Flooding Conditions at Clark Creek and Possible Mitigation

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FEMA

Federal Emergency Management Agency
U.S. Department of Homeland Security
500 C Street, Southwest
Washington, DC 20472

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1 Introduction

Buildings and agricultural land along Wisconsin Highway 113 experienced flooding from Clark Creek during the June 2008 event. In addition, the highway, which provides principal north-south access, sustained significant damage. Local residents are seeking a solution to a flood problem they maintain has increased since a 1993 flood event.

2 Background And Purpose

The Federal Emergency Management Agency (FEMA) has conducted four technical visits to the Clark Creek area as well as several non-technical visits. The technical teams included hazard mitigation specialists, floodplain managers, geologists, and professional engineers. The technical visits were conducted on August 15, September 2, September 19, and September 23, 2008.

The purpose of this document is to briefly describe what is at risk from Clark Creek floodwater, to list the mitigation possibilities as perceived by local residents, and to describe observations made by FEMA reconnaissance teams during field visits along the course of Clark Creek.

2.1 Location

The subject area is located in rural Sauk County, Wisconsin, immediately south of the City of Baraboo. Highway 113 provides the principal north-south access. Clark Creek, a seasonally influenced stream, discharges into the Baraboo River a short distance upstream from the Highway 113 bridge over the Baraboo River (Figure 1).

2.1.1 Geographical Setting

The headwaters of Clark Creek are located just north of Devil's Lake State Park at elevations of about 1400 feet msl. There are three principal branches - one of which is intermittent (Tower Road crossing). Another branch, which originates in the vicinity of Neuman Road, traverses former agricultural land and a natural preserve. This section of the stream flows through a lowland and has been impounded in four places. The headwaters flow through farm and woodland.

During its approximate 3.5 mile descent to the Baraboo River, the creek might be described in terms of 3 reaches:

1. An ***upper reach*** of the drainage basin which is relatively flat and contains wetlands;
2. A ***middle reach*** which cuts through unconsolidated glacial deposits; and
3. A ***lower reach***, where most stream-side development is located. The depositional landscape flattens as Clark Creek approaches the Baraboo River. Photographs taken after the most recent storm events reveal typical alluvial fan activity at the confluence (Figure 2).

Although Clark Creek drops about 590 feet in a distance of 3.5 miles, there are no obvious nick points. When traversing the stream from its headwaters to its confluence with the Baraboo River, the drop in elevation is barely discernible.

