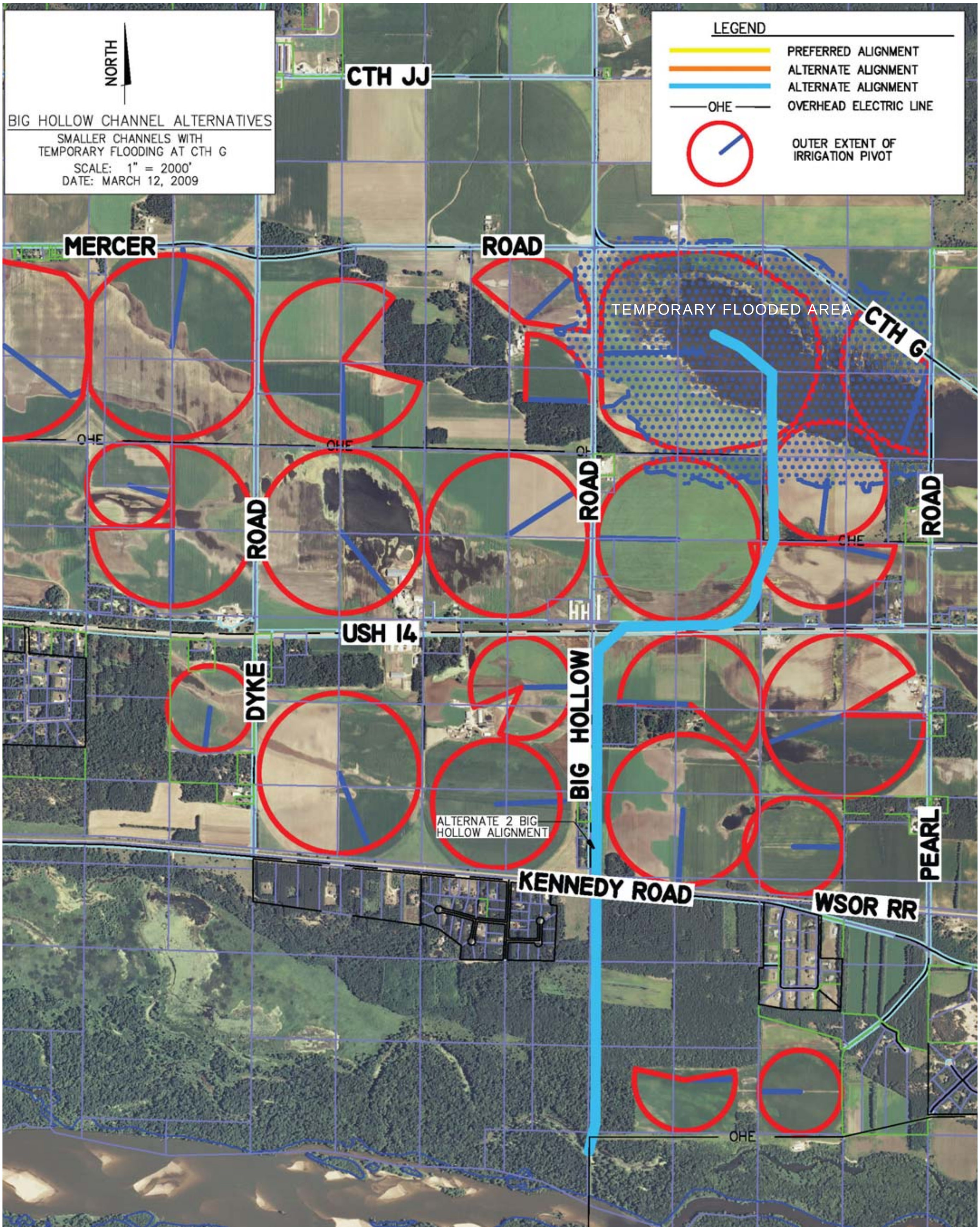


Figure 6.3-4. Big Hollow/Central Basin 15-ft Channel - Route Option 2

Parcel Number	Parcel Acreage	Estimated Easement Acres	Property Owner
032-0070-00000	58.12	2	Dale W and Judith F Clark
032-0066-00000	56.5	0.25	Dale W and Judith F Clark
032-0073-00000	40	0.1	Dale W and Judith F Clark
032-0068-00000	40	6.3	Dale W and Judith F Clark
032-0084-00000	40	8	Dale W and Judith F Clark
	Total =	16.65	
032-0080-00000	40	5.25	James A Sprecher
	Total =	5.25	
032-0085-00000	37.33	1.6	James A and Caryl L Sprecher
	Total =	1.6	
032-0591-00000	10	3	Marcus, Anthony E and Elizabeth Weston
	Total =	3	
032-0588-00000	39.9	5.25	Douglas Brander
032-0590-00000	30.1	3.5	Douglas Brander
032-0594-00000	40	5	Douglas Brander
032-0596-00000	1.1	0.25	Douglas Brander
	Total =	14	
032-0595-00000	35.65	3.25	George A Jr. and Julie Fielder
	Total =	3.25	
032-0681-00000	40	3	Walter F Joost
	Total =	3	
032-0682-00000	40	3.25	
	Total =	3.25	
032-0688-00000	41.5	0.5	Wisconsin Department of Natural Resources
	Total =	0.5	

Total Estimated Acres = 50.5

Table 6.3-9. Big Hollow/Central Basin 15-ft Channel - Option 2 – Landowner Impacts

Option 2 15-ft Channel
Utility Installations of Concern

American Transmission Co.	Overhead electric transmission 69kV
Alliant Energy	High Pressure Gas Main at USH 14
Charter	Fiber optic at USH 14 overhead and underground
Verizon	Multiple underground locations at USH 14 Underground lines at Kennedy Road Underground Fiber Optic at Railroad

Table 6.3-10. Big Hollow/Central Basin Direct Discharge 100-ft Channel - Option 2 – Utility Impacts

Option 2 15-ft Channel
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$725 - $880
Structures – 2 cell Box Culverts	$450 - $500
Erosion Control, Seeding & Restoration	$275- $330
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Utility Adjustments (Estimated)	$18 - $22
Pavement Repairs	$45 - $55
Land Acquisition	$125 - $150
Roadway Improvements (geometric improvements to CTH G, Pearl Big Hollow and Mercer Roads)	$600- $740
Construction Contingencies, Project Development, Construction Management	$310 - $380

* Land Acquisition includes flooding easement for temporary flood storage

Total Cost $ 2.6 - $3.1 Million

Table 6.3-11. Big Hollow/Central Basin 15-ft Channel – Option 2 – Opinion of Probable Costs

Additional Findings

This route is slightly more costly than option 1 but cheaper than option 3. The route discharges to Hill Slough as opposed to Bakken's Pond. Wetlands will be impacted. The slough is still a unique habitat the DNR would like to protect as it is classified as an Exceptional Resource Water (ERW) like Bakken's. With option 2 there is a possibility to discharge to the floodplain and avoid wetland and slough impacts. Additional environmental and public agency discussions can be found in section 10. The route appears to impact on center pivot irrigation equipment less as shown by the highlighted circular areas on figure 6.3-4.

Option 2 offers some additional advantages over the others. Since the option travels adjacent to roadways for longer distances it is more accessible for inspection and future maintenance. There is also the possibility of gaining WisDOT participation in the project as it would improve drainage along USH 14. This opportunity is being explored further. Besides cost participation for construction, WisDOT offers the ability to require utilities to relocate as opposed to the Town paying the utilities to relocate.

Option 1 – Big Hollow Road Route – Shown in Yellow Figs 6.3-2 & 6.3-5.

This route would originate at a flood storage area near CTH G and Pearl Road (shown in yellow on figure 6.3-5). It will run south to Kennedy Road, turning southwest roughly 2,500 ft and then turning south extending to Hill Slough in the Wisconsin River. Channel data is as follows:

Option 1 - 15-ft Channel
Design Characteristics

Bottom Width (ft)	15
Channel Length (lf)	14,650
Modeled Channel Slope (ft/ft)	0.0012
Min. Design Channel Slope (ft/ft)	0.001
Side Slopes (H:V)	4:1
Mannings n (slope roughness)	0.03

Option 1 - 15-ft Channel
Major Construction Quantities

Earthwork (CY)	250,000
Structures – 2 cell box culverts	2 – Combine Kennedy Rd and Railroad
Land Disturbance	> 30 Acres
Land Acquisition – Drainage Easement	> 50 Acres

Tables 6.3-12 & 13. Big Hollow/Central Basin 15-ft Channel - Option 1 Channel Characteristics

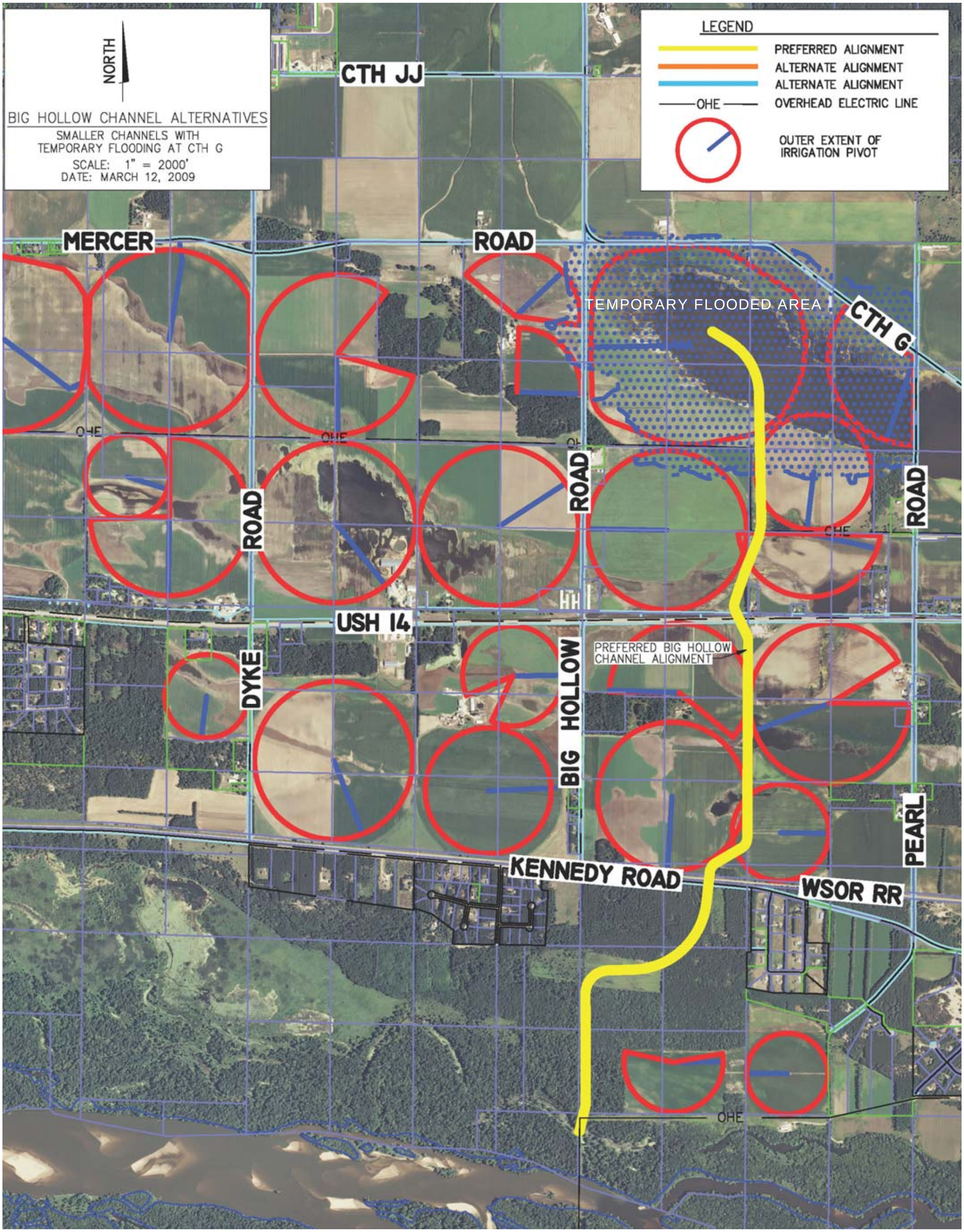


Figure 6.3-5. Big Hollow/Central Basin 15-ft Channel - Route Option 1

Parcel Number	Parcel Acreage	Estimated Easement Acres	Property Owner
032-0070-00000	58.12	2	Dale W and Judith F Clark
032-0066-00000	56.5	0.25	Dale W and Judith F Clark
032-0073-00000	40	0.25	Dale W and Judith F Clark
032-0068-00000	40	6.25	Dale W and Judith F Clark
032-0084-00000	40	8	Dale W and Judith F Clark
	Total =	16.75	
032-0080-00000	40	3.75	James A Sprecher
	Total =	3.75	
032-0085-00000	37.33	1.75	James A and Caryl L Sprecher
032-0583-00000	40	2	James A and Caryl L Sprecher
032-0584-00000	40	2.5	James A and Caryl L Sprecher
	Total =	6.25	
032-0587-00000	40	2.25	Doug Brander
032-0584-00000	40	2.5	Doug Brander
032-0602-00000	40	1.75	Doug Brander
032-0593-00000	40	3.5	Doug Brander
032-0597-00000	4.6	1	Doug Brander
	Total =	11	
032-0598-00000	32.15	3.75	George A Jr. and Julie Fielder
	Total =	3.75	
032-0680-00000	40.1	2	Walter F Joost
032-0681-00000	40	4.25	Walter F Joost
	Total =	6.25	
032-0682-00000	40	3.25	
	Total =	3.25	
032-0688-00000	41.5	0.5	Wisconsin Department of Natural Resources
	Total =	0.5	

Total Estimated Acres = 51.5

Table 6.3-14. Big Hollow/Central Basin 15-ft Channel - Option 1 – Landowner Impacts

Option 1 15-ft Channel
Utility Installations of Concern

American Transmission Co.	Overhead electric transmission 69kV
Alliant Energy	High Pressure Gas Main at USH 14
Charter	Fiber optic at USH 14 overhead and underground
Verizon	Multiple underground locations at USH 14 Underground lines at Kennedy Road Underground Fiber Optic at Railroad

Table 6.3-15. Big Hollow/Central Basin Direct Discharge 15-ft Channel - Option 1 – Utility Impacts

Option 1 15-ft Channel
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$710 - $850
Structures – 2 cell Box Culverts	$450 - $500
Erosion Control, Seeding & Restoration	$282- $340
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Utility Adjustments (Estimated)	$18 - $22
Pavement Repairs	$35 - $45
Land Acquisition	$125 - $150
Roadway Improvements (geometric improvements to CTH G, Pearl Big Hollow and Mercer Roads)	$600- $740
Construction Contingencies, Project Development, Construction Management	$275 - $325

* Land Acquisition includes flooding easement for temporary flood storage

Total Cost $ 2.5 - $3.0 Million

Table 6.3-16. Big Hollow/Central Basin 15-ft Channel – Option 1 – Opinion of Probable Costs

Additional Findings

This route is the least expensive option although comparable to option 2. The route discharges to Hill Slough as opposed to Bakken's Pond. Wetlands will be impacted. The slough is still a unique habitat the DNR would like to protect as it is classified as an Exceptional Resource Water (ERW) like Bakken's. With option 1 there is a possibility to discharge to the floodplain and avoid wetland and slough impacts. Additional environmental and public agency discussions can be found in section 10. The route appears to impact on center pivot irrigation equipment less as shown by the highlighted circular areas on figure 6.3-5.

Option 1 is the recommended option with option 2 very comparable. Further discussion of the study findings can be found in Section 13

6.4 Landowner Conversations

Dale Clark: Mr. Clark expressed a willingness to work with the Town to try to solve the drainage problems posed by the runoff from the Big Hollow Watershed. His property would include the inlet to the drainage swale and would also provide temporary storage of floodwaters until they are drained. Mr. Clark is not interested in selling his property at this time. He considers it to be his investment for retirement. He acknowledged recurrent drainage problems that have impacted the renter's ability to produce crops. He would be willing to enter negotiations for the town to purchase a drainage easement. He also is interested in offering his land as a place to utilize some of the borrow materials from the excavation of the swale.

Jerry Bindl: Mr. Bindl expressed support for the idea of creating a drainage swale to drain floodwaters from Big Hollow to the Wisconsin River. He would like to see this project accomplished as soon as possible and is willing to cooperate with the Town's efforts to address the problem.

Kevin Lins: Mr. Lins requested that the designers look at the feasibility of an alternative route with temporary flood storage. The route was considered. It turn out to be longer and the channel much larger than the recommended alternative.

Mr. Lins came in on Friday, March 27, 2009 to share additional concerns and observations:

He has concerns that any planned improvements to the Big Hollow/CTH G/ Mercer Road intersection have adequate culverts so that the water does not back up on his property.

Mr. Lins said Sauk County multiplied the number and/or increased the size of culverts under JJ in the 1990s but did not do the same for Mercer Road and Big Hollow.

Mr. Lins claims Sauk County reconstructed CTH G in the mid-1990s and also worked on culverts to "improve" drainage out of Big Hollow. He says as a result the speed in which water comes down Big Hollow to the Valley has increased dramatically. According to Lins, the water from storms used to take a half-day to travel from the CTH G/CTH B area to CTH JJ. Now it takes one to two hours to travel the same route.

Doug Brander: Mr. Brander has suggestions for minor route alterations and pointed out that wind erosion could pose a problem by blowing soil into the swale. He also noted that the swale will pass through an area where he has a pipeline between to irrigation pivots. He was supportive of the Town's efforts to find a way to get floodwaters to drain to the Wisconsin River.

Jerry Sprecher: Mr. Sprecher has met several times with our staff and is supportive of efforts to control flooding from Big Hollow. He has suggested practical changes to the route and outfall locations based on his knowledge of the landscape in particular areas.

George Fiedler: Mr. Fiedler has been contacted by telephone and is generally supportive of the effort and having the drainage swale go through his property as long as it does not have a major adverse impact on his timber management activities.

Duane and Iza Pretsch: Mr. Pretsch met with a member of the Town Board and said he was not interested in selling his property. By making a small change in the route, the drainage swale will avoid the Pretsch property.

Walter Joost, Jr.: Mr. Joost has concerns that any drainage swale not interfere with his hunting activities or his enrollment of his property in the Managed Forest Law program. Town Chairman Benny Stenner and a Jewell representative met with Mr. Joost, his family and advisors. They have several concerns: maintaining access to the prime hunting locations on the property after it is intersected by a ditch, opening the door to more trespassers and poachers by creating a "navigable stream", the ditch posing a barrier to natural wildlife migration patterns, potential loss of cropland rental income, and fair compensation for any loss of value. They asked if it would be possible to put the ditch north and west of the Joost property. The primary purpose Mr. Joost owns the property is for hunting deer and turkeys.

Jim & Caryl Sprecher: The Sprechers have been unwilling to discuss the proposal to date with either the engineers or town officials.

Marcus Weston: Mr. Weston went on record as supporting the primary Big Hollow Basin drainage route and in opposition to the alternative route down Big Hollow Road.

6.5 Big Hollow/Central Basin Channel Additional Considerations

One area that deserved additional exploration is the concept of constructed wetlands. This concept was put aside in the study as it become apparent there were issues at the CTH G & Pearl Road ponding area with creating wetlands. FAA regulations regarding waterfowl attractants make constructing a wetland at the CTH G area doubtful. The property owner also has little interest in converting the property at this time. The CTH G location is in the main path of the Tri-County Airport runway. Locating a wetland further downstream is an option. The most likely scenario would be at the end of the swale. This would afford some treatment opportunity. In addition during meetings on March 16, 2009 with DNR officials Jewell was encouraged to look at discharging the channel to the floodplain as opposed to the Hill Slough or Bakken's Pond. There were also concerns about water quality. DNR suggested a floodplain forest (a type of wetland) in this area could provide a nice resource for the landowner and afford environmental benefits. This concept should be explored in future design.

Another area deserving further study is the area between CTH JJ and Mercer Road at the base of Big Hollow. In terms of this study the focus was on handling stormwater that was collecting at the CTH G/Pearl Road area and overflowing in several directions. It is acknowledged however that additional grading in the area north of Mercer Road is necessary to direct the majority of the Big Hollow flow to a proposed flood control feature. In the development of project plans it is recommended this area be evaluated.

Finally related to the area north of Mercer Road this study recommends realignment of the intersections of Mercer Road, Big Hollow Road, and CTH G. Figure 6.5.1 shows a potential configuration. This arrangement allows for just one drainage structure to serve the intersection as opposed to the current arrangement where water passes under Mercer and flows south down Big Hollow until it can discharge east to the proposed flood storage area. In terms of a drainage structure the flows from Big Hollow would require a bridgelike structure to pass all flows without overtopping the roadway. The flows overtop the roadway now in even moderate events. Consideration should be given to allowing overtopping in extreme events with consideration to public safety and maintaining the integrity of the roadway.

