

**City Council Special Meeting  
Monday, November 3, 2008  
7:00 p.m.  
Windom City Council Chambers**

**AGENDA**

Call to Order

Pledge of Allegiance

1. Public Meeting –Des Moines River Dam Project
2. Adjourn



# **Feasibility Study**

## ***Des Moines River Dam Project***

City of Windom, Minnesota

City Project/DNR No. [REDACTED]  
SEH No. 105095 WINDM

October 29, 2008

October 29, 2008

RE: Des Moines River Dam Project  
Feasibility Study  
City of Windom, Minnesota  
City/DNR Project No.  
SEH No. 105095 WINDM

Mr. Steve Nasby, City Administrator  
City of Windom  
444 9th Street, P.O. Box 38  
Windom, MN 56101-0038

Dear Mr. Nasby:

TEXT to be included in final report

Short Elliott Hendrickson Inc. (SEH®)

Sincerely,

Rocky Keehn, PE  
Project Manager

rsn

s:\uzi\windm\102094\feasibility report draft rocky.doc

Des Moines River Dam Project  
Feasibility Study  
City of Windom, Minnesota

City Project/DNR No.  
SEH No. 105095 WINDM

October 29, 2008

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of \_\_\_\_\_.

\_\_\_\_\_  
Rocky Keehn, PE

Date: \_\_\_\_\_ Lic. No.: \_\_\_\_\_

Reviewed by: \_\_\_\_\_  
Date \_\_\_\_\_

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City of Windom, Minnesota  
Address  
City, State, Zip

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## Executive Summary

To be included in Final Report

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# Feasibility Study

## Des Moines River Dam Project

Prepared for City of Windom, Minnesota

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### 1.0 Introduction

The Des Moines River Dam (the dam), located in the City of Windom, Minnesota, has formed a natural river channel with water flowing around the east side of the dam. This has resulted in the disappearance of the dam's historic upstream water pool. There are conflicting views as to whether to keep or remove the dam. Either option will require urgent resolution because water flowing around the east side of the dam creates a potential safety hazard and may cause complete dam failure in the future. As a result, the City of Windom (City) has hired Short Elliott Hendrickson (SEH®) to facilitate in building stakeholder/public consensus and prepare this feasibility study. The purpose of this feasibility study is to assist the City in determining the future of the dam site by evaluating alternatives for the removal, reconstruction, or rehabilitation of the dam.

### 2.0 Chronology

In 1878, the first dam was built out of logs to power the nearby Collins flour mill. At the same time, the mill owners built a diversion channel (along current Highway 62) in the Des Moines River to provide water for the mill.

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Seven years later, in 1885, the log dam was washed out and reconstructed using brush and gravel. At the turn of the century, the dam was reconstructed again using concrete abutments and wooden planks.

The Collins flour mill closed in 1922 and was then destroyed by fire in 1923. In 1926, the City purchased about 50 acres of land, which included the land and the old mill site, to create Island Park. In 1947, as part of the construction of Highway 60, crews filled in the diversion channel that served the mill. This project eliminated a portion of the river width and resulted in additional flow over the top of the dam and through the park during floods.

In 1959, the United States Army Corps of Engineers (USACE) completed a study that recommended the dam be removed to eliminate problems associated with sediment accumulation and flooding. Instead of removing the dam, in 1960, the City completed its first major City-funded dam project: the construction of a by-pass culvert. Shortly after the by-pass culvert project, floods washed away much of the wooden portions of the dam in 1962, which led to the dam being reconstructed with concrete in 1963. In 1985, the dam was repaired again and, in 2007, the riverbank abutment eroded away and the historic dam pool disappeared. A summary of the historic events relevant to the dam site is presented in Table 1.

**Table 1**  
**Historical Summary of the Windom Dam**

<b>Year</b>	<b>Event</b>
1878	Dam originally constructed for the Windom (Collins) Flour Mill
1885	Dam was washed out and reconstructed using brush and gravel
~1900	Dam was washed out and reconstructed out of wood and concrete

1922	Windom Flour Mill closed down
1923	Windom Flour Mill destroyed by fire
1926	City purchased approximately 50 ac. of land owned by the Collins estate to create Island Park
1947	Channel to the mill is filled as part of the Highway 60 project
1959	USACE, Rock Island District completes a study to address problem areas along Des Moines River
1959/1960	City passes bond to build a by-pass channel which turned out to be a 60-inch culvert to help with flooding problems
1962	Floods wash away much of the wooden parts of the dam
1963	Dam reconstructed as ogee concrete dam
1985	Embankment and wing wall of dam repaired
2007	Riverbank abutment erodes away and dam fails

### 3.0 Alternative Selection Process

#### 3.1 Public Involvement

Informed consent among the stakeholders and the public is critical to reaching a successful solution for the dam. The process used to build consensus among parties was to start with smaller stakeholder groups and move toward larger public involvement. The purpose of the charrette meeting was to identify technical issues, economic components, and help answer difficult engineering and scientific questions. A summary of the project meetings is presented in Table 2.