Figure 1

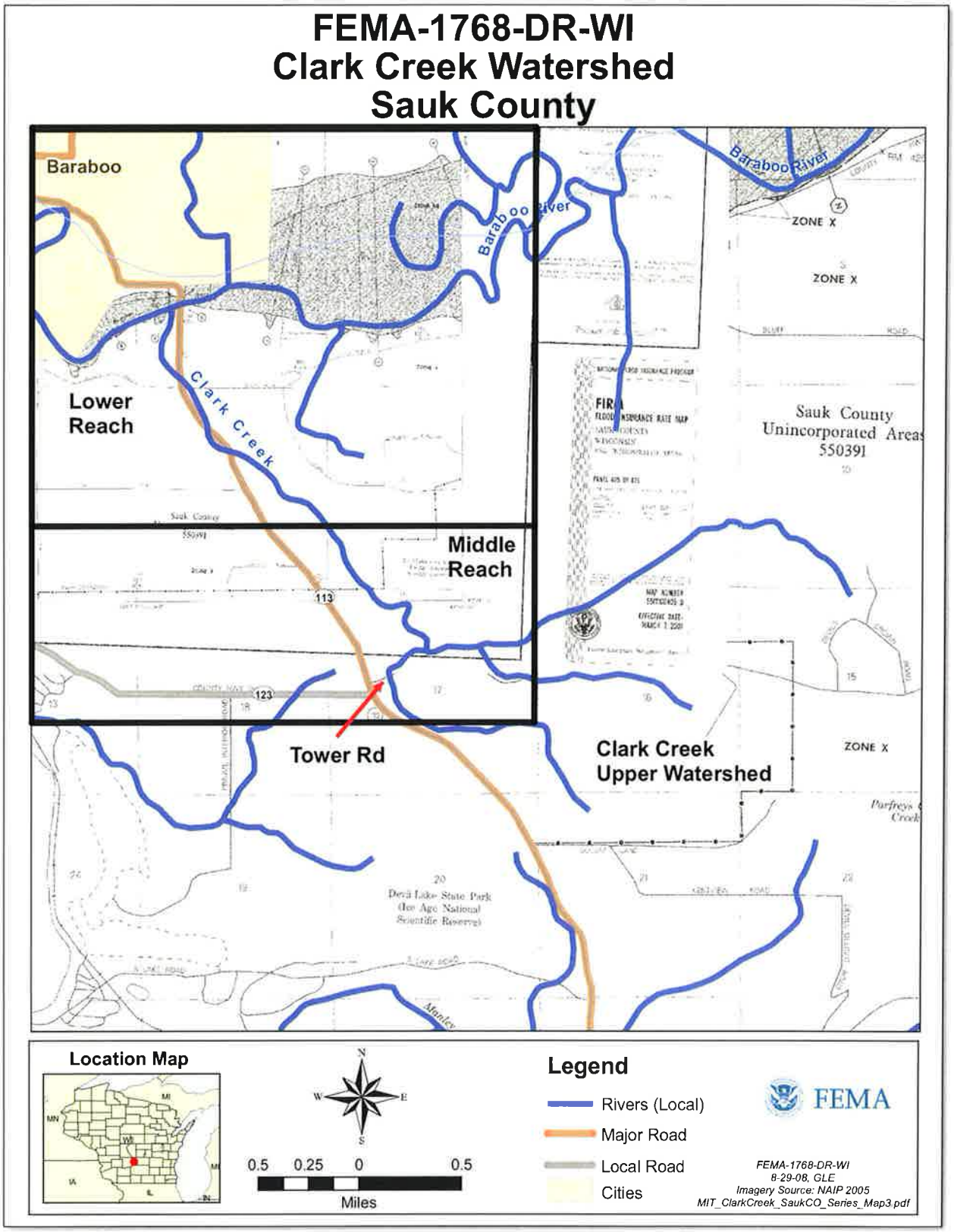

FEMA-1768-DR-WI
Clark Creek Watershed
Sauk County
Baraboo
Baraboo River
Baraboo River
ZONE X
ZONE X
Lower Reach
Clark Creek
Sauk County Unincorporated Areas 550391
Middle Reach
113
123
Tower Rd
Clark Creek Upper Watershed
ZONE X
Devil Lake State Park (Ice Age National Scientific Reserve)
Location Map
N
W
E
S
0.5 0.25 0 0.5
Miles
Legend
Rivers (Local)
Major Road
Local Road
Cities
FEMA
FEMA-1768-DR-WI
8-29-08, GLE
Imagery Source: NAIP 2005
MIT_ClarkCreek_SaukCO_Series_Map3.pdf

Figure 2

Clark Creek near confluence with Baraboo River.

2.1.2 Geology

The hilly area in which Clark Creek originates is underlain by a hard, reddish quartzite (Pb, Baraboo formation). Although no outcrops of this formation were observed, angular pieces of the rock were noted in overlying glacial deposits and in the stream bed.

The upper course of Clark Creek cuts through till associated with Quarternary glaciation. The content of the till varies. In some places, the till is predominately a silty sand or sandy silt - which the stream has carried and deposited at lower elevations. Other stream cuts have exposed a clayey till containing cobble to boulder sized rocks. The origin of the cobbles and boulders vary.

The composition and relative relief of the till is noteworthy. Most stream-cut banks in the upper reaches of Clark Creek are near vertical and easily eroded; they appear to be especially vulnerable to flood water deflected by temporary debris dams. Fine-grained material, carried by rapidly descending flood water, will quickly fill catch basins at lower elevations.

2.2 Assets at Risk

Clark Creek traverses a distance of approximately 3.5 miles before discharging into the Baraboo River. Most at-risk assets are located in the lower reach (Figures 3 and 4).

2.2.1 Structures at Risk

Approximately 60 buildings (residential / non-residential) along Clark Creek are at risk from flooding or bank collapse (PhotoAppendix). Most of the structures at risk from flooding are located within two miles of the Clark Creek – Baraboo River confluence (Figures 3 and 4). At least one residential structure is at risk from bank collapse (Figure 5).

Figure 5

House near sandy bluff in Clark Creek channel.