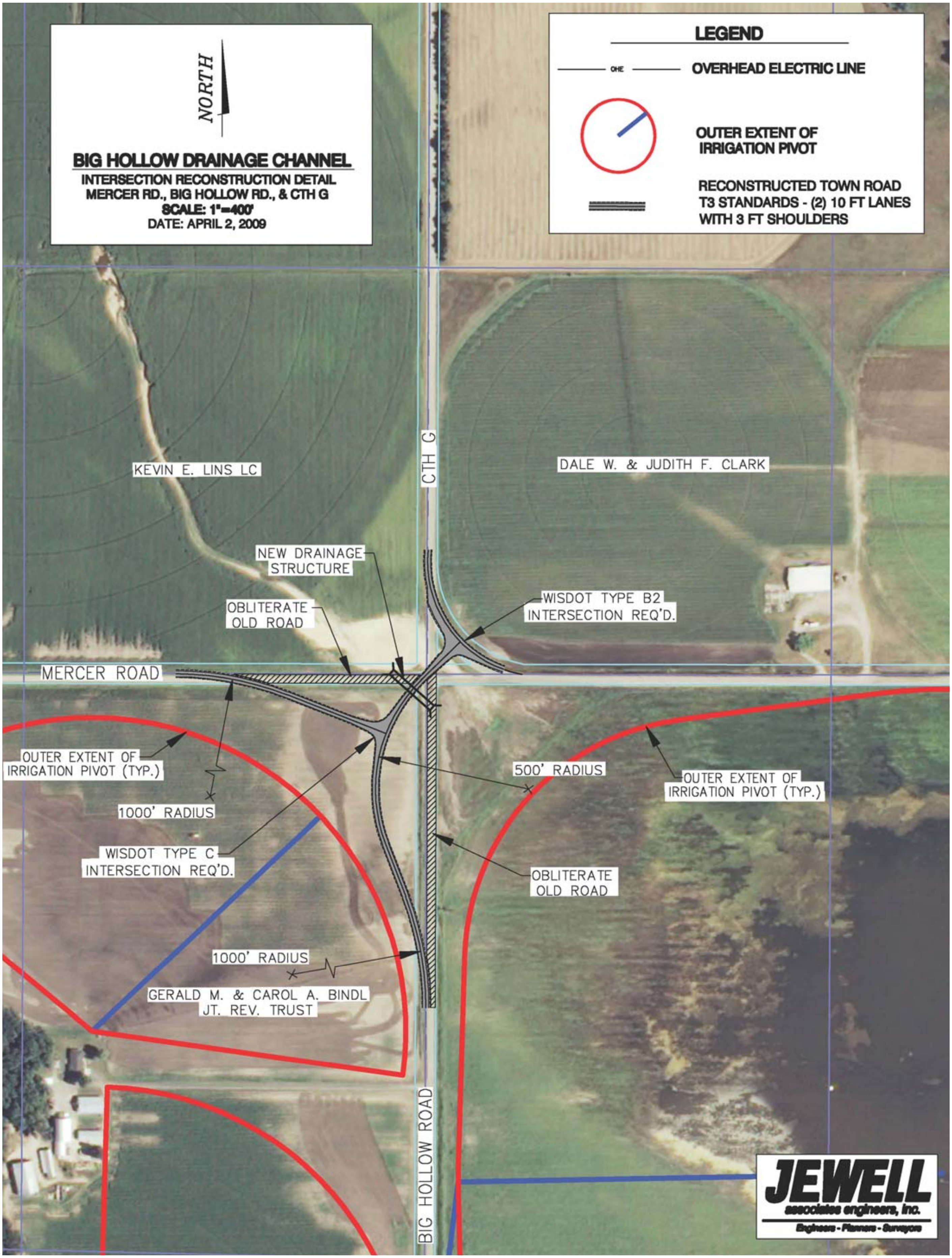


Figure 6.5-1. Reconstructed Intersection Detail Mercer Road, Big Hollow Road, and CTH G

Section 7 – East Drainage Basin

7.1 East Basin Study Background

The scope of the East Basin portion of the study was to investigate alternatives to provide relief by a drainage system of waters east of STH 23 and north of USH 14 east to the Wisconsin River. This area was studied by Montgomery and Jewell using the same processes described in sections 3.2 and section 6. One important aspect of the study was the determination that redirecting the Big Hollow flows to the Wisconsin River does not appear to eliminate all flooding from events like those that occurred in June 2008. The impacts are reduced, however the drainage basin is still large enough to generate substantial floodwaters. A further discussion of this topic can be found in Montgomery's work in Appendix A.

7.2 East Basin Channel

Based on the findings of the Big Hollow study it was again determined a controlled flooding situation may be the best solution for handling East Basin runoff. To handle the runoff without temporary flooding, a channel with a 50-foot bottom width would need to be constructed. As with the 100-foot channel studied in Big Hollow, land impacts and costs are significantly higher. Assuming allowance for temporary flooding it was determined a 5 foot bottom channel could adequately serve the east basin. For constructability purposes the proposed bottom would be 10 feet wide, but in terms of computer modeling the smaller width was assumed. The following data was generated for the East Basin for use in refinement of designs.

	June 7-8th	June 12th	10-year event	100-year event
Channel Flow				
Max Flow (cfs)	185	189	146	211
Max Velocity (ft/s)	2.6	2.6	2.4	2.7
Normal Depth (ft)	3.4	3.4	3.1	3.6
Max Depth (ft)	3.8	3.9	3.5	4.0
Basin Stage				
Max Water Depth (ft)	3.8	3.9	3.5	4.0
Max Water Elevation (ft)	722.9	723.0	722.6	723.1
Drawdown time (days)	3.3	2.6	2.0	2.7
Conceptual Channel Geometry				
Bottom Width (ft)	5	* Meets Drainage District Standards for drawdown		
Channel Length	11,000			
Bottom Slope (ft/ft)	0.0015			
Side Slopes (H:V)	4:1			
Mannings n	0.03	Source: Montgomery 2009		

Table 7.2-1. East Basin/Central Basin East – Modeled Channel Data

Several alternatives for routes to the east were explored based on both engineering design and suggestions from local residents and landowners. All were similar in length and cost with slight differences. Running closer to STH 60 required more earthwork and following a path along the Woodbury Subdivision on Davies Road was longer and brought the channel closer to residential areas. Ultimately one preferred route was selected and studied further. The route and channel had the following characteristics.

East Basin Channel
Design Characteristics

Bottom Width (ft)	10 (5ft modeled)
Channel Length (lf)	10,600
Modeled Channel Slope (ft/ft)	0.0012
Min. Design Channel Slope (ft/ft)	0.0008
Side Slopes (H:V)	4:1
Mannings n (slope roughness)	0.03

East Basin Channel
Major Construction Quantities

Earthwork (CY)	250,000
Structures – 72" Diameter Culverts	2 – STH 60 & Rainbow Rd
Land Disturbance	> 25 Acres
Land Acquisition – Drainage Easement	> 30 Acres

Tables 7.2-2 & 3. East Basin/Central Basin East- Channel Characteristics

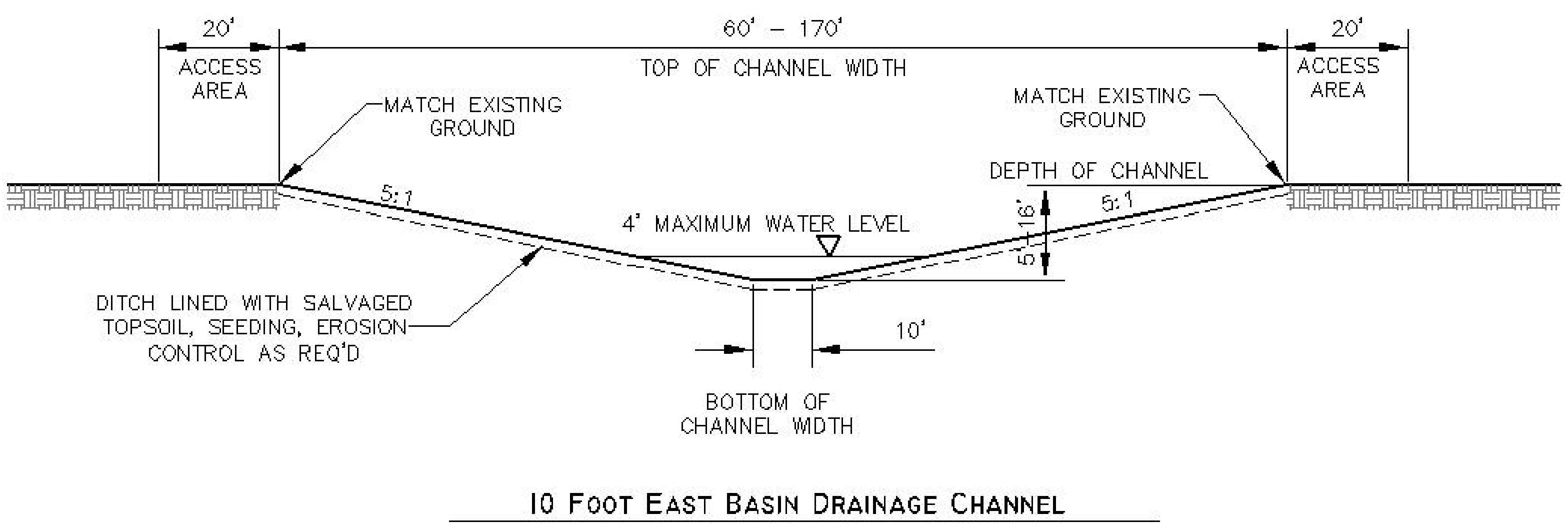


Figure 7.2-1 East Basin/Central Basin East Typical Section

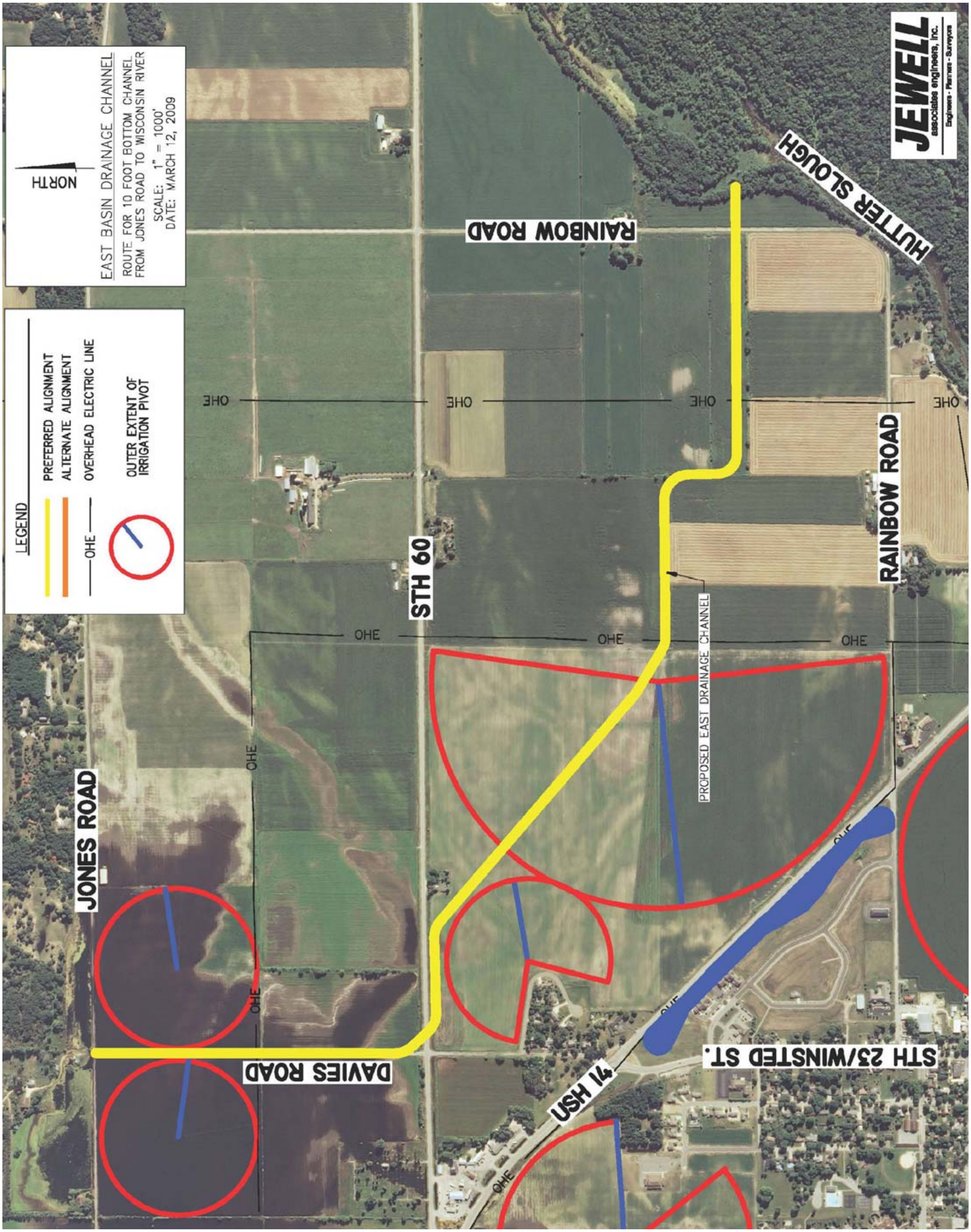


Figure 7.2-2. East Basin/Central East Channel Route

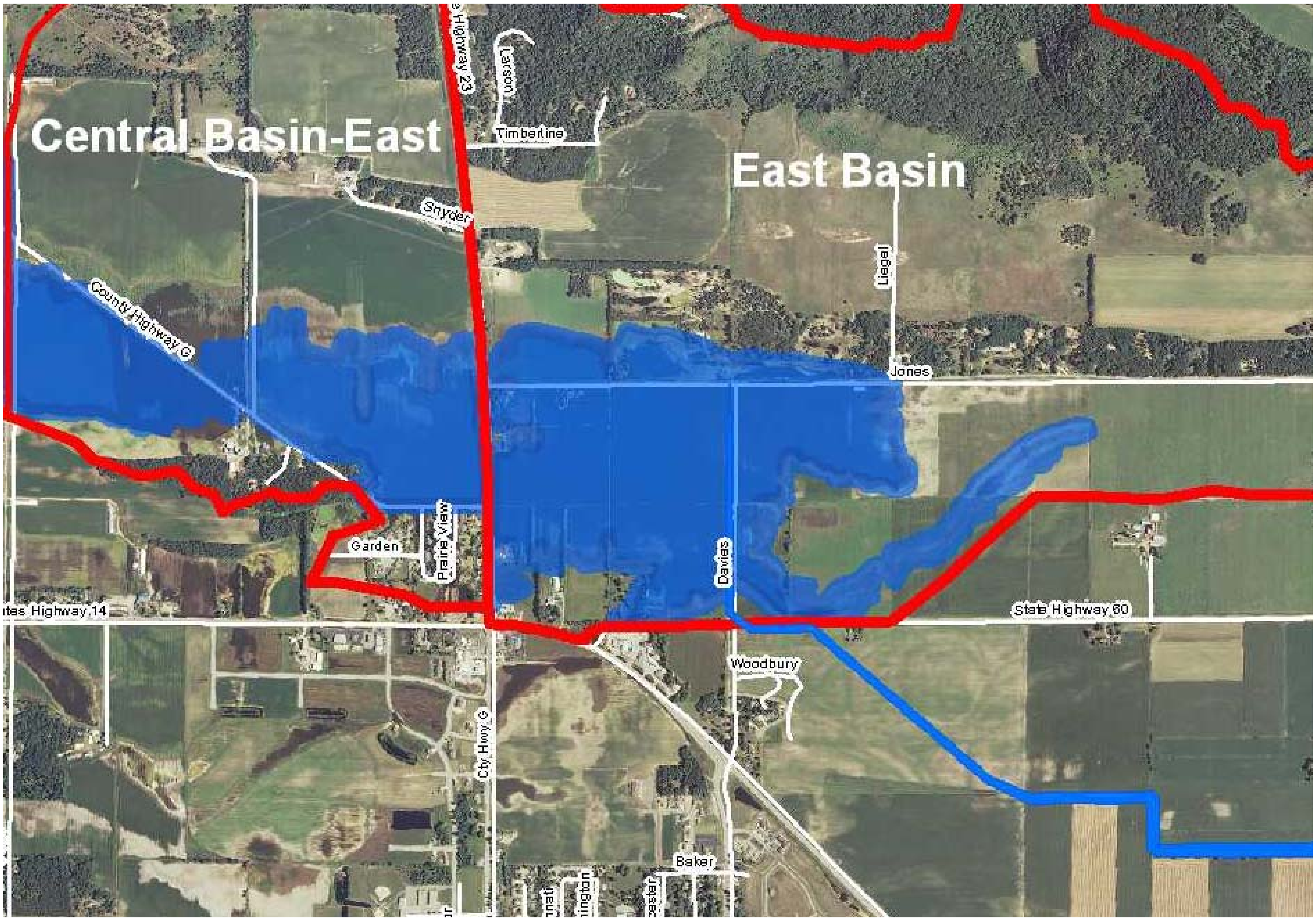


Figure 7.2-3. East Basin/Central East Temporary Flooded Areas
Source Montgomery 2009.

Parcel Number	Parcel Acreage	Estimated Easement Acres	Property Owner
032-0911-00000	22	0.5	Edna M Davies Living Trust
032-0917-00000	20	0.75	Edna M Davies Living Trust
	Total =	1.25	
032-0898-00000	40	0.25	Florian W and Dolores R Liegel
032-0915-00000	40	0.5	Florian W and Dolores R Liegel
032-0921-00000	31.41	3.5	Florian W and Dolores R Liegel
032-0927-00000	40	1	Florian W and Dolores R Liegel
032-0956-00000	9.07	0.1	Florian W and Dolores R Liegel
	Total =	5.35	
032-0919-00000	39.1	5	Marcia Wollschlager et al
032-0955-00000	20	4	Marcia Wollschlager et al
032-0959-00000	10	1.5	Marcia Wollschlager et al
	Total =	10.5	
032-0957-00000	10.93	1	Darlene Buhr Luther Family Farms Limited
032-0960-00000	10	1.5	Darlene Buhr Luther Family Farms Limited
032-0974-00000	35	0.25	Darlene Buhr Luther Family Farms Limited
	Total =	2.75	
032-0958-00000	20	4	Edith M Lins
032-0950-00000	40	5.5	Edith M Lins
032-0951-00000	40	1.25	Edith M Lins
032-0973-00000	40	0.1	Edith M Lins
	Total =	10.85	

Total Estimated Acres = 30.7

Table 7.2-4. East Basin/Central Basin East Channel Option – Landowner Impacts

East Basin Channel
Utility Installations of Concern

American Transmission Co.	Overhead electric transmission 69kV and 138kV
Verizon	Underground Fiber at Davies Road

Table 7.2-5. East Basin/Central Basin East – Channel Option - Utility Impacts

East Basin Channel
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$800 - $970
Structures – 72" DIA Culverts	$100 - $120
Erosion Control, Seeding & Restoration	$180 - $220
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Utility Adjustments (Estimated)	$18 - $22
Pavement Repairs	$36 - $44
Land Acquisition	$135 - $165
Construction Contingencies, Project Development, Construction Management	$160 - $195

* Land Acquisition includes flooding easement for temporary flood storage

Total Cost $1.5 - $1.75 Million

Table 7.2-6. East Basin /Central Basin East Channel Option – Opinion of Probable Costs

Additional Findings

As with the Big Hollow alternatives the DNR has concerns with a discharge to any river slough, in this case Hutter Slough. The east channel however does not afford as much opportunity to discharge to a floodplain 'buffer' area prior to the slough. The slough is pretty much at the base of the existing land. Additional environmental and public agency discussions can be found in section 10.

The topography is such that the ditch gets fairly deep near Rainbow Road reaching depths from 12-15 feet.

This route is disruptive to farming operations. Efforts to allow crossing of the channel by center pivot irrigation should be considered.

A final challenge in the East Basin is that the water along CTH G east of STH 23 would need to be conveyed to the channel. Drainage improvements along CTH G will be necessary.

7.3 Landowner Conversations

Dave and Florian Liegel: The Liegels met Jewell staff to discuss a proposed path for a drainage swale from the Jones Road/Davies Road area southeast to the Hutter Slough area in the bottomlands of the Wisconsin River. Florian reported that groundwater comes up to the surface near the low spot by the Jones Road/Davies Road intersection. He also said there is the equivalent of an "underground river" that runs from that spot toward the cemetery. While the proposed swale would be designed so it could be traversed by center pivot irrigation legs, Dave pointed out that it would still force him to change the way he operates his farm in terms of field work patterns. He made a later contact and said that if the Town takes care of the Big Hollow problem, he is willing to take his chances with leaving things as they are in the east basin.