Judd Maxwell, a local resident serving as group spokesman, maintains that there are approximately 20 residential

Figure 3

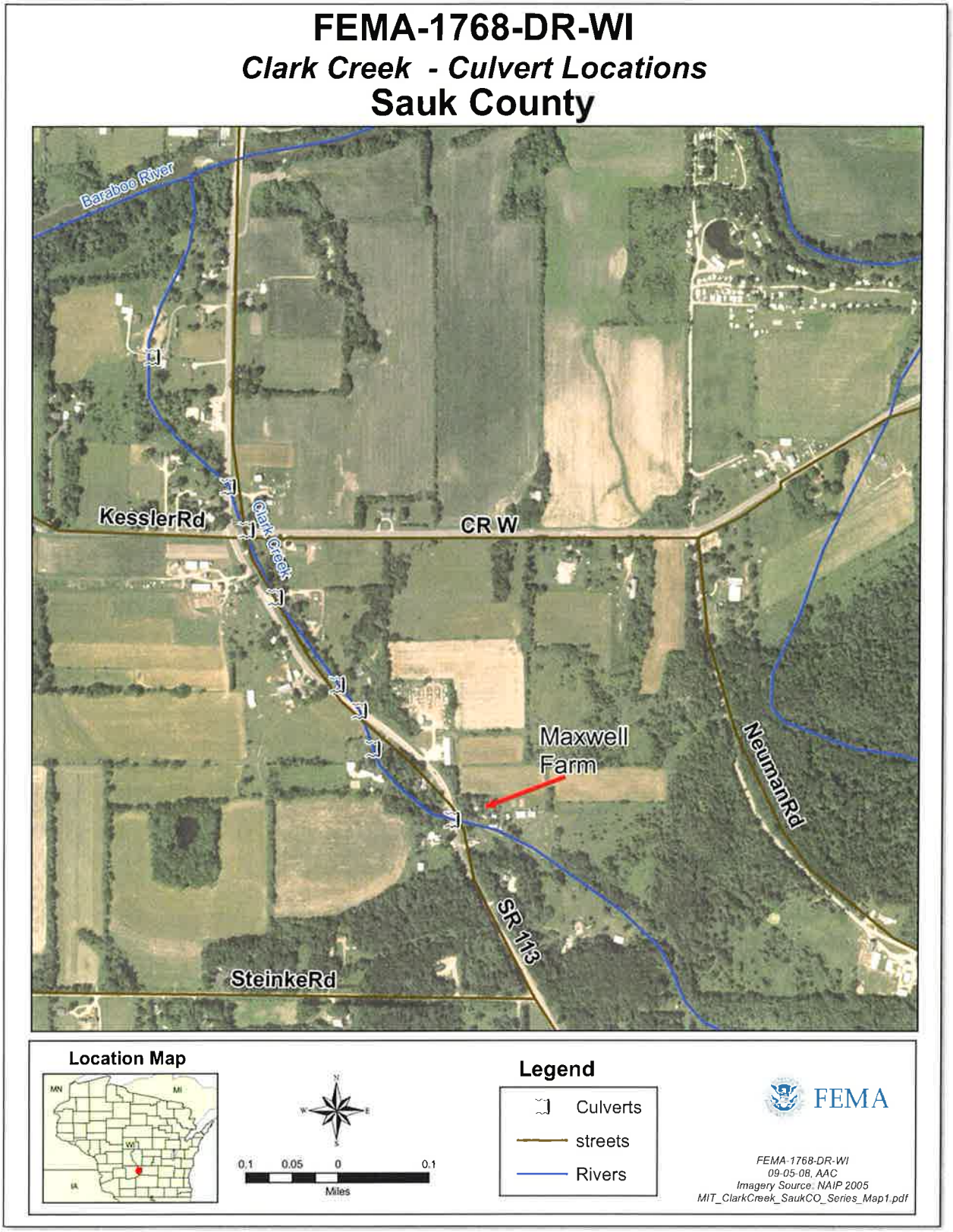
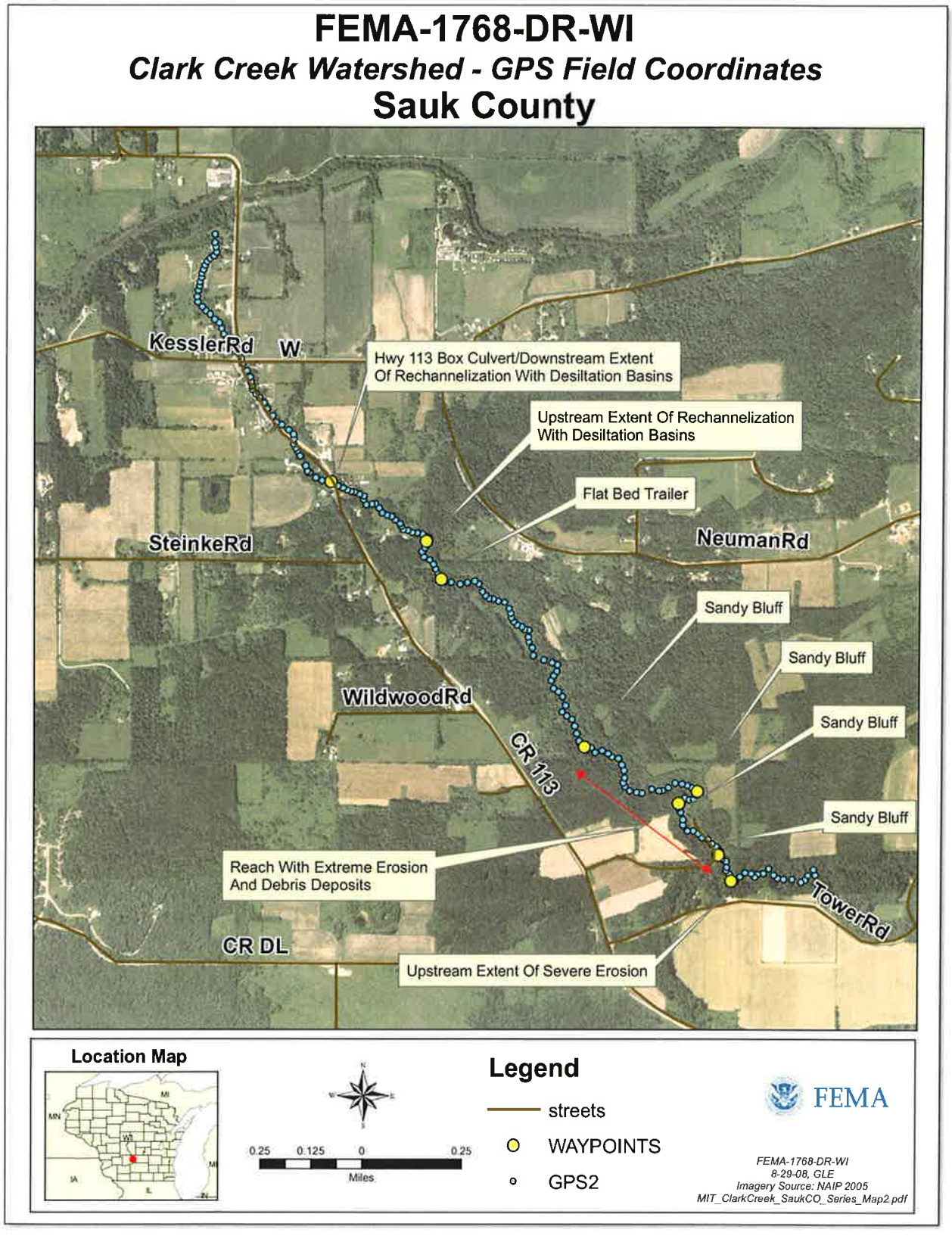

FEMA-1768-DR-WI
Clark Creek - Culvert Locations
Sauk County
Baraboo River
KesslerRd
Clark Creek
CR W
Maxwell
Farm
NeumanRd
SR 113
SteinkeRd
Location Map
MN
MI
WI
IA
N
W
E
S
0.1 0.05 0 0.1
Miles
Legend
Culverts
streets
Rivers
FEMA
FEMA-1768-DR-WI
09-05-08, AAC
Imagery Source: NAIP 2005
MIT_ClarkCreek_SaukCO_Series_Map1.pdf

Figure 4


FEMA-1768-DR-WI
Clark Creek Watershed - GPS Field Coordinates
Sauk County
KesslerRd W
Hwy 113 Box Culvert/Downstream Extent Of Rechannelization With Desiltation Basins
Upstream Extent Of Rechannelization With Desiltation Basins
Flat Bed Trailer
SteinkeRd
NeumanRd
Sandy Bluff
Sandy Bluff
WildwoodRd
Sandy Bluff
CR 113
Sandy Bluff
Reach With Extreme Erosion And Debris Deposits
TowerRd
CR DL
Upstream Extent Of Severe Erosion
Location Map
0.25 0.125 0 0.25
Miles
Legend
streets
WAYPOINTS
GPS2
FEMA
FEMA-1768-DR-WI
8-29-08, GLE
Imagery Source: NAIP 2005
MIT_ClarkCreek_SaukCO_Series_Map2.pdf

structures and 40 non-residential structures at risk. Although some witnessed flooding during the June 2008 event, none were "substantially damaged" - as defined by the Community's Floodplain Ordinance. A cursory inspection of FEMA records indicates that no flood insurance policies have been written for structures along this section of Highway 113. Maxwell maintains that 1 of the 20 homes at risk has flood insurance.

2.2.2 Agricultural Property at Risk

Agricultural land in the vicinity of Highway 113 has been inundated and eroded by rapidly moving floodwater from Clark Creek. Although the number of damaged acres has not been estimated, it is of some concern.