Edith Lins: Mrs. Lins reported that she did not have any flooding because her land was higher in elevation than properties to the west. She would prefer not to have her prime work land disrupted by a ditch but is willing to talk the proposal over at a later date if things move beyond the planning stage.

Edna Davies Living Trust: Contact was made with Debra Davies as a representative of the trust. If plans proceed for an east basin swale, a small corner of the Davies property could be affected. Ms. Davies requested and was provided with additional information. She has not taken a "for" or "against" position.

Bill Hutter: Expressed support for the Town's efforts to try to prepare for future flooding.

Marcia Wollschlager: Attempts to contact Ms. Wollschlager have not succeeded to date.

7.4 East Basin Alternative Floodwater Management

In looking for a solution for drainage issues at the CTH G & USH 14 and CTH G and Somerset intersection Jewell engineers decided to explore a different method of handling floodwater in the East Basin. The USH 14/CTHG area has poor drainage under even normal rainfall events. Water crosses under USH 14 from the north and essentially ponds on the west side of CTHG near a restaurant and lumberyard. Lack of drainage is also a problem at the intersection of CTH G and Somerset Street just south of this location.

During the 2008 flood events, water flowing through the Prairie View subdivision drained to this location. When the CTH G ditch was full, water backed up under USH 14 and eventually started to flow east when the water level raised enough. It did two things once the storage capacity in the ditch was gone, some of the flow turned west and followed USH 14, and some of the water overtopped CTH G and flooded the agricultural fields immediately north of the Village of Spring Green causing the myriad of problems described previously in this study.

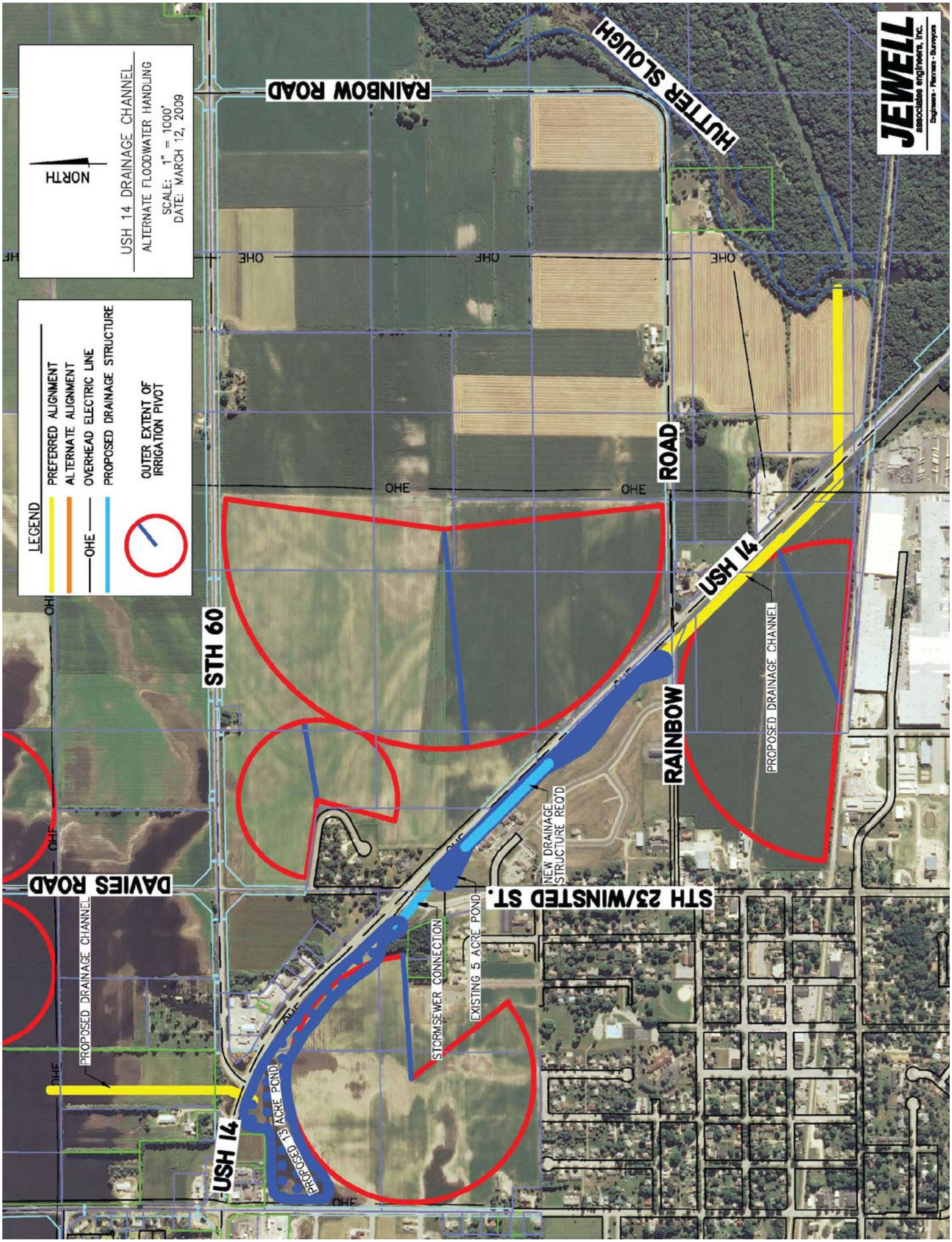


Figure 7.4-1 East Basin Alternate Floodwater Management

One potential solution is to create a retention pond along USH 14 to drain the intersection in this problematic area as well as allow for development of the Village to the north. Under this scenario floodwater would be allowed to pond north of the Village as it would under the channel alternate in section 7.2. In this case the outlet channel would run south and be routed through proposed and existing stormwater facilities before being discharged east to the Wisconsin River. Figure 7.4-1 depicts this alternative system with the channels shown in yellow, ponds shown in blue, potential new drainage structures shown in light blue. Alternately the channel along USH 14 south of Rainbow Road could be another pond serving the future development of that agricultural parcel.

This system was modeled by Jewell Engineers by first evaluating the current and potential future land use for the tributary drainage areas, evaluating soil types and determining the rainfall runoff potential. The runoff potential was determined using the Soil Conservation Service (now NRCS) methodology. The SCS TR-20/TR-55 methods is the widely accepted method for estimating the runoff from a rainfall event. The methodology defines a Curve Number (CN) and Time of Concentration (Tc) for each subwatershed to calculate the runoff volumes and peaks flows during a rainfall event. Curve numbers and Times of Concentration are determined based on existing or future land use, soils, and topography. NRCS Technical Resource (TR) documentation can be referenced for further discussion of this accepted hydrologic practice.

Using the data described above and modeling software Jewell engineers prepared a conceptual design for the system. Jewell was able to take the models developed for the existing 5 acre pond that runs along USH 14 from STH 23 to Rainbow Road as a starting point. Jewell then added the new data for the land use and proposed pond at USH 14 and CTH G. Finally Jewell used the hydrograph or flow data from the Montgomery study to simulate the flow of water entering the system from the flooded East Basin via the channel shown running under USH 14 from the north.

A schematic of the model is shown below

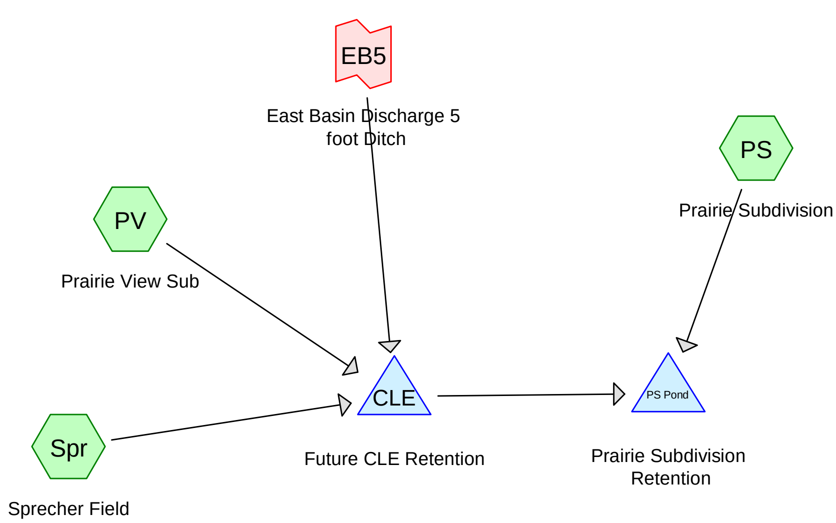


Figure 7.4.2 East Basin Alternate Floodwater Management Model Schematic

In the schematic the green areas depict land use areas generating runoff. The blue triangular areas show retention ponds and the red flag-like area represents data inputted from Montgomery.

Summaries of land use and pond data developed for the model is as follows:

Land Use

Subbasin PS: Prairie Subdivision
Runoff Area=47.000 ac Tc=18.0 min Composite CN=85

Subbasin PV: Prairie View Sub Runoff Area=34.200 ac 60.36% Impervious Runoff Tc=90.0 min Composite CN=84

Subbasin Spr: Sprecher Field Runoff Area=99.850 ac 15.17% Impervious Runoff Tc=300.0 min Composite CN=85

Total Runoff Area = 181.050 ac

Pond Data – Proposed Pond near CTH G and USH 14

Stage versus Storage Relationship

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
716.00	8.680	0.000	0.000
717.00	8.950	8.815	8.815
718.00	9.600	9.275	18.090
719.00	10.040	9.820	27.910
720.00	10.500	10.270	38.180
721.00	11.240	10.870	49.050
722.00	11.750	11.495	60.545
723.00	12.320	12.035	72.580

Pond Data – Existing Winsted St to Rainbow Rd Subdivision Pond

Stage versus Storage Relationship

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
716.00	1.680	0.000	0.000
717.00	1.950	1.815	1.815
718.00	2.600	2.275	4.090
719.00	3.040	2.820	6.910
720.00	3.500	3.270	10.180
721.00	4.240	3.870	14.050
722.00	4.750	4.495	18.545
723.00	5.320	5.035	23.580

Tables 7.4.1, 2, &3 East Basin Alternate Floodwater Management Land Use and Pond Data

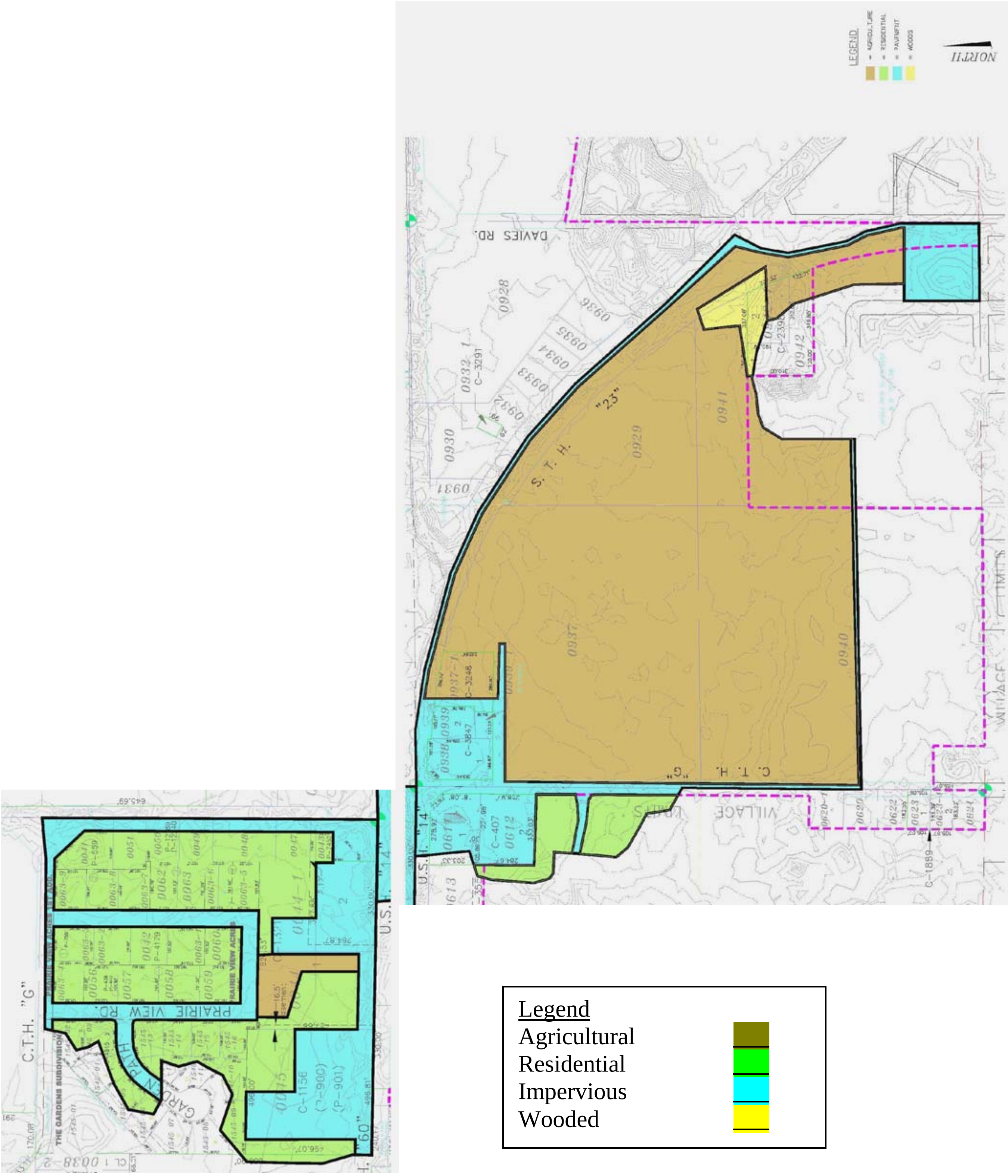


Figure 7.4.3 East Basin Alternate Floodwater Management Basin Map
(Assumes CTH G is raised and Big Hollow floodwaters are diverted elsewhere)

Through the modeling, pond and outlet pipe sizes were determined so that the potential and existing ponds did not overtop. It was determined 6 foot pipes were needed to convey stormwater under STH 23 from the CTH G and USH 14 pond to the existing pond between Winsted Street and Rainbow Road. This existing pond would need to be fitted with a 6-foot pipe under Rainbow Road as that would discharge to the channel shown in figure 7.2-1. One additional concern is that the existing pond narrows behind the existing office buildings near its northwest end. Site constraints do not allow for widening the pond to convey the flows necessary. A pipe would need to be installed the length of this bottleneck as shown on figure 7.4-1.

In terms of flood volumes the model shows 609 acre-feet at 170cfs would enter the proposed pond at USH 14 and CTH G. The subdivision pond would accept 621 acre-feet from its current area and the discharge from the new pond to the west. 621 acre-feet would discharge from the subdivision pond at 143cfs into a channel down to the Wisconsin River.

Summary of East Basin Alternate Floodwater Management

The East Basin alternate floodwater management plan using village ponds offers a feasible solution to stormwater issues along CTH G and USH 14. The alternative provides for future development north and east of the Village of Spring Green. Not shown in figure 7.4-1 is the option to connect a retention pond serving the parcel along the south side of USH 14 south of Rainbow Road. This agricultural parcel is shown on the Spring Green Comprehensive Plan as an area for industrial park expansion as well as an extension of the downtown business corridor along Jefferson Street out to USH 14.

The estimated cost of this proposal is $ 2 Million but a portion of that could be shared with future developers as the Village expands. Funding through a stormwater utility for areas north of the Village may also be an option.

This alternative has probably the most utility challenges of those found in this study, especially near the existing substation near Rainbow Road and USH 14. Throughout the route utilities to be aware of are; ATC has overhead transmission north of USH 14, Verizon has fiber optic on the east sides of Davies Road & STH 23, and Charter Communications has fiber optic east of STH 23 and Alliant Energy has gas main at USH14, and STH 60 to Davies Road as well as 3-phase power crossings at the Prairie Subdivision and near the substation leading to the Spring Green industrial park.

Finally, the design of this alternative must take into account the hazards of bringing the East Basin floodwaters towards the Village. That said the alternative could stand alone without introducing floodwater as a means of alleviating existing flooding issues within the Village and providing for development opportunities in the future.

Section 8 – West Drainage Basin

8.1 West Basin Study Background

The scope of the West Basin portion of the study was to investigate alternatives to provide drainage by a waterway system from the lands near the Tri-County Airport to the Wisconsin River and/or Bear Creek. This area was studied by Montgomery and Jewell using the same processes described in sections 3.2 and section 6. One important aspect of the study was the determination that redirecting the Big Hollow flows to the Wisconsin River does not appear to eliminate all flooding from events like those that occurred in June 2008. The impacts are reduced, however the drainage basin is still large enough to generate substantial floodwaters. A further discussion of this topic can be found in Montgomery's work in Appendix A.

Another finding in the initial study of the west basin was that the Tri-County Airport essentially divides the ponded floodwater on its northwest and southeast side (see figures 8.2.3). When the floodwaters rise the two areas combine as shown in figure 8.2.1. As the water recedes it reverts to two ponded areas. This poses design challenges as to completely drain the basin it may be necessary to have two channels or provide a means of drainage across the airport.

8.2 West Basin Channel

Based on the findings of the Big Hollow study it was again determined that a controlled flooding situation may be the best solution for handling West Basin runoff. Assuming allowing temporary flooding, it was determined a 20 foot bottom channel could adequately serve the West Basin. Although there is less runoff volume in the West Basin than the Central/Big Hollow and East Basins, the larger channel is needed because less flood depth is available for temporary storage. Essentially the flooding needs to be spread out shallower over a larger area and a larger channel is needed to drain it from the area fast enough to prevent uncontrolled or unanticipated flooding.

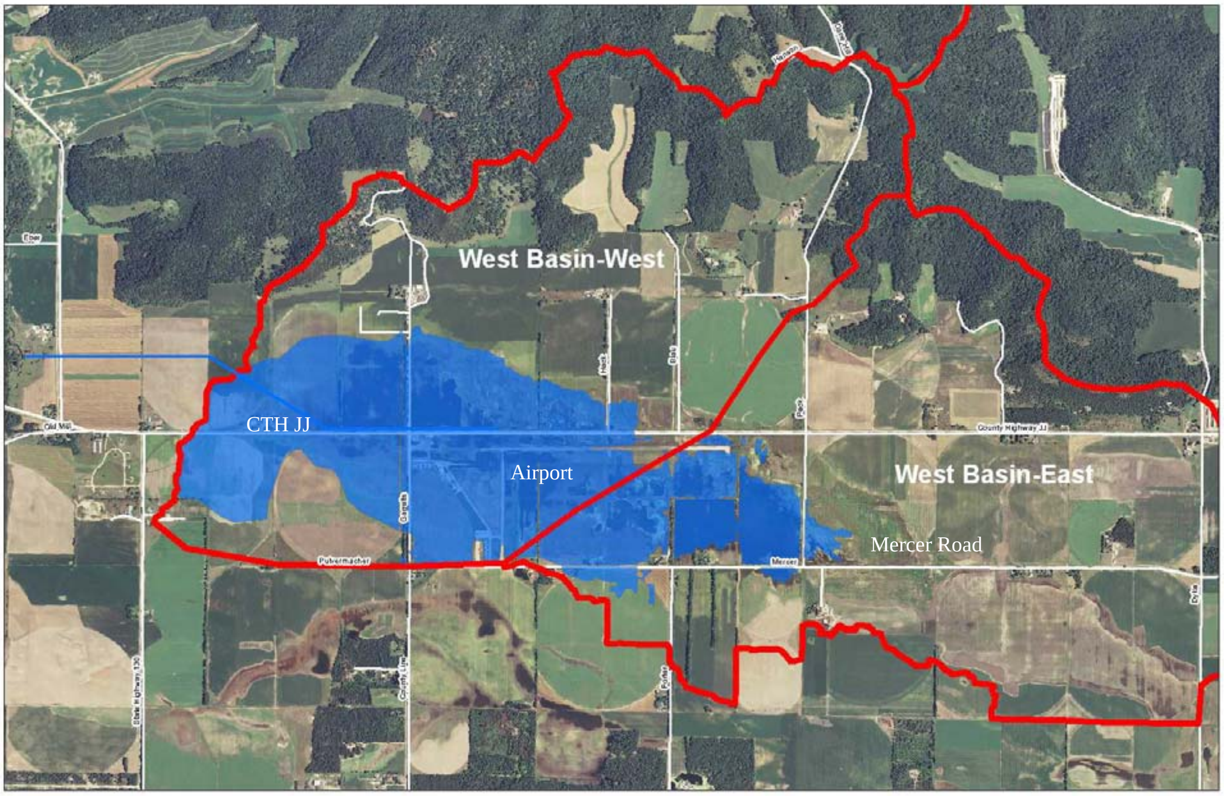


Figure 8.2.1 – Temporary Flooded Area at Tri-County Airport

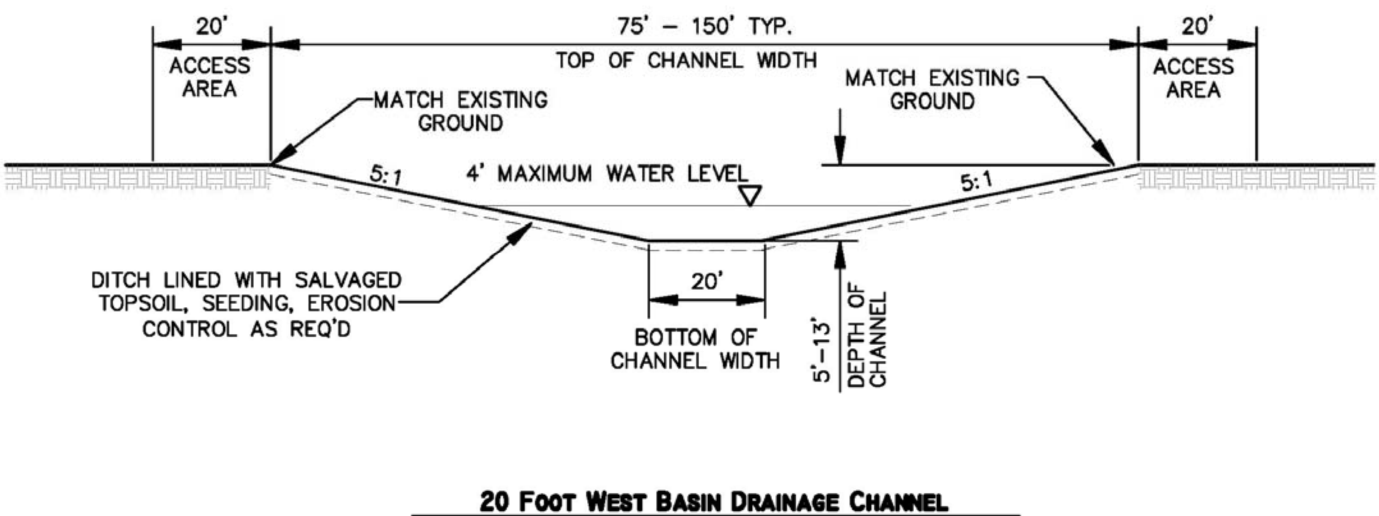


Figure 8.2.2 – Proposed Typical Section for West Basin Channel

The following data was generated for the West Basin for use in refinement of designs.