2.2.3 Roads and Bridges at Risk

Three roads and nine culverts crossings are at risk from Clark Creek's debris-laden flood water:

1. Wisconsin Highway 113 (0.25 miles north of Steinke Road to Baraboo River Bridge)
2. Sauk County Road at Highway 113 intersection (Figure 3)
3. Tower Road east of Highway 113 (Figure 1)

The problems associated with these crossings are well known to local residents and highway maintenance crews. A number of culverts are not aligned with the present stream channel (Figure 3). Consequently, water-borne debris will continue to form dams at the culvert crossings; this will restrict, and probably re-route, the stream flow. Until this problem is resolved, the State, Sauk County, and local residents must bear the cost of these repairs. State Highway 113 was still officially closed more than three months after the June 2008 flood event. State Highway 113 is not eligible for FEMA's Public Assistance (PA) funding because it is covered by the "Emergency Relief" program of the U.S. Federal Highway Administration (FHWA).

A portion of Tower Road in the upper Clark Creek Watershed is at considerable risk. Its location is but a short distance east of the Highway 113 intersection (Figure 1). The problem involves an intermittent stream crossing through an undersized culvert. A FEMA reconnaissance team noted the remnants of several debris dams a short distance upstream. The collapse of an upstream debris dam coupled with an undersized and or a poorly maintained culvert could produce a road wash-out. It appears that the floodwater overtopped this section of Tower Road during the June 2008 event.

3 Reducing the Risk to People and Property

Resolving the Clark Creek flood problem must be accomplished at the local level and include an analysis of physical and geological settings. Consequently, FEMA has made a concerted effort to include local citizens and the local government in seeking a solution. This section presents several possibilities for reducing flood damage. Some are short-term solutions. Some may be too expensive, or impractical. Nevertheless, it is important to consider each one as each may have some merit.

3.1 Watershed Analysis

An effective solution to local flood damage should begin with a watershed analysis. As of the date of this report, this initiative has not begun for the Clark Creek watershed area. Consequently, the

mitigation options suggested by local residents may be expensive, unworkable, or possibly provide short term relief only. A truly effective plan needs to include a consideration of the natural setting and how it has changed over a period of time.

Any analyses must address the changes that appear to have occurred in the watershed during the 1993 event. None of the residents in the lower reach of Clark Creek experienced flooding prior to 1993. In the 15 years since 1993, they have experienced flooding events 5 times with extreme amounts of debris. It must be determined if the changes to the watershed are beginning to stabilize or if they can be stabilized by structural or other means.

3.2 Possible Mitigation

Local residents have discussed mitigation options among themselves, and several options were discussed at a September 2, 2008, meeting with FEMA representatives and Sauk County officials. Options considered by local residents and FEMA have included the following:

1. ***Stabilization of the Banks to Pre-1993 Conditions.***
   Stream bank stabilization projects in the upper and middle sections of Clark Creek (Figure 1) could eliminate or greatly reduce future bank erosion. The project should include the use of geo-textile fabrics as well as selective re-vegetation activities.

2. ***Realignment of the Channel of Clark Creek.***
   The creek channel could be realigned. However, this option would require a variety of engineering and environmental considerations. Realignment would affect a number of properties and probably would be cost prohibitive.

3. ***Installation of Flow Diverters.***
   Strategically placed "flow diverters" could stem bank erosion in existing problem areas. However, diverters should be viewed as a partial or perhaps a temporary solution to a complex problem. Even slight shifts in stream course could alter their effectiveness. They should be used in concert with other mitigation strategies.

4. ***Construction of sediment-catchment Basins along the Stream.***
   Catchment basins are designed to collect water borne sediment before it is deposited over wide areas downstream. They must, of course, be cleaned of deposited sediment on a regular basis. The Wisconsin Department of Natural Resources has begun a re-channelization project, in the lower reach by the Maxwell Farm, which includes the construction of several catchment basins (Figures 4 and 6).

Figure 6

Construction of desiltation basin in Clark Creek Channel.

5. **Construction of a Dam at the Clark Creek Headwaters.**
   Flooding within the middle and lower reaches of Clark Creek could be reduced by the construction of a dam in the upper watershed. However, this option contains a number of complex considerations: the cost and benefits of such an undertaking probably would eliminate dam construction for serious consideration.

6. **Construction of an Emergency Spillway at Maxwell Farm. (Figure 3)**
   This option could divert stream flow from Clark Creek across the Maxwell Farm property to the Baraboo River. Such an undertaking would be expensive and involve property issues as well as environmental considerations.

7. **Realignment of Highway 113.**
   The highway could be realigned to avoid multiple creek crossings. This would be expensive and would involve a number of environmental and other considerations.