	June 7-8th	June 12th	10-year event	100-year event
Channel Flow				
Max Flow (cfs)	322	331	271	374
Max Velocity (ft/s)	2.8	2.8	2.6	2.9
Normal Depth (ft)	3.2	3.2	2.9	3.5
Max Depth (ft)	3.6	3.7	3.3	3.9
Basin Stage				
Max Water Depth (ft)	3.6	3.7	3.3	3.9
Max Water Elevation (ft)	715.6	715.7	715.3	715.9
Drawdown time (days)	N/A	3.5	3.1	3.8
Conceptual Channel Geometry				
Bottom Width (ft)	20			
Channel Length	10,000			
Bottom Slope (ft/ft)	0.0013			
Side Slopes (H:V)	4:1			
Mannings n	0.03			
To meet Drainage District requirements and drain the floodwater in 48 hours for a 10 year storm a 35 foot wide bottom channel is required.				

Table 8.2-1. West Basin – Modeled Channel Data
Source: Montgomery 2009.

Several alternatives for routes to the west were explored based on both engineering design and suggestions from local residents and landowners. As stated previously the West Basin offers challenges in terms of designing a single solution to encompass the problems at both ends of the airport. This study presents two potential arrangements in addition to discussion of a third option proposed by a local group interested in a drainage district.

8.3 West Basin Drainage District Option

The West Basin is also unique in that it is an area of the River Valley where landowners had joined together in an effort to form a drainage district. Drainage Districts are explained in more detail in Section 11.4 but essentially it is a form of local governance for drainage issues. As of the date of this study a Drainage Board has been established for the area but further study is necessary prior to the formation of a Drainage District. A cursory review of the proposed drainage district route was conducted as part of this study and the results are presented below. It must be pointed out that without providing a means of draining the airport to the drainage district channel there will still be flooding issues at the northwest side of the airport. It is also important to note the Drainage District channel will only address flooding issues within the West Basin. It will not impact flooding of the River Valley resulting from runoff from Big Hollow or the Central and Eastern Basins.

Drainage District Channel
Design Characteristics

Bottom Width (ft)	20
Channel Length (lf)	11,142
Modeled Channel Slope (ft/ft)	0.0013
Min. Design Channel Slope (ft/ft)	0.0013
Side Slopes (H:V)	4:1
Mannings n (slope roughness)	0.03

Drainage District Channel
Major Construction Quantities

Earthwork (CY)	200,000
Structures – 2 X 60 Inch Culverts	4 – USH 14 and combined Kennedy Road and Railroad Structure
Land Disturbance	> 25 Acres
Land Acquisition – Drainage Easement	> 35 Acres

Tables 8.2-2 & 3. West Basin Drainage District Channel Characteristics

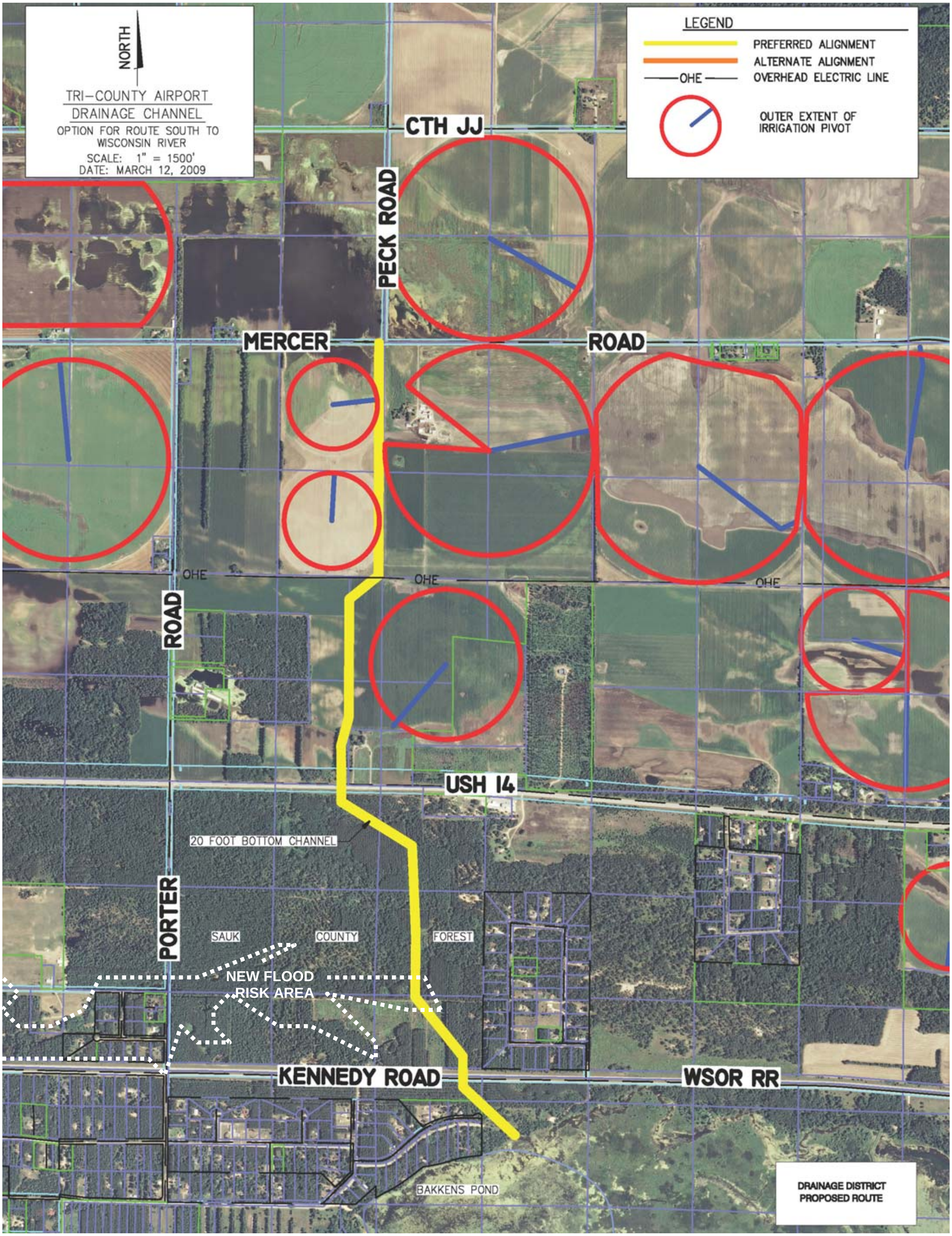


Figure 8.2-2. West Basin Drainage District Channel Route

Parcel Number	Parcel Acreage	Estimated Easement Acres	Property Owner
032-0145-00000	49.27	4.25	Hartung Brothers Inc
032-0149-00000	40	4	Hartung Brothers Inc
	Total =	8.25	
032-0142-00000	50.05	0.1	Jeffrey A Sprecher
032-0143-00000	40	0.5	Jeffrey A Sprecher
032-0150-00000	12.5	3	Jeffrey A Sprecher
032-0161-00000	5.83	1	Jeffrey A Sprecher
	Total =	4.6	
032-0164-00000	6.67	0.1	Bob and Lola Ewers
	Total =	0.1	
032-0151-00000	19.88	1.75	Milton N and Shirley Sprecher
032-0162-00000	22.37	2.5	Milton N and Shirley Sprecher
	Total =	4.25	
032-0256-00000	40	2	Sauk County
032-0254-00000	33.7	3.25	Sauk County
032-0255-00000	41.2	4.75	Sauk County
032-0264-00000	9.75	5	Sauk County
	Total =	15	
032-0265-00000	1.8	0.5	Mark D - Heather L Robson and Leach
	Total =	0.5	
032-0263-00000	9.5	0.05	Wisconsin Department of Natural Resources
032-0267-00000	40.5	2	Wisconsin Department of Natural Resources
	Total =	2.05	

Total Estimated Acres = 34.75

Table 8.2-4. West Basin Drainage District Option – Landowner Impacts

West Basin
Drainage District Channel
Utility Installations of Concern

American Transmission Co.	Overhead electric transmission 69kV north of USH 14
Verizon	Multiple Underground copper at USH 14 Underground copper and fiber optic at Kennedy Road
Charter	Fiber optic underground at USH 14
Alliant Energy	Gas Main at USH 14

Table 8.2-5. West Basin Drainage District Option – Utility Impacts

West Basin
Drainage District Channel
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$704 - $850
Structures – 4- 60" DIA Culverts	$177 - $215
Erosion Control, Seeding & Restoration	$185 - $225
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Utility Adjustments (Estimated)	$18 - $22
Pavement Repairs	$36 - $44
Land Acquisition	$145- $175
Construction Contingencies, Project Development, Construction Management	$160 - $195

* Land Acquisition includes flooding easement for temporary flood storage

Total Cost $1.5 - $1.75 Million

Table 8.2-6. West Basin Drainage District Option – Opinion of Probable Costs

Additional Findings

This route is a shorter and potentially less costly route than those proposed to run to Bear Creek. The estimate does not take into account additional grading that may be required at the Tri-County Airport to drain that area which will increase the overall project cost.

Discharging to Bakken's Pond may prove difficult. The channel would discharge close to a protected State Natural Area in Bakken's Pond but the Wisconsin Department of Natural Resources (DNR) has indicated the entire pond is an important natural resource. Disturbing wetlands will be an issue near Bakken's Pond. There is also the need to work with Sauk County for permission to route the channel through the Sauk County Forest. Additional environmental and public agency discussions can be found in section 10.

This route is less disruptive to farming operations than the options to Bear Creek. The route appears to avoid irrigation pivot impacts.

One final point of concern is that providing a drainage structure under Kennedy Road may place lands immediately north of the road at greater risk from flooding. Currently, Kennedy Road acts as essentially a levy, blocking floodwaters from flowing north into the Sauk County Forest. A new drainage structure would allow floodwaters to back up into the county forest where a large area sits at or 1-2 feet above the 100-year floodplain of the river (see figure 8.2-2 for approximate area). For events larger than the 100-year flood, the potential exists for risk to adjacent residential areas. This issue needs to be considered in the design of a channel south from the airport to Bakken's Pond.

8.4 West Basin Routes to Bear Creek

In the West Basin, Jewell also examined two routes to direct water west to Bear Creek. Draining to Bear Creek offers a few advantages. There are fewer enviromental issues with the DNR. Bear Creek has more capacity to handle pollutant loading according to the DNR. It is also not classified as an exceptional resource water (ERW) like the river sloughs and Bakken's Pond. Routing the channels west also avoids providing more costly drainage structures for USH14, Kennedy Road, and the railroad. Finally there appears to be less risk to properties from floodwaters backing up into the channels.

West Basin Channel to Bear Creek – Option 1

Based on the flow characteristis and design standards stated in section 8.2 the following was determined for option 1 for a channel to Bear Creek. The route is shown in figure 8.4.1.

Bear Creek Option 1
Design Characteristics

Bottom Width (ft)	20
Channel Length (lf)	11,122
Modeled Channel Slope (ft/ft)	0.0013
Min. Design Channel Slope (ft/ft)	0.001
Side Slopes (H:V)	4:1
Mannings n (slope roughness)	0.03

Bear Creek Option 1
Major Construction Quantities

Earthwork (CY)	350,000
Structures – 2 X 60 inch to 72 inch culverts each	4 – CTH JJ and STH 130
Land Disturbance	> 35 Acres
Land Acquisition – Drainage Easement	> 40 Acres

Tables 8.4-1 & 2. West Basin - Bear Creek Option 1

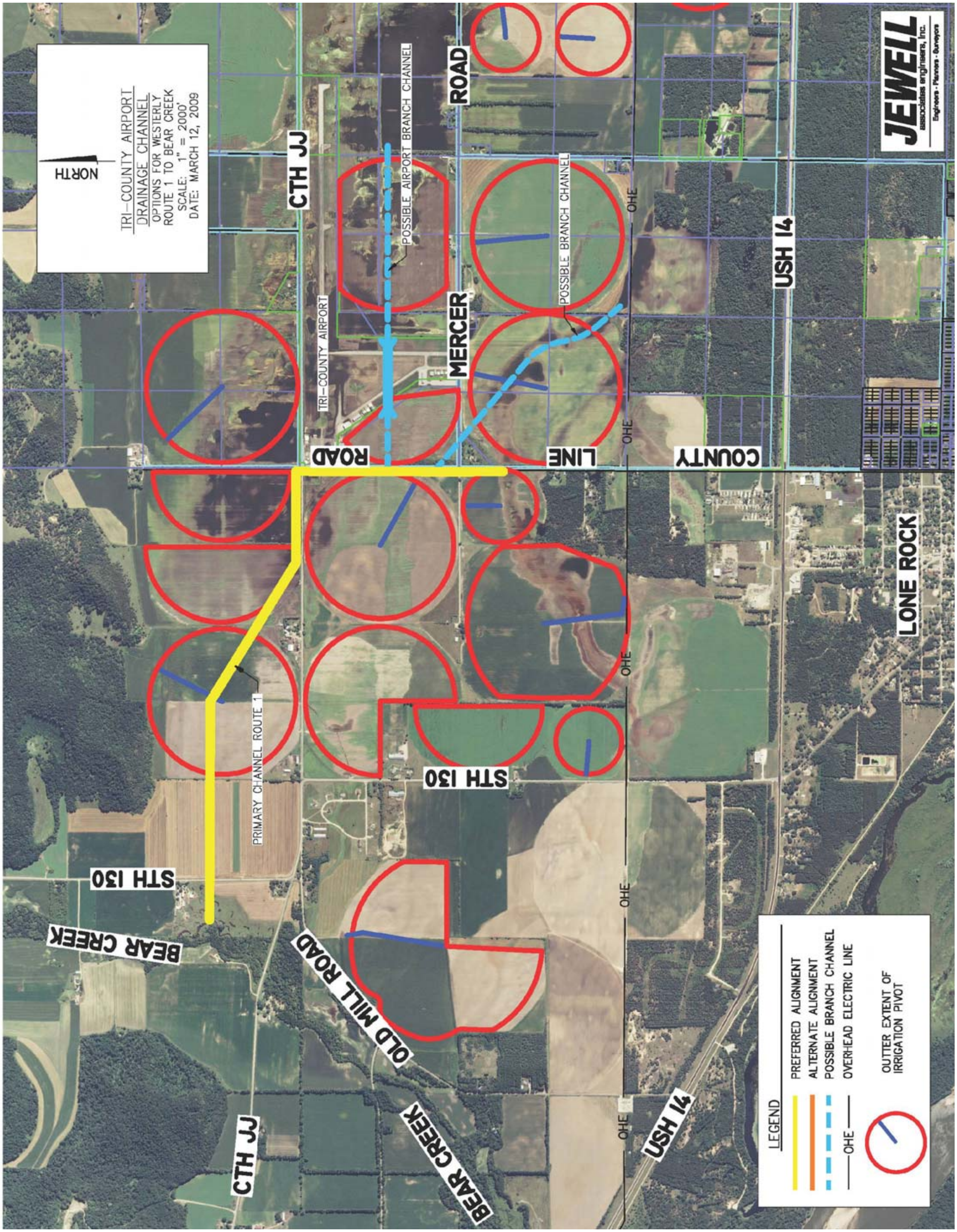


Figure 8.4-1. West Basin - Bear Creek Option 1 Channel Route

Parcel Number	Parcel Acreage	Estimated Easement Acres	Property Owner
006-3512-1000	7.5	3	Kenneth W and Helen A Smith
006-3511-1000	7.5	4.75	Kenneth W and Helen A Smith
	Total =	7.75	
006-3512-2000	32.5	0.75	Milton and Shirley Sprecher
006-3512-1000	32.5	1.5	Milton and Shirley Sprecher
	Total =	2.25	
006-3622-0000	40	6.5	Greenheck Farms Limited Partnership
006-3623-0000	40	1.75	Greenheck Farms Limited Partnership
006-3624-0000	40	5.5	Greenheck Farms Limited Partnership
006-3613-0000	40	6	Greenheck Farms Limited Partnership
	Total =	19.75	
006-3614-0000	40	3.5	Garrelts Farm LLC
032-1216-00000	38.15	0.75	Garrelts Farm LLC
	Total =	4.25	
006-3641-2000	2.25	0.75	Tri-County Regional Airport
	Total =	0.75	
006-3641-1000	37.75	4	Hartung Farms
006-3644-0000	40	4	Hartung Farms
	Total =	8	

Total Estimated Acres = **42.75**

Table 8.4-3. West Basin - Bear Creek Option 1 – Landowner Impacts

West Basin
Bear Creek Option 1
Utility Installations of Concern

Verizon	Multiple underground copper installations route
Alliant Energy	3 phase electric for airport at CTH JJ

Table 8.4-4. West Basin - Bear Creek Option 1 – Utility Impacts

West Basin
Bear Creek Option 1
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$1036 - $1255
Structures – 4 X 60" – 72" DIA Culverts	$159- $195
Erosion Control, Seeding & Restoration	$235 - $284
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Utility Adjustments (Estimated)	$18 - $22
Pavement Repairs	$36 - $44
Land Acquisition	$163- $198
Construction Contingencies, Project Development, Construction Management	$205 - $248

* Land Acquisition includes flooding easement for temporary flood storage

Total Cost $1.9 - $2.3 Million

Table 8.4-5. West Basin - Bear Creek Option 1– Opinion of Probable Costs

Additional Findings

This route is slightly more expensive than the proposed drainage district route but it has fewer environmental concerns and less flooding risk.

This route is slightly less disruptive to center pivot irrigation equipment than option 2 for routing to Bear Creek. It does however require branch ditching (shown in light blue on figure 8.4-1) for draining of the airport and properties to the south that were flooded in 2008.

West Basin Channel to Bear Creek – Option 2

Based on the flow characteristis and design standards stated in section 8.2 the following was determined for option 2 for a channel to Bear Creek. The route is shown in figure 8.4.2. The route offers the ability to drain the southeast side of the airport with minimum grading on the actual airport grounds.