8. **Replacing Culverts at Maxwell Farm with a Bridge.**
   Replacing the culvert with a bridge with a much larger cross-sectional area of flow would help prevent the creek from leaving its channel at that point. This could be done in combination with repair and extension of the dike along the Maxwell property. Although preferable to a culvert, a bridge would require a variety of studies (e.g., hydraulic and hydrologic) and would be expensive. Costs and benefits certainly would be a factor.

9. **Replacing Culverts at Maxwell Farm with a Low Water Crossing.**
   A "Low Water Crossing" is a depression in the roadway that will accommodate the high volume of water flooding events like those experienced during this past event (Figure 7). This proposal would require replacing the existing culverts with a culvert or bridge, properly designed to accommodate the 35-year annual storm event as determined by the Wisconsin Department of Transportation. These new crossings can handle the water flow from the lesser events. However, during the exceptional periods, the water flows over the roadway. This designed overtopping allows much of the debris carried by the flood waters to cross the roadway without blocking the flow of the water. The limitations for these crossings are the fact that during these high flow periods, the road is impassable until the flood waters subside.

Figure 7

Low water crossing.

10. ***Realignment of the Culverts.***
    Several culverts along Clark Creek should be realigned to conform to the present stream flow.

11. ***Installation of Debris Barriers at Entrances to Culverts.***
    Debris barrier and/or deflectors can be installed at culvert entrances to prevent blockage from floating debris. This option can be demonstrated to be cost effective. During the June 2008 flood event approximately 112 tri-axle loads of debris were removed from the box culvert at the Maxwell Farm area.

12. ***Installation of Perforated Standpipes in Lieu of the Standard Culverts.***
    The standpipe allows debris to float up with the rising waters without impacting flow into the culverts. A limitation of this option is the standpipe is vulnerable to damage from high velocity flows.

13. ***Acquisition.***
    This seems to be a popular solution with several residents, although not supported by all. The purchase of large parcels would be problematic. Local officials have informed residents that State or Federal funds for acquisition probably would not be available. This "buy-out" approach only would address the immediate needs of the community. As more of the upper level silt is allowed to wash down stream the buy-out approach will need to be incorporated in future disaster events until the stream slopes stabilize or are fortified.

14. ***Relocation.***
    This could be a viable option for some. Considerations include whether or not property is available outside a recently-mapped floodplain. Relocation appears to be one of the suggested practical options for structures located high above Clark Creek on rapidly eroding banks.

15. ***Elevation / Flood-Proofing of Structures.***
    This is an option, although expensive and not without special considerations. If riparian properties are remapped as being within a 100-year floodplain, Wisconsin's floodplain management statutes (Chapter NR 116) become effective. Wisconsin statutes require that new or substantially improved residential structures be placed on fill that is not less than 1 foot above the regional (1%) flood elevation. In addition, the statute requires that the fill must extend at least 15 feet beyond the limits of the structure [NR 116.13(2)]. There are other options for non-residential buildings [NR 116.13(4) and (5)].

4 Conclusions and Recommendations

4.1 Stream Maintenance in the Middle Reach of Clark Creek

Recent field visits to Clark Creek underscored the need to remove woody debris from the stream and relocate large boulders that have the potential of causing down-stream damage. The addition of silt and debris to a clear-water run-off displaces a volume of water which leads to higher water surface elevations downstream. This increased downstream flow exacerbates flooding and flood damage to assets. Additionally, the debris itself can cause significant damage.

Flood and siltation problems in the lower reach of Clark Creek can not be resolved without mitigating up-stream causes. Debris dams are particularly problematic. Removing woody debris from the upper

reaches of Clark Creek may be one of the few cost-effective options. One possibility includes the use of a skidder or similar piece of logging equipment with a chipper. In this manner, the volume of woody debris can be reduced in place and not have to be transported out of the area (Figures 8 and 9).

Figure 8

Debris pile in the middle reach of Clark Creek.

Figure 9

Sediment deposition near Baraboo River confluence.

4.2 Engineering Solutions

Mike Klitzke, PE, (FEMA) considered possible engineering solutions to the historical flooding problems of this area. His conclusion was that controlling or re-routing Clark Creek, much of which is located in Devil's Lake State Park, "...probably would not be approved". He concluded that, "... severe events, such as those that occurred in June, will result in similar flows and consequences to downstream areas."

Given these two statements, our conclusion to best address the issues at hand is:
We recommend that a watershed study be conducted by the U.S. Department of Agriculture (USDA) through the Natural Resources Conservation Service (NRCS). Either the "Emergency Watershed Protection Program" or "Small Watershed Program, Flood Prevention Program" would be adequate in evaluating the given situation. In undertaking these studies, scientific as well as engineering principles can be evaluated / incorporated into the final corrective action plan. This will insure that all environmental considerations will be adequately addressed and supported.

4.3 Acquisition vs. Relocation

Klitzke also noted that the natural topography of the area is going to dictate the route of Clark Creek during significant flood events. His conclusion is partly based on an unsuccessful attempt to control the direction of the creek in the vicinity of the Maxwell Farm during the June 2008 flood event. He noted that attempts to modify or control the routing of the creek during severe flooding are probably not practical or even possible. He concluded that, "Any diversion would simply relocate the problem somewhere else along the waterway." As a consequence, he suggested the following:

1. Identify the natural floodway portion of the creek; and
2. Relocate any structures out of harm's way.

He eliminated an overall buy-out program because of cost, but noted that, "...there might be a couple of buildings suitable for buy-outs due to their being located immediately adjacent to the creek and not on large tracts of land."

4.4 Flood Insurance

The new Flood Insurance Rate Map (FIRM), to be distributed in September 2008, probably will depict the area in question to be in a Special Flood Hazard Area. With this in mind, it would be prudent for affected property owners to purchase a NFIP "Preferred Risk" flood insurance policy, at relatively low rates before the FIRM becomes effective.

5 Alternate Funding Sources

U.S. Department of Homeland Security (DHS)
Federal Emergency Management Agency (FEMA)
Hazard Mitigation Grant Program (HMGP)

Purpose: To prevent future losses of life and property due to disasters; to implement State or local hazard mitigation plans; to enable mitigation measures to be implemented during immediate recovery from a disaster; and provide funding for previously identified mitigation measures to benefit the disaster area.
Project grants are administered by the State of Wisconsin

Contact: Roxanne Gray, State Hazard Mitigation Officer
(608) 516-0294
Roxanne.gray@wisconsin.gov

U.S. Department of Housing and Urban Development (HUD)
Community Planning and Development (CPD)
Community Development Block Grants (CDBG) / Entitlement Grants

Purpose: The most appropriate disaster related use of these funds is for long-term recovery needs. Examples of this include acquisition of flood-prone properties and making other mitigation efforts to protect damaged properties from, and reduce the cost of future disaster damage.

Contact: Office of Block Grant Assistance, CPD, HUD
451 Seventh Street SW
Washington, DC 20410
(202) 708-3587

U.S. Department of Agriculture (USDA)
Farm Service Agency (FSA)
Emergency Conservation Program

Purpose: To enable farmers to perform emergency conservation measures to control wind erosion on farmlands; to rehabilitate farmlands damaged by wind erosion, floods, hurricanes, or other natural disasters; and to carry out emergency water conservation or water-enhancing measures during times of severe drought.

Contact: Conservation and Environmental Program Division
FSA, USDA
P.O. Box 2415
Washington, DC 20013
(202) 720-6221

U.S. Department of Agriculture (USDA)
Natural Resources Conservation Service (NRCS)
Conservation Technical Assistance

Purpose: Conservation systems are to reduce erosion, improve soil and water quality, improve and conserve wetlands, enhance fish and wildlife habitat, improve air quality, improve pasture and range condition, reduce upstream flooding, and improve woodlands. NRCS can collect, analyze, interpret, display, and disseminate information about the condition and trends of the nation's soil and other natural resources so that people can make good decisions about resource use and about public policies for resource conservation.

Contact: Deputy Chief for Programs (Tom Christensen)
NRCS, USDA
P.O. Box 2980
Washington, DC 20013
(202) 720-3340
www.nrcs.usda.gov

U.S. Department of Agriculture (USDA)
Natural Resources Conservation Service (NRCS)
Emergency Watershed Protection Program (EWP)

Purpose: To assist sponsors in implementing emergency recovery measures to relieve imminent hazards to life and property created by a natural disaster that causes a sudden impairment of a watershed.

Assistance Provided: Technical and financial assistance. The EWP provides funding to project sponsors for such work as clearing debris from clogged waterways, restoring vegetation, stabilizing riverbanks. The measures taken must be environmentally and economically defensible.

Contact: Deputy Chief for Programs (Tom Christensen)
NRCS, USDA
P.O. Box 2980
Washington, DC 20013
(202) 720-3340
www.nrcs.usda.gov

U.S. Department of Agriculture (USDA)
Natural Resources Conservation Service (NRCS)
Small Watershed Program, Flood Prevention Program

Purpose: To work through local government sponsors and help participants solve natural resource and related economic problems on a watershed basis. Projects include watershed protection, flood

prevention, erosion and sediment control, water supply, water quality, fish and wildlife habitat enhancement, wetland creation and restoration, and public recreation in watersheds of 250,000 or fewer acres.