Bear Creek Option 2
Design Characteristics

Bottom Width (ft)	20
Channel Length (lf)	25,700
Modeled Channel Slope (ft/ft)	0.0013
Min. Design Channel Slope (ft/ft)	0.0007
Side Slopes (H:V)	4:1
Mannings n (slope roughness)	0.03

Tables 8.4-6. West Basin - Bear Creek Option 2 – Design Characteristics

Bear Creek Option 2
Major Construction Quantities

Earthwork (CY)	350,000
Structures – 2 X 60 inch -66 inch culverts each location	6 – County Line Rd, STH 130, Old Mill Rd
Land Disturbance	> 45 Acres
Land Acquisition – Drainage Easement	> 50 Acres

Tables 8.4 - 7. West Basin - Bear Creek Option 2 Quantities

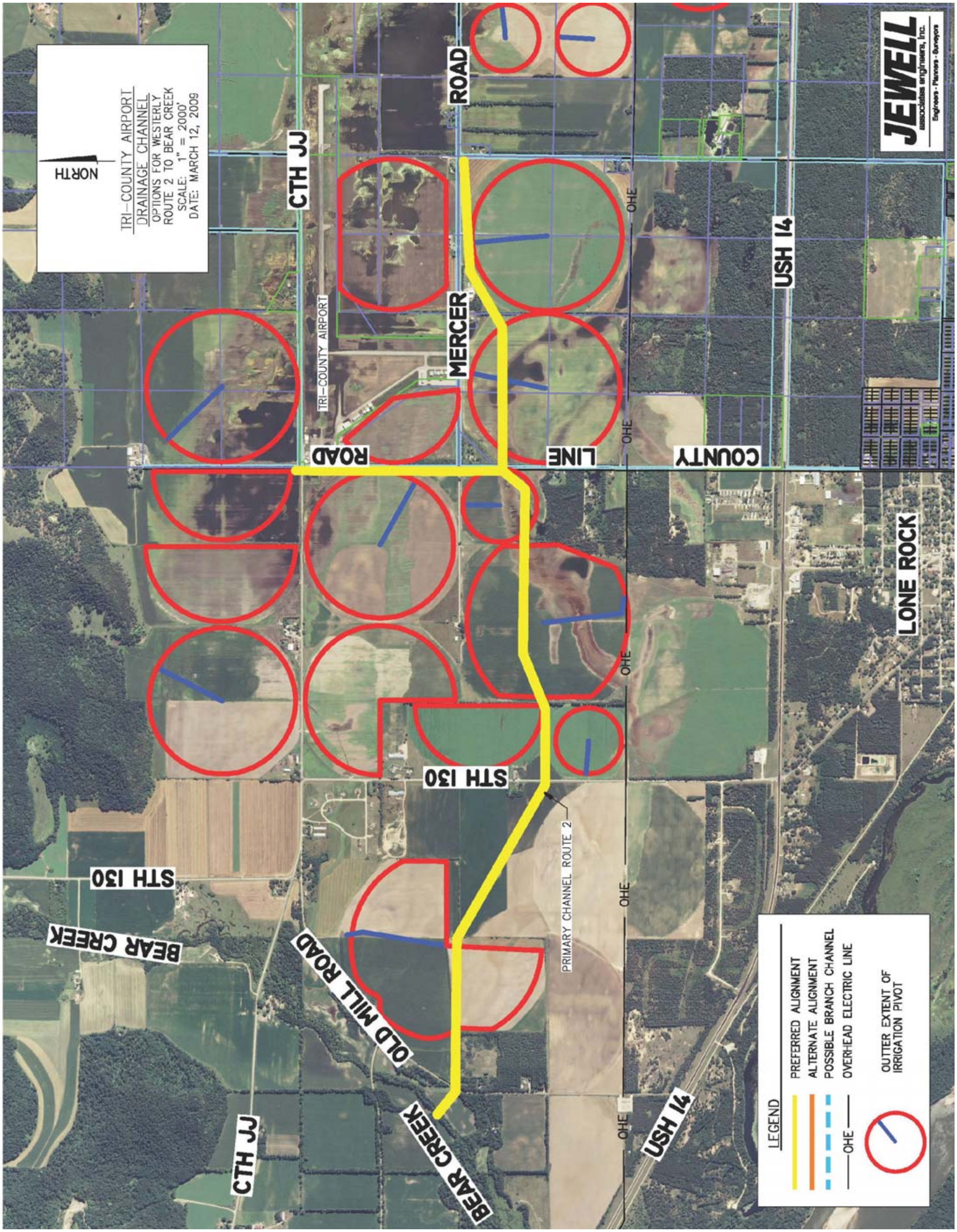


Figure 8.4-2. West Basin - Bear Creek Option 2 Channel Route

Parcel Number	Parcel Acreage	Estimated Easement Acres	Property Owner
032-0174-00000	46.96	4.75	Milton and Shirley Sprecher
032-0173-00000	47.68	3.5	Milton and Shirley Sprecher
006-3711-0000	45.17	4	Milton and Shirley Sprecher
	Total =	8.25	
032-0179-00000	45.52	4.25	Hartung Brothers Inc
032-0182-00000	38	3.25	Hartung Brothers Inc
006-3712-0000	45.12	4	Hartung Brothers Inc
006-3721-1000	44.71	4.25	Hartung Brothers Inc
	Total =	15.75	
006-3722-1000	41.99	1.75	Hartung Farms
006-3723-0000	40	2	Hartung Farms
	Total =	3.75	
006-3814-0000	40	0.25	Terry A and Dawn D Sprecher
006-3811-2000	10	2	Terry A and Dawn D Sprecher
	Total =	2.25	
006-3811-1000	40.01	3.5	Donna O'Donnell
006-3812-1000	40.07	5.25	Donna O'Donnell
	Total =	8.75	
006-3822-2000	27.72	0.5	Kay L K Taylor
	Total =	0.5	
006-3543-0000	40	0.25	Albert W and Ann M Greenheck
006-3821-0000	45.13	2	Albert W and Ann M Greenheck
006-3534-0000	40	3	Albert W and Ann M Greenheck
006-3822-1000	10	1.25	Albert W and Ann M Greenheck
006-3533-1000	37.2	3.5	Albert W and Ann M Greenheck
	Total =	10	
006-3444-1000	24.8	0.75	Kenneth F and Karen A Edgerly
	Total =	0.75	

Total Estimated Acres = 50

Table 8.4-8. West Basin - Bear Creek Option 2 – Landowner Impacts

West Basin
Bear Creek Option 2
Utility Installations of Concern

American Transmission Co.	Overhead electric transmission 69kV north of USH 14
Verizon	Underground copper installations throughout

Table 8.4-9. West Basin Drainage District Option – Utility Impacts

West Basin
Bear Creek Option 2
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$1056 - $1278
Structures – 6 X 60" – 66" DIA Culverts	$165- $200
Erosion Control, Seeding & Restoration	$257 - $311
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Utility Adjustments (Estimated)	$18 - $22
Pavement Repairs	$55 - $65
Land Acquisition	$172- $209
Construction Contingencies, Project Development, Construction Management	$215 - $260

* Land Acquisition includes flooding easement for temporary flood storage

Total Cost $2.0 - $2.4 Million

Table 8.4-10. West Basin - Bear Creek Option 2– Opinion of Probable Costs

Additional Findings

This route is more expensive but has fewer environmental concerns and less flooding risk than the proposed drainage district route to the south. When considering that option 1 and the drainage district route may require multiple ditches or branch ditching to address all flooding near the airport, option 2 could become more cost competitive.

This route is more disruptive to center pivot irrigation equipment than option 1 for routing to Bear Creek.

8.5 Landowner Conversations

Tony Garrelts: Mr.Garrelts met with Jewell staff and said he supports formation of a drainage district to come up with a solution to the flooding on the west end of the Town. For now he would prefer for the drainage district to concentrate on properties located between Dyke Road and County line Road. He prefers a drainage route to the south with the outlet at Bakken's Pond.

Jeff Sprecher: Jeff Sprecher met with Jewell staff and also would like to see a drainage district formed to take care of the water on the west end of the Town.

Milton Sprecher: Milton Sprecher met with a Jewell representative to discuss his theory that the berms at Bakken's Pond and Long Lake inhibit drainage from the river valley to the Wisconsin River. He also expressed the opinion that the natural path of drainage for this part of the Town is to the west to Bear Creek in Richland County.

Mark Higgs: Mr. Higgs is the manager of Tri-County Airport. He is very concerned about the impact the flooding has had on airport operations and would like to see a solution. He agreed to contact the Bureau of Aeronautics to see if there is any funding available to assist paying for a drainage project for the airport.

William Mertens: Mr. Mertens lives adjacent to the area where the proposed Jasen Dane Drainage Ditch would outlet into Bakken's Pond. Mr. Mertens is very concerned about the potential such a ditch would have to increase flood risks for those who live along Flowage Road and in the Wismar Forest Subdivision. He is also concerned about the potential detrimental effects on wildlife and plants in Bakken's Pond if chemical-laden runoff water enters the pond.

Greg Greenheck: Mr. Greenheck farms in the Town of Buena Vista. He met with Jewell staff to learn more about the flood control study and in particular any plans to create a drainage project to the west to conduct flood water toward Bear Creek. He looked at several route options and offered comment.

Herman Kaldenberg: Mr. Kaldenberg has meet with Jewell staff on multiple occasions to learn more about proposed drainage plans and the elevations of various parts of the valley and how this topographic information is used to develop drainage design.

Section 9 – Village of Spring Green Storm Water Discharge

9.1 Village Stormwater Discharge at Shifflet Road Background

Over 200 acres of Village and Town property drain through pipes or overland to the farm fields between Shifflet and Carpenter Roads. In times of normal precipitation, flooding and crop damage are persistent at this location. This damage is a continuing source of potential liability for the Village. This area does not naturally discharge to the Wisconsin River. In June 2008 the water at this location ponded to the point of crossing Shifflet Road and traveling southwest. It only reached the river after local residents dug a trench to release the floodwater. This trench was subsequently refilled. Through the summer of 2008 the Town pumped water to the Village stormsewer system, adding to the flooding problem in this area.

As part of this study Jewell Associates studied means of controlling stormwater at this location through the use of a detention area. The detention area would control the stormwater discharge by allowing it to pond temporarily in a dry pond or artificial wetland area and slowly discharge to the river. Two pond alternatives were evaluated for this location.

Option 1 – Create an 18-acre detention pond or artificial wetland through the creation of berms. The detention pond would discharge to the Wisconsin River via an excavated channel with a 15-foot bottom.

Option 2 – Create a 27-acre detention pond or artificial wetland with a 2,700 LF 36-inch diameter pipe outlet discharging the Wisconsin River.

Alternately the Village could pursue a "No Build" alternative by reaching a formal agreement with the landowner for the stormwater discharge. This could come in the form of a drainage easement or similar instrument. The disadvantage to this alternative is it does not address the fairly regular overtopping of Shifflet Road and the potential threat to downstream properties.

Option 1 & 2 are shown in figure 9.1-1 below.

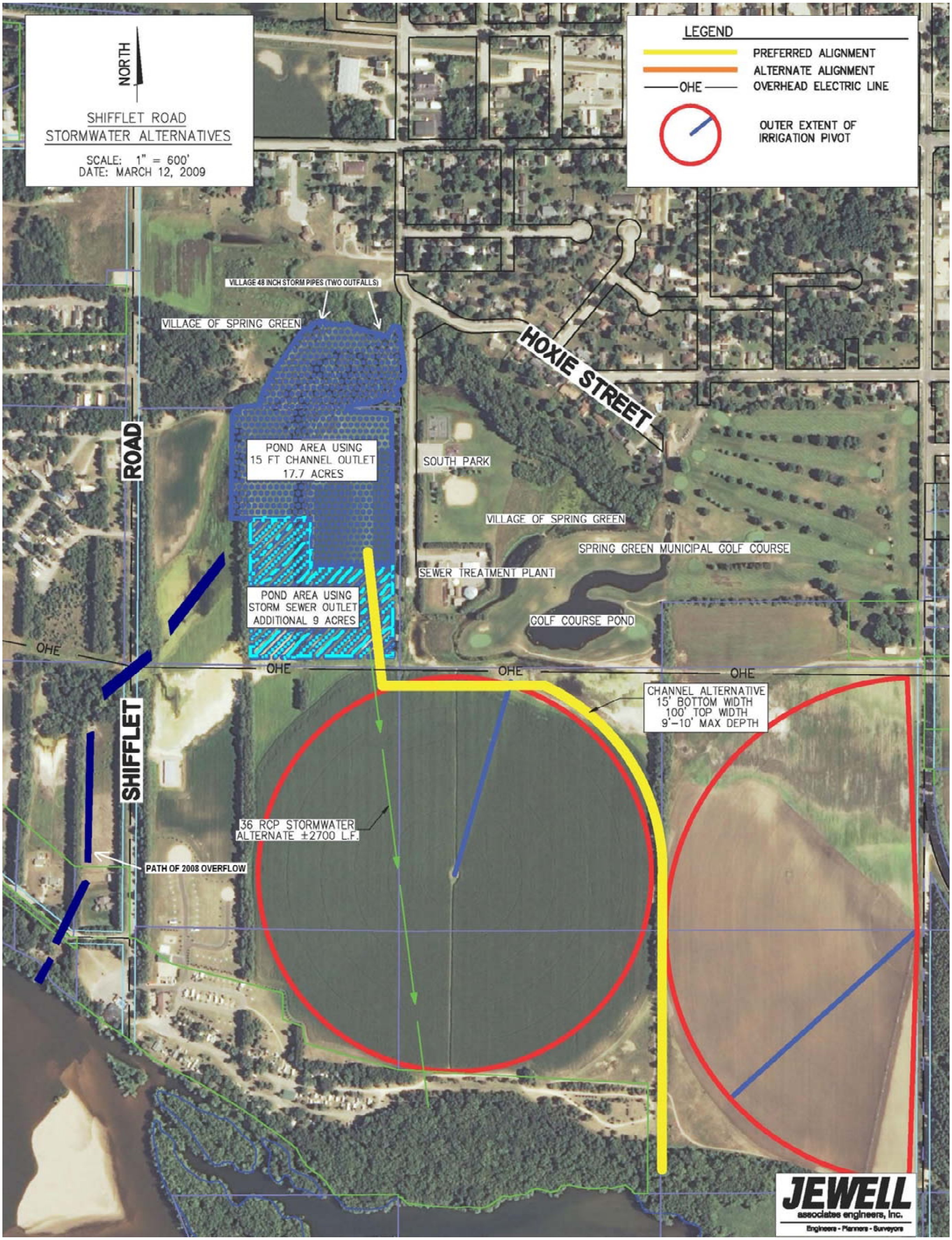


Figure 9.1-1 – Village Stormwater Discharge at Shifflet Road

9.2 Shifflet Road Discharge Design Methodology

Sizing of the stormwater detention area and discharge was modeled by Jewell Engineers similar to the modeling for the East Basin alternative floodwater management concept described in section 7.4. Engineers determined the current and potential future land use for the tributary drainage areas, evaluated soil types and determined the rainfall runoff potential. The runoff potential was determined using the Soil Conservation Service (now NRCS) methodology. The SCS TR-20/TR-55 methods is the widely accepted method for estimating the runoff from a rainfall event. The methodology defines a Curve Number (CN) and Time of Concentration (Tc) for each subwatershed to calculate the runoff volumes and peaks flows during a rainfall event. Curve numbers and Times of Concentration are determined based on existing or future land use, soils, and topography. NRCS Technical Resource (TR) documentation can be referenced for further discussion of this accepted hydrologic practice.

Using the data described above and modeling software, Jewell engineers prepared a conceptual design for the system. Jewell was able to take the models developed for the WisDOT STH 23 reconstruction project built in 2005. That project included construction of a regional stormwater retention facility that in times of extreme events can discharge to the Shifflet Road area. The retention facility is labeled "golf course pond" on figure 9.1-1. The model was updated to conform to the current modeling software and Jewell then added the new data for the areas draining to the Shifflet Road area either overland or via the two village stormsewer systems that discharge to the location.

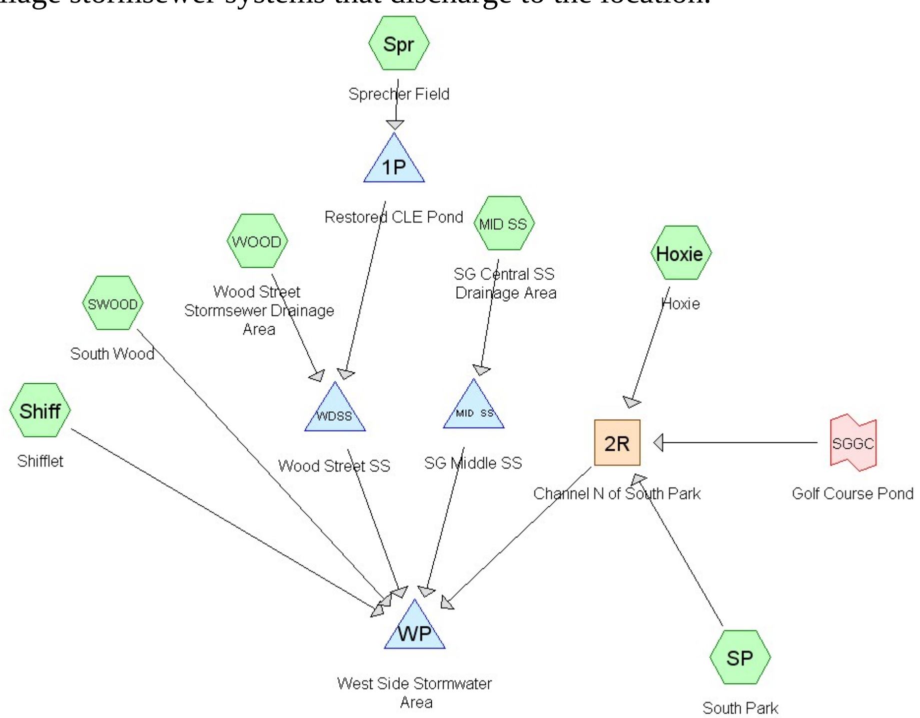


Figure 9.2-1. Shifflet Road Discharge Floodwater Management Model Schematic

In the model node schematic in figure 9.2-1 the green areas depict land use areas (basins) generating runoff. The blue triangular labeled areas 1P and WP represent retention ponds, the triangles labeled WDSS and MID SS represent the Village stormsewer discharges to the Shifflet Road area. Finally the red flag-like area represents data inputted for the model of the golf course retention area developed for the WisDOT STH 23 reconstruction project built in 2005. A map of the basins used in the model is shown in figure 9.2.2. This area is essentially the western half of the Village of Spring Green.