Contact: Deputy Chief for Programs (Tom Christensen)
NRCS, USDA
P.O. Box 2980
Washington, DC 20013
(202) 720-3340
www.nrcs.usda.gov

U.S. Department of Agriculture (USDA)
Natural Resources Conservation Service (NRCS)
Watershed Surveys and Planning

Purpose: To assist Federal, State and local agencies and tribal governments in protecting watersheds from damage caused by erosion, floodwater, and sediment, and in conserving and developing water and land resources.

Resource concerns addressed by the program include water quality, opportunities for water conservation, wetland and water storage capacity, agricultural drought problems, rural development, municipal and industrial water needs, upstream flood damages, and water needs for fish, wildlife, and forest-based industries.

Contact: Deputy Chief for Programs (Tom Christensen)
NRCS, USDA
P.O. Box 2980
Washington, DC 20013
(202) 720-3340
www.nrcs.usda.gov

U.S. Department of Agriculture (USDA)
Natural Resources Conservation Service (NRCS)
Wetland Reserve Program

Purpose: A voluntary program to restore wetlands. Participating landowners can establish conservation easements of either permanent or 30-year duration, or can enter into a restoration cost-share agreement where no easement is involved. In exchange for establishing a permanent easement, the landowner receives payment up to the agricultural value of the land and 100 percent of the restoration costs for restoring the wetlands. The 30-year easement payment is 75 percent of what would be provided for a permanent easement on the same site and 75 percent of the restoration cost. The voluntary agreements are for a minimum 10-year duration and provide for 75 percent of the cost of restoring the involved wetlands. In all instances, landowners continue to control access to their land.

Contact: Deputy Chief for Programs (Tom Christensen)
NRCS, USDA
P.O. Box 2980

Washington, DC 20013
(202) 720-3340
www.nrcs.usda.gov

U.S. Department of Agriculture (USDA)
Rural Development / Rural Housing Service (RHS)
Rural Housing Service Section 502 Direct and Guaranteed Loan Program

RHS Section 502 Direct Loan Program: To provide housing assistance to very low-and low-income applicants to purchase, build, or rehabilitate a home in a rural area. Payment assistance is available to eligible applicants and may lower the effective interest rate on a mortgage to as little as 1 percent.

RHS Section 502 Guaranteed Loan Program: To provide credit assistance to applicants whose income does not exceed 115 percent of the area median income.

Contact: Director, Single Family Housing Guaranteed Direct Loan Division
RHS, USDA
1400 Independence Avenue SW
Room 2250
Washington, DC 20250
(202) 720-1452

U.S. Department of Agriculture (USDA)
Rural Development / Rural Housing Service (RHS)
Rural Housing Service Section 504 Repair Grants and Loans

RHS Section 504 Repair Grants: To provide assistance to repair homes of very low-income homeowners age 62 years or older living in a rural area.

RHS Section 504 Repair Loans: To provide very low-income homeowners in rural areas with loans to repair their homes. Loans are available at 1 percent interest with up to 20 years to repay.

Contact: Director, Single Family Housing Guaranteed Direct Loan Division
RHS, USDA
1400 Independence Avenue SW.
Room 2214-Stop Code 0783
Washington, DC 20250
(202) 720-1474

Reference

Dott, Robert H. and John W. Attig, *Roadside Geology of Wisconsin*, 2004.i

Headwater area in upper reach of Clark Creek tribuatry near Neuman Road.

Debris pile in the channel of an intermittent reach of Clark Creek near Tower Road.

Debris pile and erosion in middle reach of Clark Creek.

Debris pile and erosion in middle reach of Clark Creek.

Sandy bluff in middle reach of Clark Creek.

Sandy bluff in middle reach of Clark Creek.

Sandy bluff and debris pile in middle reach of Clark Creek.

Sandy bluff in middle reach of Clark Creek.

Sandy bluff and debris pile in middle reach of Clark Creek.

Sandy bluff in middle reach of Clark Creek.

Sandy bluff and debris pile in middle reach of Clark Creek.

Sandy bluff in middle reach of Clark Creek.

Debris pile in middle reach of Clark Creek.

Debris pile in middle reach of Clark Creek.

Flatbed trailer in middle reach of Clark Creek.

Desiltation basin at upstream extent of rechannelization of Clark Creek.

Misaligned Highway 113 box culvert near Maxwell Farm at downstream extent of rechannelization of Clark Creek.

Misaligned Highway 113 box culvert in foreground and County Road W dual corrugated metal pipe culverts in background in lower reach of Clark Creek.