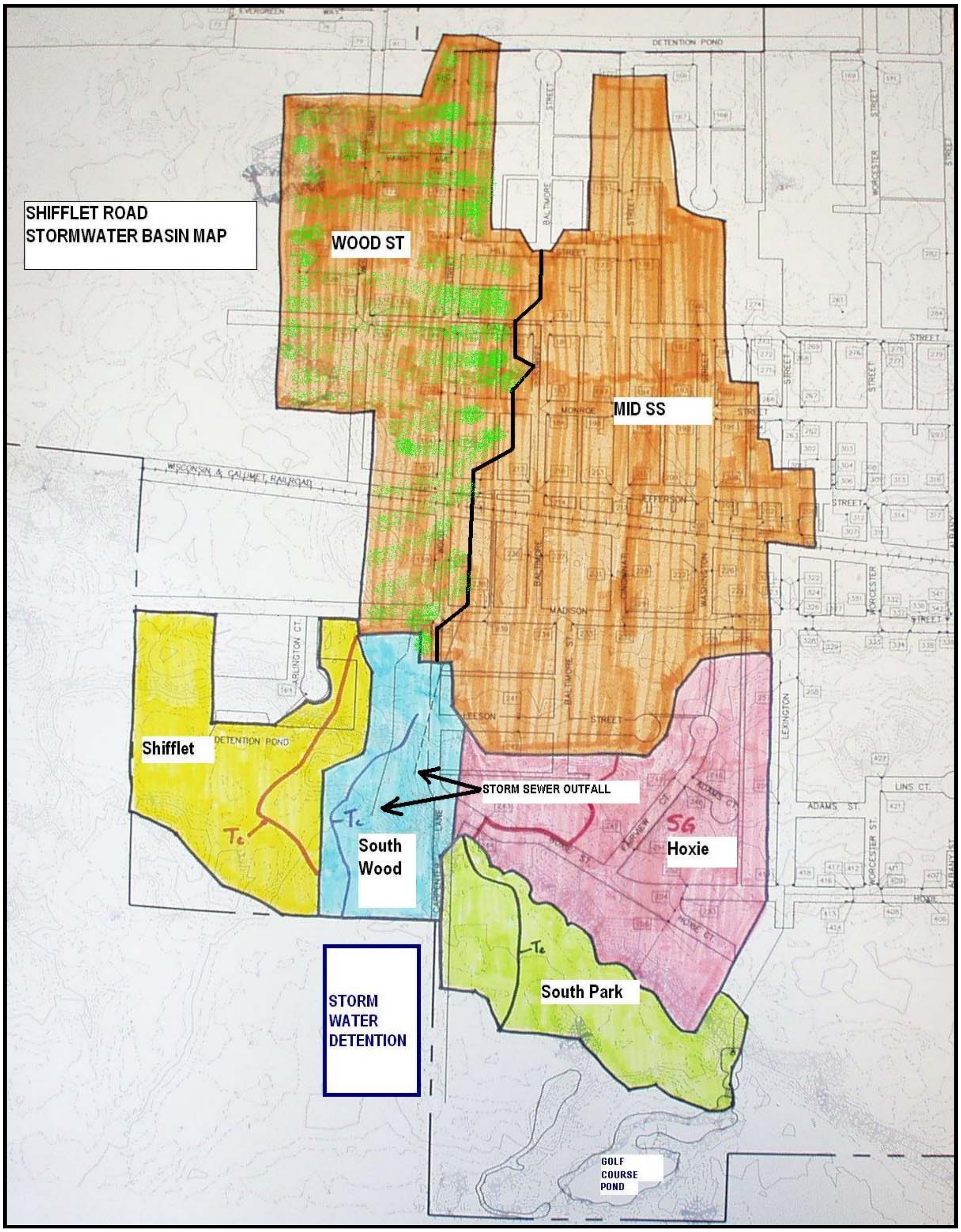


Figure 9.2-2. Shifflet Road Discharge Drainage Basin Map

It should be noted the Wood ST and MID SS Basin curve numbers were developed from the data used to develop the modeling of the WisDOT STH 23 reconstruction project. The STH 23 model represents the eastern side of the Village where essentially the same land use and street patterns exist. Jewell Engineers determined a composite curve number for the urbanized areas of the east side of the village and used this number for the Wood ST and MID SS basin. Additionally for these two basins representations of the storm sewer system were entered as a well. As stated previously they are shown as the blue triangles WDSS and MID SS in figure 9.2.1. The model nodes for this sewer were developed by using plans from the reconstruction of Wood Street in 1994, Spring Green storm sewer system survey mapping, and the knowledge the system did not significantly back up during the June 2008 events. Based on this knowledge the model was manipulated to produce a realistic flow discharge from the stormsewer system for the 100 year event. Knowing the piping was 48-inch and the head pressure on the system the intent was to show the "throttling back" effect of the stormsewer system on the rainfall runoff from basins Wood ST and Mid SS. Modeling the storm sewer in this manner does not affect the volume of water discharged, only the rate it enters the proposed detention pond. The modeling was conducted in this manner using engineering judgment for the effects of surcharging on the 48-inch storm sewer pipes discharging to the Shifflet Road area. Had just the Manning's open channel capacity of a 48 inch pipe been used the resulting flows would have been lower. This modeling was intended for estimating an approximate required size for the detention basin. More involved modeling may be necessary during the final design of a detention pond but it is unlikely the resulting pond size will differ significantly.

Summaries of land use and pond data developed for the model are as follows:

Pond Data – Proposed Village West Detention Basin with Channel Outlet

Stage versus Storage Relationship

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
707.00	8.700	0.000	0.000
708.00	9.000	8.850	8.850
709.00	16.250	12.625	21.475
710.00	17.700	16.975	38.450

Pond Flow and Storage Data

Peak Elev=709.19' Storage=24.543 af Inflow=347.89 cfs 62.072 af
Infiltrated =27.07 cfs 7.395 af Primary=128.10 cfs 47.376 af Outflow=155.17 cfs 54.771 af

Table 9.2-1 Shifflet Road Discharge Pond Modeling Data for a Channel Outlet

Pond Data – Proposed Village West Detention Basin with Storm Sewer Outlet

Stage versus Storage Relationship

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
707.00	17.700	0.000	0.000
708.00	18.000	17.850	17.850
709.00	25.250	21.625	39.475
710.00	26.700	25.975	65.450

Pond Flow and Storage Data

Peak Elev=709.06' Storage=40.970 af Inflow=347.89 cfs 62.072 af
Infiltrated =26.42 cfs 15.775 af Primary=13.70 cfs 8.194 af Outflow=40.12 cfs 23.969 af

Table 9.2-2. Shifflet Road Discharge Pond Modeling Data for a pipe outlet

Land Use

Subbasin Hoxie: Hoxie Runoff Area=28.974 ac 46.43% Impervious Runoff Depth>3.38"
Flow Length=979' Tc=28.2 min CN=78 Runoff=95.82 cfs 8.159 af

Subbasin MID SS: SG Central SS Runoff Area=66.880 ac 0.00% Impervious Runoff Depth>3.91"
Tc=0.0 min CN=83 Runoff=546.17 cfs 21.817 af

Subbasin Shiff: Shifflet Runoff Area=19.520 ac 3.16% Impervious Runoff Depth>1.91"
Flow Length=1,300' Tc=59.2 min CN=62 Runoff=21.26 cfs 3.103 af

Subbasin SP: South Park Runoff Area=15.100 ac 0.00% Impervious Runoff Depth>2.15"
Flow Length=920' Tc=63.5 min CN=65 Runoff=17.94 cfs 2.708 af

Subbasin Spr: Sprecher Field Runoff Area=40.000 ac 0.00% Impervious Runoff Depth>1.95"
Tc=300.0 min CN=68 Runoff=16.05 cfs 6.489 af

Subbasin SWOOD: South Wood Runoff Area=13.460 ac 16.22% Impervious Runoff Depth>2.19"
Flow Length=1,085' Tc=21.2 min CN=65 Runoff=34.16 cfs 2.461 af

Subbasin WOOD: Wood Street Runoff Area=49.000 ac 0.00% Impervious Runoff Depth>3.91"
Tc=0.0 min CN=83 Runoff=400.15 cfs 15.985 af

Discharge from Link to Golf Course Pond
Inflow=26.57 cfs 2.586 af
Area= 87.690 ac 35.07% Imperv. Primary=26.57 cfs 2.586 af

Total Runoff Area = 232.934 ac Runoff Volume = 60.722 af Average Runoff Depth = 3.13"

Table 9.2-3. Shifflet Road Discharge Modeling Land Use Data

Once the model was established pond sizing and outlet sizing for the two selected options were evaluated. Tables 9.2.1 & 9.2.2 show that an 18-acre detention pond or artificial wetland would be needed for option 1 with a channel discharge and a 27-acre pond would be required for a discharge via a 36 diameter stormsewer pipe under option 2. The actual constructed size of the storm water facilities would be slightly larger when access for maintenance, berm width and added berm height for addition freeboard were considered.

9.3 Shifflet Road Discharge Summary

The costs and impacts of the two options were determined and are presented below:

Option 1 – Create an 18 acre detention pond or artificial wetland through the creation of berms. The detention pond would discharge to the River via an excavated channel with a 15-foot bottom.

Option 1
Major Construction Quantities

Earthwork (CY)	150,000
Pond Size	18 Acres +
Land Disturbance	> 20 Acres

Table 9.3 - 1. Shifflet Road Discharge - Option 1 - Channel Outlet - Quantities

Option 1
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$205 - $250
Erosion Control, Seeding & Restoration	$110 - $133
Mobilizations, Traffic Control, Misc. Construction	$55 - $60
Land Acquisition	$70- $90
Construction Contingencies, Project Development, Construction Management	$55 - $65

Total Cost $500,000 – $600,000

Table 9.3-2. Shifflet Road Discharge - Option 1 - Channel Outlet - Opinion of Probable Costs

Option 2 – Create a 27 acre detention pond or artificial wetland with a 2,700 LF 36-inch diameter pipe outlet discharging to the Wisconsin River.

Option 2
Major Construction Quantities

Earthwork (CY)	100,000
Pond Size	18 Acres +
Land Disturbance	> 20 Acres

Table 9.3 - 3. Shifflet Road Discharge - Option 2 - Stormsewer Outlet - Quantities

Option 2
Opinion of Probable Cost (in thousands)

Earthwork, Clearing	$150 - $185
Erosion Control, Seeding & Restoration	$120 - $140
Mobilizations, Traffic Control, Misc. Construction	$55 - $65
36" Storm Sewer and Endwalls	$75 - $90
Land Acquisition	$65 - $80
Construction Contingencies, Project Development, Construction Management	$55 - $65

Total Cost $525,000 – $625,000

Table 9.3-4. Shifflet Road Discharge - Option 2 - Stormsewer Outlet - Opinion of Probable Costs

The options are comparable, however option 1 is preferred by the landowner. Mr. Terry Shifflet was open to the idea of developing a detention basin/ drainage project to solve the recurrent flooding of his property and other properties south of the Village of Spring Green. He would prefer that the discharge be a drainage swale between his property and Hartung Brothers' property rather than a concrete pipe buried in his property. He is willing to negotiate with the Village to get this project accomplished. Running the swale between the two properties affords the opportunity to drain the Hartung lands as well as impacting less farmland.

In terms of utilities impacts should be minimal. ATC has an electric transmission line passing over the site and the channel would need to avoid the associated poles.

Environmental concerns will be similar to what was seen with any of the channels discharging to a slough. The DNR will have concerns and will desire to minimize the impacts to wetlands and downstream habitat. The preference would be a discharge to the main river channel.

Section 10 – Project Coordination

10.1 Environmental Coordination–Wisconsin Department of Natural Resources

Wetlands are regulated by the U.S. Army Corps of Engineers, the Wisconsin Department of Natural Resources under Wisconsin Administrative Code NR 103, and sometimes by local counties, cities and villages. A River Valley flood control project may require wetland disturbance and thus would be subject to the jurisdiction and permit requirements of the DNR and Corps A joint permit application for DNR and the Corps can be submitted with the Application For Wetland Water Quality Certification Department Of Natural Resources Form 3500-53n (R 1/2002).

Chapter 30 of Wisconsin Statutes covers Navigable Waters, Harbors and Navigation. Chapter 30 is administered by DNR and there is a corresponding permit program for activities occurring near these protected waters.

On December 12, 2008 Jewell staff met with James (Andy) Morton, Lower Wisconsin River Basin Coordinator and Jean Unmuth, Water Resources Management Specialist, of the Wisconsin Department of Natural Resources regarding permitting and project coordination related to potential flood control construction. The following list of potential issues were discussed:

<u>Environmental Concerns</u>

Nutrient and Pesticide runoff and "loading" to the Wisconsin River is a big concern. Opportunities for infiltration, bans of certain agrichemicals, restricted agrichemical application practices, and other methods of protecting and improving runoff should be explored.

The DNR has not yet determined if a discharge control structure would be required for the swale near the River. This could be in the form of some kind of stormwater treatment feature at the point of discharge. They are looking at "passive control" structures on other projects.

<u>Army Corp/DNR Permitting</u>

Grading activities in Hydric Soils (wetland indicator soils) may require a permitting. This would likely require an Army Corps general permit.

Grading activities in wetlands, such as a point of discharge near the river will require an Army Corps general permit.

DNR Chapter 30 Permitting

A chapter 30 permit will be required for grading near the Wisconsin River. The Chapter 30 permit is multifaceted and covers numerous activities in or near navigable waters. Generally one chapter permit application can be submitted for multiple activities. DNR had the following concerns regarding Chapter 30 permitting.

A Notice of Intent will be required under Wisconsin Regulations NR 151/216 for the disturbance of more than 1 acre of land. The DNR administers this permitting.

Grading at or below the ordinary high water mark (OHWM) of the Wisconsin River or associated sloughs will require dredging/stabilization permitted under chapter 30.

The classification of the waterway determines the stringency of the permit. This area of the Wisconsin River is classified as an "exceptional resource water" and permit requirements will be more involved.

The issue of "connecting" a pond via a swale to the Wisconsin River could cause permitting issues or affect water quality requirements. A constructed wetland or stormwater ponding area at the base of Big Hollow connected via a swale to the Wisconsin as is proposed may qualify for "connected pond" status.

General

There was some uncertainty if a DNR wastewater permit would be required for a swale discharge to the river. Traditionally this type of activity has not been permitted as a point source discharge however DNR is reviewing this practice.

There was some discussion as to whether stewardship easements through DNR or otherwise could be used to secure land in and around a potential swale.

Additional comments from Jean Unmuth of the DNR were received on December 26, 2008 via an email sent to Jewell containing the following memo.

"River Valley Flood Control Proposal
Jean Unmuth, Water Resources Specialist, Lower Wisconsin Basin
Memo to the File: 12/19/08

Water Resources Concerns

- Artificial & flashy water level increases and negative impacts to slough and riverine species habitats – herps, aquatic insects & fishes.

- Erosion and sedimentation, high suspended solids can negatively impact water clarity of sloughs & river – sloughs have excellent water clarity & unique submerged plant community habitat different than the main river channel.
- Draining groundwater that contributes coldwater to sloughs & wetlands.
- Effects on Endangered, Threatened & Special Concern plant, fish, animal, insect, bird species that use sloughs – documented species in many sloughs.
- Water quality degradation of wetlands, sloughs and WI. R. – draining pesticides, herbicides, nutrients from primarily agricultural lands, but also residential impervious surfaces & lawns.
- GW contamination in area wells - contain high atrazine, nitrates, nitrites – what's the impact of draining water on GW wells & contaminants.
- Draining wetlands via main and lateral ditches.
- SG Township Comprehensive Plan (2005) goals & objectives for agriculture; use it as a tool to guide project recommendations– "Encourage conservation farming practices that minimize pollution of surface water & soil contamination", "Protect & preserve forest resources."
- Comprehensive plan goals & objectives for natural resources, use it as a tool to guide project recommendations – "…provide for a long-lasting, high quality natural setting. Preserve and protect the quality of the Town's lakes, rivers, and streams, and provide for adequate green space near water resources." …"minimize run-off, erosion and contamination in Spring Green…"
- Consider cumulative impacts of drains to the Wisconsin River. "

Jewell staff also met with the DNR on March 16th, 2009 and conducted a field visit to project sites on March 24th, 2009. The results of those meetings are found in Appendix E. The concerns did not differ significantly from what is discussed above. Some additional comments of note were a preference to discharge channels overland in the floodway as opposed to directly to the sloughs to avoid various waterway permitting issues. There was also a desire by the DNR for Big Hollow and West Basin projects to discharge to Bear Creek or directly to the main river channel. Jewell staff discussed the technical challenges of discharging directly to Bear Creek or the main river channel from Big Hollow.

10.2 Environmental Coordination–Projects with Federal Funding

If federal funds or significant federal technical assistance is given to a River Valley drainage project, federal environmental policy may affect the project design. This can include projects done in cooperation with the Wisconsin Department of Transportation. The National Environmental Policy Act (NEPA) requires all federal agencies to review and document potential enviromental impacts during planning and design. In addition: unavoidable adverse environmental effects; alternative plans; "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity"; and irreversible and irretrievable impacts to the environment are to be reviewed and documented. Environmental documents are subject to review by government agencies having legal authority over impacts or the expertise to evaluate impacts. Environmental documents are also subject to review by the public.

During the design process it should be evaluated if any of the lands converted to drainage use were purchased with federal dollars that may require additional environmental documentation and possible compensation. County forest lands and Lower Wisconsin Riverway properties are potential areas where this may apply.

Most standard WisDOT environmental documents, are based on NEPA requirements and are an excellent guideline in various potential additional federal requirements such as archaelogical and historical property reviews, environmental justice, noise and air pollution policy and agricultural policy. Further federal requirements regarding acqusition of farmland is described in section 10.6

10.3 Wisconsin Department of Transportation

Several individuals were contacted within the Wisconsin Department of Transportation (WisDOT) to determine the requirements for installation of drainage facilities under USH 14, STH 130 and STH 60. To date there is still some question within DOT as to whether the maintenance or real estate sections would review and permit a potential project. Under either scenerio the Storm Water Engineer in the Bureau of Equity/Environmental Services would review the hydrology and hydraulic designs related to any new structure. The current regional storm water engineer for WisDOT is Wendy Braun. Ms. Braun was contacted regarding this study.

The requirement for a new drainage structure is that it can safely pass a 100-year event without overtopping the roadway. Chapter 13 of the WisDOT Facilities Development Manual (FDM) can serve as a reference for design. Designing for passing an entire 100 year event through a structure without allowing a backwater (upstream ponding) condition can be costly. The backwater condition caused by the drainage structure should be analyzed to determine the affects of ponding upstream of the roadway. It was explained to Ms. Braun that based on local terrain it may be necessary to design structures to not cause much of a backwater condition. The terrain is so flat that if water was allowed to overtop a proposed drainage channel it could flood a large area. It was also suggested that the requirements of Wisconsin Adminsitrative Code Trans 233 be evaluated during design. Trans 233 has more to do with land divisions however there is a storm water requirement component. WisDOT is responsible to enforce Trans 233 to preserve traffic flow, enhance public safety, and ensure proper highway setbacks and storm water drainage. Drainage is evaluated to help ensure that storm water flowing from a new development does not damage a highway or its shoulders.

Ms. Braun also explained she thought a group within WisDOT was looking into providing additional drainage structures under USH 14. She planned to check into this issue and get in contact with Jewell staff to avoid duplication of efforts.

A potential option for WisDOT participation in the project is through a State Highway Rehabilitation-Maintenance (SHRM) project. SHRM projects are described in the State Highway Maintenance Manual (MM) Policy 13.02 and the Facilities Development Manual (FDM) Procedure 3-1-5. Both of these documents state, "SHRM projects span the gap between routine maintenance and improvement projects. Their primary focus is to preserve and maintain existing roadways and structures. They are not intended to upgrade or improve highway facilities." The MM goes on to say, "For this reason, structural and/or safety enhancements would not typically be expected; however, it is permissible to include them when it can be done easily and inexpensively. In the case of a project resulting from this study it could involve a SHRM project within a highway corridor for drainage structures or channel and ditch cleaning improvements in the Highway Right of Way. WisDOT cooperation with a potential project, whether through a SRHM project or other programs, should be explored further as the project is developed.

10.4 Railroad Coordination

Jim Bolitho, Supervisor, Railroad Engineering & Safety Unit at the Wisconsin Department of Transportation was contacted regarding railroad issues. According to Mr. Bolitho, the existing drainage patterns in the Spring Green area have not been a problem for railroad operations.

Any new drainage opening under the Wisconsin and Southern (WSOR) railway line along Kennedy Road is subject to Wisconsin Administrative Code Trans 29. Jim Tracey (608-267-7946) of WisDOT's railroad section is available as a resource to answer questions on the process. A new drainage structure should be designed to not increase the backwater experience at the 100 year event. Adequate hydrological and hydraulic analysis should be undertaken to verify that any changes to the existing drainage patterns will not adversely affect the railroad and that any new drainage structure under the railroad will convey the water brought to it.

The rail line through the River Valley area is owned by the State of Wisconsin and leased to the WSOR. Wisconsin & Southern Railroad has standard plans for railroad bridge construction. If our studies determine that a bridge is warranted it is advisable to review the WSOR standard plans. Railroad structures are to be designed for Coopers E-80 with diesel impact per AREMA recommended practice, including alternate live load, and any unique design features the site may require.

For the design and construction of a bridge or drainage structure coordination with WSOR is necessary. Ben Meighan is the current contact at WSOR. Construction affecting railroad operations or on railroad right of way will need to be coordinated with WSOR. Construction contract documents will need to make provision for insurance and railroad flagging, and staging the work around train operations.

10.5 Utility Coordination

Underground and above ground utilities are located throughout all routes explored. Jewell contacted Diggers Hotline and WisDOT to find utilities in the area and then contacted the individual facilities to request maps of their installations. Utility mapping can be found in Appendix B. In terms of Alliant Energy, overhead electric facilities and electric services to homes were not included in the mapping. This type of installation is easier to relocate or adjust than other installations so it was not deemed as significant. A brief description of significant utility installations is provided below. Please reference section 6- section 9 for discussions on the utility installations of concern for the various studied projects. Please keep in mind these facilities are in place as of March 2009. Future additions or alternations to facilities are anticipated. This information is for planning purposes only and does not absolve the need to contact Diggers Hotline prior to final design or construction.

<u>Alliant Energy - Natural gas and electric</u>

<u>Natural Gas</u>

Alliant has natural gas installations throughout the project. Mains are located along USH 14. High pressure (125-400 psi) main extents from Pearl Road to west of Dyke Road where it changes to a 60 PSI main. There is also a 60psi main along USH 14 in the Village along the USH 14 corridor in various locations.

<u>Electric Facilities</u>

Alliant has overhead and underground electric facilities throughout the township. Underground 3 phase electrical service is located at various locations such as CTH JJ near the airport and

<u>American Transmission Company – Overhead electric</u>

ATC has transmission lines throughout the Township. There are two main lines that cross through a substation along USH 14 and Rainbow Road. One is a primarily east-west running 69kV line and the other is a primarily North-South running 138kV line.

<u>Charter Communications – Fiber optic and Coax</u>

Jewell did not obtain copies of coaxial cabling. Fiber optic facilities are located along USH 14 from STH 23 to the west extending outside the project limits. The facilities are also located along STH 23 from USH 14 running south. The line is primarily underground along STH 23 and alters from aerial to underground along USH 14.

Prairie Sanitary District – Low pressure sewer forcemain

The PSD is located in the township along USH 14 and in the Prairie View Subdivision. If Prairie View homes are bought out by FEMA it will dramatically reduce the size of the PSD. PSD impacts would be unlikely in terms of constructing channels.

Northern Natural Gas – Pipeline

Northern NG has a major pipeline running north-south near the west side of the Village. There is also a compressor station near Jones Road and STH 23. The pipeline may be an issue in addressing drainage along CTH G when addressing issues in the East Basin.

Verizon Communications – Fiber optic and copper line

Verizon has facilities throughout the River Valley. Copper line is buried all over to service homes and businesses. The USH 14 has facilities paralleling both sides of the highway.

Of more concern are fiber optic facilities. Verizon has fiber facilities running east-west along the railroad corridor and north-south along Davies Road and STH 23.

Sauk County Emergency Management – Fiber optic

This facility runs down the east side CTH G down Big Hollow and turns east following CTH G to STH 23. It then runs north to Jones Road and then east on Jones to the Thuli Road communications tower.

The line may be an issue in addressing drainage along CTH G in the East Basin. It may also be of concern when changing the geometrics of CTH G in addressing the flood issues in Big Hollow.

Village of Spring Green – Water and sanitary sewer

The village has facilities throughout the municipal boundary as well as a connection from the Prairie Sanitary District (PSD). Water facilities may be in conflict with plans for the alternate East Basin flooding plan in the connection of the proposed and existing ponds via a pipe under STH 23.

The sanitary facilities would benefit in general from addressing the flooding and its affects on the PSD and Village sanitary facilities.

10.6 Natural Resource Conservation Service and DATCP Coordination

NRCS Assisitance

The Natural Resource Conservation Service (NRCS) was contacted immediately following the June events to request assistance related to the flooding. The NRCS (formally SCS) responded that no files were located regarding a past design for a drainage ditch design for Big Hollow, however they did recall preliminary work done in 1993. (Some of the1993 work by Westbrook Engineers was located in applications to Wisconsin Department of Development for assistance.)

NRCS also responded they would not be able to provide assistance under the NRCS Emergency Watershed Protection Program (EWP) as current program rules so not allow for construction of new channels, enlarging existing channels or construction of new flood control structures. Essentially the program acts to restore flood damaged facilites of this nature back to pre flood condition.

The NRCS offered to provide technical assistance to the Village and Town as time and staffing allowed. Scott Mueller of NRCS met with Jewell staff to discuss drainage swale options and design. It is recommended any final flood control swale or structure plans be routed to NRCS for comment.

NRCS Requirements

If federal funds or significant federal technical assistance is given to a local program through any government agency, NRCS will be involved through the Federal Farmland Protection Policy Act (FPPA). Specifically the act applies if prime or unique farmland of statewide or local importance is aquired and converted to nonagricultrual use. Developers of the project must determined whether any of that land is protected by the FPPA. This is accomplished by completing the Farmland Conversion Impact Rating (FCIR), also known as USDA Form AD 1006. More information on the FPPA can be found and a copy of Form AD 1006 can be found at the website http://www.wi.nrcs.usda.gov/technical/soil/comply.html and in Chapter 5-5-5 of the WisDOT Facilities Development Manual.

DATCP

Corrdination with the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) may be required for several issues related to the construction of flood control measures. DATCP regulates the drainage district program under Chapter ATCP 48 of Wisconsin Administrative Code, granting authority to county drainage boards for the operations. Additional discussion regarding drainage districts can be found in Section 7 of this report.

DATCP is also responsible for assessing the agricultural impact of projects distrupting 5 or more acres of farmland from any one farming operation if the public entity has the power to condemn property. Agricultural impact statements (AIS) analyze the potential impact of public construction projects on farmland and farm operations. Recommendations are made in the AIS on methods to reduce project impacts. DATCP may prepare an agricultural impact statement if an acquisition of less than five acres will have a significant impact on a farm operation. The authority to regulate agricultural impacts is found in chapter 32.035 of Wisconsin Statues regarding Eminent Domain.

Another potential area of involvement with DATCP is the removal of land from Agricultrual Preservation programs involving tax incentives. When land is removed from Ag Preservation status DATCP should be notified by the local unit of government as it may affect taxation of the parcel. Depending on the status and ownership of land acquired for a drainage project this issue may need to be addressed.

Section 11 – Funding

11.1 General

Within the scope of this study Jewell was to explore avenues for funding of potential flood control projects. In addition to exploring the options listed below, Jewell, at the direction of the Town, is actively pursuing several of these options. In particular a Big Hollow project has drawn the interest of the US Department of Commerce Economic Development Administration (EDA) via the Economic Adjustment Assistance program. The project has passed the initial phases of EDA review and Jewell will continue to pursue this option past the completion of this study as directed by the Town.

Several additional options for funding follow:

11.2 Bonding and Borrowing

<u>Board of Commissioners of Public Lands</u>

The Board of Commissioners of Public Lands oversees the State Trust Fund Loan program for public purposes. The Town would be eligible to apply for these loans. Current loan limit per calendar year is $5,000,000. Current rates are 4.25% for loans up to five years in term, 5.25% for loans five to ten years in term, and 6.25% for loans of 10 to 20 years in term.

<u>Other Borrowing</u>

The Town of Spring Green could choose to borrow from local banks and lending institutions depending on rates and terms. Municipalities in Wisconsin must not exceed their General Obligation Debt Limit as determined by the Wisconsin Department of Revenue. The debt limit is set as a percentage of the equalized value of the municipality. For the Town of Spring Green the debt limit, based on 2007 equalized value, is $8,338,890.

<u>Bonding</u>

Another option for financing projects would be to explore the option of municipal bonding. Municipal bonds are bonds that are issued by state and local governments. By issuing municipal bonds, local governments generally borrow money for major capital projects such as bridges, roads, hospitals, schools, and sewer systems. Many people choose to invest in municipal bonds for their tax efficiency and their fixed cash flow over the life of the bond. Municipalities offer either general obligation bonds or revenue bonds. General obligation bonds are secured by the credit of the issuing municipality while revenue bonds are secured by a specific project. This distinction makes revenue bonds a riskier investment for the purchaser since their repayment is dependent on the success of the underlying project. The bonds are generally purchased by investment banks which then package them for sale to other investors. Based on the current state of the economy interest in bond investing is higher than normal causing a drop in the interest rate paid by the bond issuer. Bonding may be a competitive alternative to traditional borrowing and should be explored as a project is developed.

11.3 Stormwater Utilities and Special Assessments

Towns have to the authority to make special assessments for construction of any public work or improvement and they may, by ordinance, provide that the cost of installing or constructing any public work or improvement shall be charged in whole or in part to the property benefited. Ch. 66.0701 Wis. Stats. In addition Towns have the authority to construct and fund sewerage systems to handle storm water and surface water. Ch. 66.0821.

However, the statutes dealing with the above powers of Towns both contain the following exception: “Except as provided in s. 66.0721”.
66.0721(3) reads: “Except as provided in sub. (3), no town sanitary district or town may levy any special assessment on eligible farmland ….. for the construction of a sewerage or water system.”

“Eligible farmland” is defined as a parcel of 35 or more acres of contiguous land which is devoted exclusively to agricultural use….with gross farm profits of not less than $6,000 in the year prior to the proposed assessment or $18,000 in the preceding three years.
The exceptions to 66.0721(3) have to do with subsequent land divisions and pre-existing sewerage facilities.

It therefore appears that setting up a stormwater utility or special assessment district in a Town to pay for projects designed for handling stormwater or surface water in a rural area would not be feasible when much of the property to be included is working farmland which could not legally be assessed for such purposes.

A stormwater utility in the Village is a more viable source of funding both new stormwater utilities and maintaining existing stormwater facilities. The advantage to forming the utility is that these costs could potentially be removed from levy limit calculations since they are related to the utility.

11.4 Drainage Districts

In Chapter 88, Wisconsin Statutes provide for the creation and operation of drainage districts as a means of funding drainage and stormwater control projects that involve working farmland and other classes of property. The Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) regulates the drainage district program under chapter ATCP 48 of Wisconsin Administrative Code granting authority to county drainage boards for the operations. ATCP Chapter 48 covers specific drainage design criteria, permit requirements, agency and railroad coordination, and other relevant matters. An orderly legal process for establishing a drainage board, outlining its duties, petitions to establish a drainage district, engineering the design of drains, establishing drainage benefits and damages, and making assessments to fund the construction, ongoing maintenance, public notice and public hearing requirement, and required professional engineering and legal services is covered by the statute and code.

11.5 Grants and Cost Share Programs

Wisconsin Office of Recovery and Reinvestment

Stimulus Program

WORR is the state office charged with coordinating and evaluating the new Federal Stimulus Program in Wisconsin. The Big Hollow/Central Basin drainage project has been submitted for consideration by this program as well as to the Governor's office. Support for the project from state and federal representatives has been given.

Army Corps of Engineers

Flood Control Program

The Big Hollow/Central Basin drainage project has flow quantities that meet the qualification for funding of a flood control study by the Corps. However, contact with the Corps St. Paul District revealed that there has not been any funding for studies for several years and there is a waiting list of communities to be studied when the program gets funded again. Corps flood control projects cannot proceed until a study has been conducted. The Federal Stimulus Program and the federal FY09 budget include some funding for construction of previously delayed flood control projects, but there is no money for new studies.

US Department of Commerce Economic Development Administration (EDA)

Economic Adjustment Assistance

The Midwest Region of the EDA received a supplemental appropriation of over $70 million to help communities in 6 states including Wisconsin recover from natural disasters that occurred in 2008. The program is the Economic Adjustment Assistance Program. The Town of Spring Green has submitted an application to EDA for 75% of the cost of the Big Hollow/Central Basin drainage project.

Wisconsin Department of Commerce

Community Development Block Grant - Emergency Assistance Program

The Wisconsin Department of Commerce has received $44 million is supplemental appropriations from the US Department of Housing and Urban Development to help communities, families and businesses in the disaster declared counties and entitlement communities recover from the floods and other declared disasters of 2008. The Town of Spring Green has submitted an application for a CDBG-EAP to cover the remaining 25% of the Big Hollow/Central Basin drainage project submitted to EDA.

Community Development Block Grant – Public Facilities

Community Development Block Grant Public Facilities grants (CDBG-PF) grants typically fund 20 to 25% of a locally sponsored project. In most circumstances 51% or more of the households benefited by this type of grant must qualify as low to moderate income (LMI). In certain circumstances classified as Urgent Local Need, communities that do not meet the LMI criteria may be eligible for CDBG-PF funds.

United States Department of Agriculture

Rural Utilities Program

The Rural Utilities Service of USDA administrates a Water and Waste Disposal Loan and Grant Program. The majority of funds available are long term loans. Grants are available to communities that qualify due to having a median household income (MHI) below the Wisconsin threshold, $46,632 (2000 US Census). The Town of Spring Green was above the grant threshold with an MHI of $49,028.

Natural Resources Conservation Service (NRCS)

The NRCS has some watershed management and flood control programs but has little funding for any new programs. There may be some stimulus money injected into these programs but there is long backlog of projects in line for any funds for study or construction. Our analysis indicates that that it would not be feasible to contain the Big Hollow watershed flooding with typical NRCS flood control dams.

Section 12 – Cost - Benefit Analysis

12.1 Introduction

Presenting a cost benefit analysis in this study has several intended purposes. First it allows further comparison of alternatives for addressing flooding in the East, West and Central/Big Hollow Basins. The cost benefit analysis allows the Town and Village of Spring Green to evaluate potential costs of these projects after construction so that the costs may be considered when drafting budgets and planning long term capital improvements. Finally cost versus benefit will be considered by outside providers of funding in their evaluation of the worthiness of Spring Green flood control projects.

There are several costs to consider when comparing cost versus benefit. Project cost not only considers the initial capital investment of construction but also design and construction administration costs, future maintenance costs; and any potential closeout or salvage costs. These collective costs are considered life cycle costs of a project. Further discussion of each of these elements follows.

Life Cycle Costs

Life cycle costs are the expenses incurred during the lifetime of a project. Life cycle costs include design, the initial capital cost of construction and the present worth of annual O&M costs adjusted for the present worth of the salvage value of the project at the end of the service life. In the case of the River Valley flood control projects, little or no salvage value is anticipated.

Capital costs

Capital costs consist primarily of land, and construction costs including all labor, equipment and materials. Capital costs also include construction observation and administration costs.

Design, Permitting and Contingency Costs

Design and permitting costs include costs for site investigations, surveys, planning, design, and permitting of a project. Contingency costs are the unexpected costs incurred during the development and construction of a project. For the purposes of this study these costs will be added to the capital costs.

Operation and Maintenance (O&M) Costs

Operation and maintenance costs are the expected annual costs associated with a project. The operation and maintenance costs are usually expressed as an annual percentage of capital costs, or the actual costs of individual activities can be determined. In this study the, O&M costs are considered as a percentage of the project costs. Various USEPA data as well as other stormwater resources suggest the anticipated annual O&M costs for stormwater facilities to range from 3% to 5% of the base construction costs. It is the judgment of Jewell Associates that this finding will hold true for the proposed flood control channel albeit the percentage is assumed closer to 2% of the base construction costs. Tables 12.1-1 and 12.1-2 show anticipated maintenance activities for the stormwater ponds and flood channels proposed in this study.

Typical Dry Retention Pond Maintenance

Activity	Schedule
Check for erosion on pond banks and bottom. Repair as required.	Semi-Annual Inspection
Inspect for damage to the banks Monitor for sediment accumulation in the pond bottom and forebay. Examine to ensure that inlet and outlet control structures and piping are free of debris	Annual Inspection
Repair eroded areas Mowing Noxious weed management Litter/ Debris Removal	Standard Maintenance
Seed or sod to restore dead or damaged ground cover	Annual maintenance (as needed)
Remove sediment from the forebay	5- to 7-year maintenance*
Monitor sediment accumulations, and remove sediment when the pond volume has been reduced by 25 percent	25- to 50-year maintenance*

* remove sediment sooner as inspections indicate

Table 12.1-1. Typical Dry Retention Pond Maintenance

Typical Vegetated Channel Maintenance

Activity	Schedule
Check for erosion banks and bottom. Repair as required.	Semi-Annual Inspection
Inspect for damage to the banks Monitor for sediment accumulation in bottom Inspect Bridges or Culverts	Annual Inspection
Repair eroded areas Mowing Noxious weed management Litter/ Debris Removal	Standard Maintenance
Based on inspection, plant an alternative grass species if the original grass cover has not been successfully established. Replant wetland species (for wet swale) if not sufficiently established.	Annual maintenance (as needed)
Remove sediment from select areas	5- to 7-year maintenance*
Complete Channel Sediment Cleaning Culvert and Bridge Rehabilitation/Redeck	25-year maintenance*
Culvert and Bridge Replacement	50-year maintenance*

* remove sediment sooner as inspections indicate

Table 12.1-2. Typical Vegetative Channel Maintenance

12.2 Life Cycle Costs

As discussed previously life cycle costs includes design, construction (capital costs), operation and maintenance (O&M), and any closeout or salvage activities. For the purpose of this study the projects will be analyzed over a 100-year period using costs adjusted to present worth. It is assumed the projects will be needed into perpetuity, but for the purpose of comparison the 100-year period will be used. Annual maintenance ranges from 3%-5% for stormwater structures, but 2% will be assumed for channels. The 5-7 year spot cleaning of sediment is assumed to be covered within the 2% annual maintenance figure. It is also assumed the projects will have no salvage value after 100 years. Further financial analysis is suggested for determining budget needs at the time an individual project enters plan preparation and is further studied. At that time costs can be converted to annual expenses for loans on capital costs, annual maintenance costs, and savings for amortized long-term maintenance and replacement costs.

For this study the 100-year analysis period for each project will need costs adjusted to present worth. The purpose of adjusting the costs it to provide an equal “apples to apples comparisons of costs and benefits. For this analysis an interest rate of 5% will be assumed being close to the cost of borrowing for a municipality. Using compound interest factors for 5% interest the following adjustment factors are found. In the chart n represents the period (in this case years), P/F represents the factor to adjust future cost to present worth and P/A represents the factor to adjust annual costs to present worth. These factors are based on standards economic analysis.

Compound Interest Factors – 5% Interest

Period (n)	Present Worth Factor P/F	Present Worth Factor P/A
20	.3769	12.462
23	.3256	13.489
25	.2953	14.094
40	.1420	17.159
46	.1065	17.87
50	0.0872	18.256
60	.0535	18.929
69	.0311	19.31
75	0.0258	19.485
80	.0202	19.596
92	.01132	19.773
100	0.0076	19.848

Table 12.1-3. Compound Interest Factors – 5% Interest

As an example the cost of option 1 for the 15-foot drainage channel for the Big Hollow/Central Basin area (section 6.3) would be figured as follows:

Costs in Thousands (from table 6.3-16):
Capital Costs: $2750 (Using Average of Range)
Annual Maintenance: $55 (2% of capital cost)
25-year Channel Cleaning: $146.5 (Estimated $10 per LF)
25-year Box Culvert Maintenance (3X$50) =$150
50-year Culvert Replacement (3X475) $475 =$1425

Road maintenance will not increase over current requirements and will not be considered. A new culvert at the CTH G/Big Hollow Road Intersection is considered above.

Using the data in table 12.1-3 and the capital costs listed above, all costs can be converted to present worth and used to represent Life Cycle Cost. A sample calculation for option 1 for the 15-foot drainage channel for the Big Hollow/Central Basin area is shown below. In the calculation (P/F, 5%, n) represents the factor to adjust future cost to present worth at 5% interest over n years. The factor (P/A, 5%, n) represents the factor to adjust annual payments to present worth at 5% interest over n years. These factors are based on standards economic analysis and are shown in table 12.1-3.

Therefore Life Cycle Cost = $2750+55(P/A, 5%,100)+$146.5(P/F,5%,25) +$146.5 (P/F,5%,50) +$146.5 (P/F,5%,75) +$146.5 (P/F,5%,100) +$150(P/F,5%,25) +$150 (P/F,5%,50) +$150 (P/F,5%,75) +$150 (P/F,5%,100) +$475(P/F,5%,50) +$475(P/F,5%,100) =

Adding the factors from table 23.1-3: $2750+55(19.848) +$ 146.5(.2953) +$146.5(.0872) +$146.5(.0258) +$146.5(0.0076) +$150(.2953) +$150(.0872) +$150(.0258) +$150(0.0076) $1425(.0872) + $1425(0.0076)

= $ 4100.04 or **$4.10 Million**

It is very important to realize this Life Cycle Cost based on present worth is a means of comparison only. It will differ from just summing up annual, future and present costs significantly. One way to represent this cost is it would require $4.10 million placed in an interest earning account at 5% interest to cover the design, construction (capital costs), future replacement costs, and annual operation and maintenance (O&M) through the 100 year life of this project.

Based on this methodology the Life Cycle Costs of the various alternatives are as follows:

Life Cycle Cost of Flood Control Channels – 100 Year Period

Basin	Option	Ditch Bottom Width	Length (LF)	Life Cycle Cost (Million)
Big Hollow/Central	1	100	14,044	$9.76
Big Hollow/Central	2	100	20,895	$9.96
Big Hollow/Central	1	15	14,650	$4.16
Big Hollow/Central	2	15	14,820	$4.24
Big Hollow/Central	3	15	17,000	$5.29
East	-	10	10,600	$2.37
West	Drainage District	20	11,142	$2.39
West	Bear Crk 1	20	11,122	$3.01
West	Bear Crk 2	20	25,700	$3.23

Table 12.1-4. Life Cycle Costs – Channel Alternatives

In the case of the ponds proposed for the Village the Life Cycle Cost is based on the capital costs and annual maintenance only.   Maintenance costs are assumed to be 3% of the capital costs.

Life Cycle Cost of Ponds – 100 Year Period

Pond	Option	Life Cycle Cost (Million)
Shifflet Road	1	$0.877
Shifflet Road	2	$0.917
East Basin	-	$3.19

Table 12.1-5. Life Cycle Costs – Pond Alternatives

12.3 Project Benefits

In terms of a cost-benefit analysis, the benefits of the River Valley Flood Control projects are the savings of the costs and losses resulting from flood events.   From Section 1.5 the some of the costs of the 2008 flood were as follows:

Costs of 2008 Flood – 100 Year Period

Type of Loss/Cost	Cost (Million)
Agricultural Losses	$9
Business Damage	$1.4
Business Revenue	$0.850
FEMA IHP Claims	$1.07
FEMA Housing Assistance	$1.06
FEMA Other Needs	$0.03
Village FEMA Claims	$0.140
Village FEMA Illegible costs	$0.01
Town FEMA Claims	$.205
Town FEMA Illegible Costs	$0.088
Total	$13.853*

* Does not include potential housing buyout costs

Table 12.1-6. 2008 Flood Costs

Again for the 100-year analysis period the costs and losses will need costs adjusted to present worth. An interest rate of 5% will be assumed using compound interest factors found in table 12.1-3. The 23-year recurrence factor found in Section 2.1 will be used to determine the recurrence of flood costs in the 100-year analysis period.

Adjusting the 23-yr recurring flood costs to present worth:

$13.85 + $13.85(P/F,5%,23) +$13.85 (P/F,5%,46) +$13.85 (P/F,5%,69) +$13.85 (P/F,5%,92)

$13.85+$13.85(.3256) +$13.85 (.1065) +$13.85 (.0311) +$13.85 (0.0076)

=$20.37 Million

Assuming a 20-year recurrence the costs change to

$13.85+$13.85(.3769) +$13.85 (.1420) +$13.85 (.0535) +$13.85 (0.0202)+$13.85(0.0076)
= $22.16 Million

It is again very important to realize this cost of flood losses is based on present worth is a means of comparison only. It will differ from just summing up 5 flood events in a 100 year period. This calculation would yield the actual $69.25 million expended or lost to flooding in a 100 year period. The present worth calculation allows “apples to apples” comparison of all the various costs and benefits over time.

12.4 Benefit Versus Cost

Having adjusted the costs of the various projects and the cost of the benefits, the savings of flood damaged costs, a comparison can be made. From section 12.3 it can be seen the benefits from controlling flooding in the River Valley area are estimated at a present worth of $20.37 million for a 23-year flood recurrence and $22.16 million saved for a 20-year recurrence.

In terms of costs to completely address the flood issues of all three Basins; the East, West, and Central/Big Hollow basins should be considered. To complete the B/C analysis, one selected alternative from each basin should be considered. The selected alternative and corresponding life cycle costs are as follows. West Basin option 2 was selected as it can address flooding on both ends of the Tri-County airport.

Big Hollow Option One	$4.16 Million
East Basin	$2.37 Million
West Basin Option 2	$3.23 Million
	$ 9.76 Million

Therefore the Benefit to Cost Ratio for the projects are:

$20.37/$9.76 = 2.09 for a 23-year recurrence and

$22.16/$9.76 = 2.27 for a 20-year recurrence

Generally a B/C ratio >1 is considered desirable, and using this assumption the cost benefit analysis of Spring Green flood control projects appears positive.

In terms of the pond projects studied for the Village of Spring Green a B/C analysis in the same manner presented above will not yield a positive result. The flood losses would not be offset greatly by one or both of the pond options proposed in Sections 7.4 and Section 9. The merits of those projects are more alleviation of long time nuisance flooding and crop damage. While the projects will benefit the community the benefits are not financially significant compared to the benefits of the larger scale flood control projects.

Section 13 – Conclusions and Recommendations

13.1 Conclusions

Based on the findings of the River Valley Flood Control Investigation by Jewell Associates Engineers and Montgomery Associates Resource Solutions the following conclusions are drawn.

1. The magnitude and the nature of the River Valley flooding is unique and offers challenges in terms of determining patterns of drainage and ultimately predicting and controlling the movement of floodwaters.
2. The installation of drainage channels with bottom widths of 10-20 wide and allowing land to temporarily flood in a controlled manner can be employed to address flooding in the River Valley area.
3. "Installation of the drainage channels will reduce recharge in the northern portion of the valley, producing a reduction in the water table elevation. There will probably be some increase in recharge produced by runoff flows in the temporary flood storage areas and drainage swales near the Wisconsin River, which could result in localized increases in groundwater levels. "Montgomery 2009.
4. The installation of a drainage channel for the Big Hollow and Central Basin Watersheds will reduce but not eliminate all flooding in the East Basin near the Village of Spring Green or the West Basin near the Tri-County Airport.
5. Environmental issues related to Bakken's Pond and the Wisconsin River Sloughs will be a design and political challenge for any project to go forward.
6. WisDOT involvement in a project can offer cost savings in terms of utility relocations and cost sharing.
7. The involvement of State, Federal and local Agencies, utilities, and the Wisconsin Southern Railroad is critical to the success of any River Valley flood control project.

Big Hollow & Central Basin

1. The installation of a drainage channel with a bottom width of 15 feet and allowing land to temporarily flood in a controlled manner near CTH G and Pearl Roads can be employed to address flooding in this area.
2. Employing a single large channel running to the Wisconsin River or Bear Creek without temporary flooding is cost prohibitive and creates more impact and constructability challenges than a smaller channel with temporary flooding.

3. Route Options 1 and 2 described in Section 6 are the preferred alternative routes for the Big Hollow and Central Basin Areas.
4. To meet Drainage District requirements and drain the floodwater in 48 hours for a 10-year storm a 20-foot wide bottom channel is required.

East Basin

1. The installation of a drainage channel with a bottom width of 10 feet and allowing land to temporarily flood in a controlled manner near Davies and Jones Roads and to the west can be employed to address flooding in this area.
2. Flooding in the East Basin will be reduced but not eliminated by addressing runoff from Big Hollow.
3. To completely address flooding in the east basin grading along CTH G to the east may be necessary.
4. Multiple Routes are available to direct water east from the Davies and Jones Road area. The route showed in section 7 is preferred but can be modified to address local issues.
5. This channel can meet Drainage District requirements and drain the floodwater in 48 hours for a 10-year storm if Big Hollow flooding is addressed separately.
6. Reevaluation of the design of this channel will be required if Big Hollow flows are not addressed separately.
7. Creating a series of interconnected ponds along the north limits of the Village of Spring Green discharging to the Wisconsin River offers an possible alternative to the Davies Road & Jones to Rainbow Road channel described in Section 7.

West Basin

1. The west basin flooding issues can not be addressed with a single channel starting from the northwest or southeast side of the airport. Grading or a channel is needed to connect the two areas of flooding so that they may be relieved.
2. The installation a drainage channel with a bottom width of 20 feet and allowing land to temporarily flood in a controlled manner near the airport can be employed to address flooding in this area.
3. A wider channel is required as less flood depth is available for storage in this basin due to terrain and the adjacent airport.
4. Flooding in the West Basin will be reduced but not eliminated by addressing runoff from Big Hollow.
5. The route proposed by the residents forming a Drainage District in the West Basin is the shortest route and possibly the least expensive, but may only address flooding on the southeast end of the airport. If additional grading is required to address the northwest corner of the airport, the other study options are more cost

competitive. This route also has more environmental issues and the potential for creating an increased flood hazard.

6. To meet Drainage District requirements and drain the floodwater in 48 hours for a 10-year storm a 35-foot wide bottom channel is required.

13.2 Recommendations

1. As a first priority, Jewell Associates Engineers recommends to the Town the construction of a Big Hollow drainage channel and temporary flood storage area. Implementation of Town drainage projects for the east basin and west basin may be postponed until the effectiveness and performance of the Big Hollow project for flood mitigation over a wide area can be evaluated. For the Big Hollow project, option 1 as described in section 6.3 is the recommended alternative. Further consideration of option 2 may be warranted if WisDOT participation can be garnered.
2. Proceed with the buyout of homes in the Prairie View subdivision and other flooded areas to reduce the likelihood of future flood damage especially considering the postponement of construction of an East Basin.
3. Even with a successful buyout program, the Town should consider raising CTH G, Prairie View Road, and Garden Path to maintain access to homes remaining in the Prairie View and Garden Path developments.
4. If drainage districts are to be formed in the Town of Spring Green as a means of constructing and financing additional drainage improvements, the Town Board may share the findings of this study with the drainage board and their engineer.
5. Pursue Town and Village zoning restriction on flood areas based on the mapping created by Fred Iausly and the findings of this study.
6. Support the ongoing efforts of the Wisconsin Geological and Natural History Survey to monitor groundwater at the wells established for this study. Wells not monitored by WSNHS can be monitored by the Town and the data recorded if needed.
7. Determine the need for additional groundwater study for a particular project based on the continued monitoring and study of groundwater by WGNHS. WGNHS findings may be sufficient to evaluate the project impacts. Otherwise additional study can be conducted.
8. sIt is unrealistic to assume any of these projects can readily be accomplished by the Town without incurring substantial debt and its negative effect on other town needs. The Town should continue to pursue funding opportunities to support the projects. Jewell Associates can continue these efforts as directed by the Town and Village of Spring Green.

9. The Village of Spring Green should explore grant opportunities for the Shifflet Road area. DNR has grants programs for stormwater management and municipal flood control.

10. The Village of Spring Green should examine the potential benefits and possible disadvantages of the East Basin Alternate Floodwater Management discussed in Section 7.4. The long-term growth of the Village should be considered.

11. The Village of Spring Green should explore a stormwater utility as a means of supporting construction and maintenance of new and existing stormwater infrastructure.

Section 14 – References

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Westbrook Engineers, Letter to Wisconsin Department of Development from Randy M. Lund, Re: Funding Submittal Town of Spring Green, December 23, 1993.

14.2 Electronic Media –Websites and Presentations

Attig, John W., and Gotkowitz, M.B 2008. "Water and the Valley – Issues Underlying the Flood of 2008", Powerpoint presentation.

Vavrus, Steve, "Climate Model Prediction of Future Climate Change in Wisconsin", Center for Climatic Research, University of Wisconsin, powerpoint presentation, 2008.

Wisconsin Department of Natural Resources

Homepage	http://www.dnr.wisconsin.gov/
Permitting	http://www.dnr.wisconsin.gov/org/water/fhp/waterway/
Wetlands	http://www.dnr.wisconsin.gov/wetlands/
State Natural Area	http://dnr.wi.gov/org/land/er/sna/sna247.htm

Wisconsin Department of Transportation

Homepage	http://www.dot.wisconsin.gov/
FDM and MM	http://roadwaystandards.dot.wi.gov/standards/

US Department of Labor Bureau of Labor Statistics
CPI Adjustment http://www.bls.gov/bls/inflation.htm

US Environmental Protection Agency
Stormwater BMP's http://www.cfpub.epa.gov/npdes/stormwater/menuofbmps

14.3 Individuals

These individuals warrant recognition of their contribution to this study

Madeline Gotkowitz, hydrogeologist, Wisconsin Geological and Natural History Survey (WGNHS) – Author of many reports on the geology of Sauk County, creator of groundwater model for the River Valley area used in this study.

Fred Iausly, Senior GIS Analyst, Town of Spring Green Plan Commission Chairperson - gathered and mapped image and survey data related to the flooding.

Appendix A – Surface Water and Groundwater Analysis

River Valley Flood Control Investigation:
Surface Water and Groundwater Analysis

By Montgomery Associates Resource Solutions, LLC
March 2009

Appendix B – Utility Mapping

Appendix C – Business Loss Survey

2008 Spring Green Flooding Business Loss Survey

Prepared by Don Greenwood, Jewell Associates Engineers, Inc from Local Interviews

Businesses in the flood zone reported the following losses.

Prairie House Motel: The motel has been closed since June 8 and may never open again. The pre-flood value of the property was $1,164,900.00.
The 51-room motel was typically fully booked during the summer season with an average room rate of $79 per night. This equates to a revenue loss of $4,029 per night or $370,668 from June 9 to September 8, 2008.

Wisconsin River Resort: Reports of flooding in the Spring Green area and a flooded access roadway impacted this business in the Town of Spring Green and resulted in cancellations and lost revenue of an estimated $33,000 in June and July.

Umhoefer Do It Center: This building supply and hardware business located near the intersection of USH 14 and STH 23 North was severely impacted by the flooding with access to the business compromised and the lumber yard flooded. Estimated inventory loss was $42,000. Loss of business during the two week period when access to the business was blocked by the flood totaled $210,000. Damage to buildings and other parts of the site was estimated at $20,000.

Rumble Seats, a highway restaurant/drive-in on USH 14, closed due to flooding from June 8 to July 14. Owner estimated damage to the building was $25,000 or more. Loss of business due to closure during prime season was calculated at $60,000 to $65,000.

Classic Auto Body on USH 14: Owner reported an estimated revenue loss of $30,000 to $40,000 due to the impact of the flood on business.

Spring Green Auto Parts on USH 14: Owner reported $20,000 loss of sales in June and July due to the flooding.

The Hanor Company on USH 14: $25,000 to $30,000 in estimated damage to their office building. No reported loss of revenue.

Ernie's Highway 14 Auto Repair & Alignment: estimated $20,000 - $25,000 in lost business due to the flooding.

Rite-Way Plaza convenience store and gas station, USH 14: Manager reported a $12,000 loss of car wash revenue due to the 10 days the car wash was flooded and closed.

Chef's In: Owner reported $10,900 in lost business due to flooding.

Woody's Liquor: The owner reported a loss of sales of $4,000.

Pecks Farm Market West on USH 14: Due to flooded fields lost 120 acres worth of produce. This resulted in near complete elimination of the business' wholesale market and an estimated revenue loss of $200,000+.

Arthur's Restaurant: The owner on of the restaurant at the corner of USH 14 and STH 23 reported $9,500 in damages and $15,000 in lost business in June and July due to the flood.

Round Barn Motel: Room revenue was down $28,000 to $34,000 due to the flood. Damage to the septic system, the parking lot, electrical, furnace and air conditioning was estimated at $50,000 by the owner. The Round Barn Motel and Restaurant are located in the flood zone on USH 14.

Round Barn Restaurant: Lost rental revenue was $15,000.

Tri-County Airport in the northwest corner of the Town of Spring Green had its runways under water for six weeks and was completely shut down during that time. Flocks of waterfowl on nearby flooded fields created another type of hazard for aircraft and limited use of the airport by certain types of aircraft even after it reopened. The airport suffered $40,000 in loss of fuel sales and $45,000 in damage to airport facilities. All area corporate jet aircraft were dislocated from their normal use of the airport until late November when the water on the surrounding land froze and waterfowl left the area. Private touring aircraft that would come to visit local sites of interest went elsewhere

Appendix D – Wisconsin Geological and Natural History Survey March 19, 2009 Letter Regarding Town of Spring Green Summer 2008 Groundwater Analysis

Appendix E –DNR Meeting Notes March 16th & 24th, 2009

Meeting Notes 3-16-09

Topic: Proposed flood control drainage projects for Town of Spring Green
Location: Jewell Associates Engineers' office, Spring Green

Participants
Wisconsin Department of Natural Resources:
Andy Morton – Lower Wisconsin River Basin Coordinator
Eric Rortvedt - Stormwater Ch. 216/151 Permitting
Jeff Schure – Wetlands, Ch. 30 Permitting
Jean Unmuth – Water Resources
Becky Roth – Wildlife Management
Brian Hefty – Property Manager, Lower Wisconsin State Riverway

Jewell Associates Engineers:
Greg Jewell – Project Manager – Flood Study
Ed Lilla – Project Engineer – Flood Study
Don Greenwood – Grant Specialist

Summary
Greg Jewell provided a short presentation about the 2008 floods, its causes and impacts and the recommended project to create drainage for flood waters originating in the Big Hollow Watershed. Pdf versions of the two public information meeting presentations on the flood control study will be emailed to each of the Department representatives.

It was explained that the scale and depth of the proposed drainage project was such it would not be conducting surface water or groundwater to the bottomlands of the Wisconsin River under normal conditions. The channel would be designed to function when the water table is elevated and an extreme storm event (or events) occurred. Under normal conditions the runoff from Big Hollow is absorbed by the soil shortly after it enters the valley.

Jean Unmuth explained that the Lower Wisconsin River and its backwaters are classified as Exceptional Resource Waters and have standards that must be met. Eric Rortvedt said the standards have to do with the assimilative capacity of the receiving waters. The main river channel and Bear Creek have a higher assimilative capacity. It is understood that the usual standard is that waters draining into a water body must not carry nutrients, suspended solids or other chemicals that exceed the background levels of the receiving water. (It is also understood that the Department has some flexibility in applying the ERW standard if an exception is based on a threat to public health. Threats to public health could include high levels of e coli bacteria in flood waters and blue-green algae blooms.)

Concern was expressed about any direct discharge to Bakken's Pond or the Hill Slough. In addition to part of Bakken's Pond being a designated State Natural Area, Becky Roth noted that Bakken's Pond is a major wildlife resource and heavily utilized by many valuable species of fish, mammals, birds and amphibians. It is also a popular hunting and fishing area. Nutrient loading could contribute to major algae blooms and degrade the pond habitat.

Rather than have construction activity in wetlands, Jeff Schure suggested the channel outlet be located above the wetlands. This potentially eliminates the need for wetland and chapter 30 permitting. If wetland impacts are unavoidable, through the permitting process the designer must prove the project can not avoid wetland impacts.

Jeff Schure stated a chapter 30 permit would be required for several potential impacts including; outletting the channel below the OHWM, disturbing 10,000 sf or more with 300 feet of a water body, or for wetland impacts. The question of whether the proposed project or other similar projects would require a point source discharge permit as well is being discussed within the Department. A decision has not yet been reached. Rortvedt said part of the reason the Department is giving the point source permit question a careful look is because nothing like the proposed drainage project has been seen in many decades.

In terms of the design of the channel, Eric Rortvedt suggested forming a more parabolic or rounded shape to the bottom of the channel. This will concentrate lower flow volumes and likely cause less day to day impact on the plantings across the remainder of the channel base.

Jean Unmuth and Andy Morton suggested that nutrient and ag-chemical management by farmers whose lands would contribute runoff to the channel or would serve as temporary flood storage areas would be beneficial in terms of water quality as well as CRP buffers. The effectiveness of the width of CRP buffering (grass buffering) in the flood storage areas was questioned by the group. In upstream areas 'the wider the better' seemed to by the consensus at as much as 100 feet wide per side of a drainage way.

Department staff asked about the proposed drainage district and its plans. The preliminary route and outlet were reviewed. Andy Morton said a meeting is scheduled with the engineer working on that project.

It was suggested that Bear Creek might have more assimilative capacity and would be less vulnerable to the package of nutrients, solids and chemicals that flood waters may carry. Greg Jewell explained that directing all the Big Hollow flood water toward Bear Creek would require a tremendous amount of excavation and an extremely wide and deep ditch. Such a project would have major impacts on farmland and would be much more costly than the currently recommended alternative. Jean Unmuth stated if there was no alternative to go west to Bear Creek she would then agree with Jeff Schure in terms of not directly discharging to the slough and would like to see management practices employed by the farming operations especially at the Clark Farm.

Riverway Forester Brad Hutnik was unable to attend the meeting, but Jean Unmuth relayed his comment that discharge into the floodplain forest might be helpful in the establishment of desirable bottomland species such as Swamp White Oak. There is also concern that even with a channel discharging to the floodplain as opposed to the slough there is a potential for “cutting” in the floodplain forest.

Brian Hefty said if the discharge is on state-owned lands, it would likely require a land use agreement between the Town and the Department.

Don Greenwood reported the possibility the Economic Development Administration of the US Department of Commerce may be willing to commit major funding to the proposed Big Hollow Drainage project. If that happens things may move quickly. Asked what can be done to expedite the permit process, Andy Morton said the first step that would be helpful is a site visit to the area of the proposed discharge. It was agreed that Department staff and Jewell staff involved with the project will meet on Tuesday, March 24 at 9 a.m. at the Jewell office to conduct the site visit. Prior to that Jewell staff will visit the site to flag locations.

Meeting Notes 3-24-09

Topic: Field Visit to proposed flood control drainage projects for Town of Spring Green
Location: Big Hollow 15-ft Channel Option 1&2 Outfall & Big Hollow watershed

Participants
Wisconsin Department of Natural Resources:
Eric Rortvedt - Stormwater Ch. 216/151 Permitting
Jeff Schure – Wetlands, Ch. 30 Permitting
Jean Unmuth – Water Resources
Brian Hefty – Property Manager, Lower Wisconsin State Riverway
Brad Hutnik - Riverway Forester

Jewell Associates Engineers:
Ed Lilla – Project Engineer – Flood Study
Don Greenwood – Grant Specialist

Summary

The group visited the outfall of the Big Hollow 15 foot channel options 1&2 and toured the Big Hollow watershed as far north as CTH JJ. The field visit was a follow up to a March 16, 2009 meeting between DNR and Jewell staff. The DNR expressed the same concerns as the March 16th meeting. Water quality and wetland impacts will be issues. There was also concern that an existing channel in this area was running with what appeared to be groundwater. DNR staff was concerned that during the moderate rains occurring during the visit this channel and several feeder channels were flowing. During the tour of the watershed there was also concern of the amount of running and ponding water for the moderate rain that was occurring. This quantity pf flowing water would suggest the channel may discharge stormwater even during moderate rain. Jewell staff countered that the unusual high groundwater and saturated soil conditions that persisted in 2008 were still an issue and thus resulting in abnormal conditions.