**Table 2  
Summary of Project Meetings**

Meeting Date	Meeting Description
July 23, 2008	Project kickoff/baseline meeting
Sept 9, 2008	Stakeholders meeting
Sept 16, 2008	Charrette meeting
Sept 22, 2008	City staff/ stakeholders meeting
Sept 30, 2008	Public Meeting I
Sept 30, 2008	City staff/stakeholders meeting
	Radio Broadcast
	Public Survey
Nov 3, 2008	Stakeholders meeting – Draft Review
Nov 3, 2008	Public Meeting II
Nov 24, 2008	City staff/Stakeholders meeting
Dec 1, 2008	Council Presentation

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## 3.2 Project Alternatives

The following project alternatives were developed by SEH and the stakeholders group at the September 22, 2008 meeting and presented at the first public meeting on September 30, 2008. These alternatives have been categorized under two different headings based on whether the historic dam pool is retained or eliminated. A brief description of each alternative is provided in the following text and **Appendix A** contains concept images of each alternative.

### 3.2.1 Retain Historic Dam Pool Alternatives

#### 3.2.1.1 Alternative #1 – Repair Existing Dam

The first alternative is to repair the existing dam in its current location with the addition of a concrete spillway at the location of the historic overflow. The hydraulic roller would be eliminated by placing large rocks at a stable slope at the toe of the dam.

#### 3.2.1.2 Alternative #2 – Remove Dam and Build a New One

The second alternative is to completely remove the old dam and build a new one. The new dam would be built to eliminate the hydraulic roller effect and provide fish passage.

#### 3.2.1.3 Alternative #3 – Rock Riffle Dam Over Current Dam

The third alternative is to build a rock riffle dam. A rock riffle dam could be constructed over the current dam with some minor modifications to the existing structure.

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3.2.1.4 Alternative #4 – Upstream Rock Riffle Dam

Alternative #4 is to remove the existing dam and construct a series of rock riffles, starting near the current dam and moving upstream approximately 200 feet.

3.2.1.5 Alternative #5 – Rock Riffle Dam between Current Dam and Highway 62 Bridge

The last alternative to retain the historic dam pool is a rock riffle dam between the current dam and the Highway 62 bridge. This alternative also includes removing the existing dam. The total length of the dam for this alternative would span several hundred feet and the pool widths would vary.

**3.2.2 Eliminate Historic Dam Pool Alternatives**

3.2.2.1 Alternative #6 – Retain the Dam and Stabilize Channel

The first pool elimination alternative is to retain the dam and stabilize the channel (existing dam breach point). Minor repairs to the dam would be needed.

3.2.2.2 Alternative #7 – Remove the Dam and Stabilize Channel

The second pool elimination alternative is to remove the dam and provide some minor bank stabilization.

3.2.2.3 Alternative #8 – Do Nothing

The final alternative is to do nothing. This alternative would leave the dam as is and provide warning signs and fencing to deter access to the site.

**3.3 Alternative Refinement**

At the September 30, 2008 stakeholder meeting, the eight alternatives presented at the first public meeting were narrowed down to four

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alternatives. Alternatives 1, 3, 4, and 7 were selected for further consideration.

The selection of the four alternatives was based on the public input from the September 30, 2008 public meeting, public surveys, and stakeholder input. The public survey results are included in **Appendix B**.

If a dam remains in place and a pool is created the following key assumptions were made for all pool in alternatives:

1. There are no upstream construction projects proposed. Future repairs to the bridge would be done by MnDOT and any future bank erosion at the apartments and homes would not be an issue since the pool of water would provide the necessary protection. Also, any future bank protection due to the erosion water pool wave actions due to wind or damage during high flows would need to be done as a project not related to this project.
2. The new dam or repaired dam would be constructed at a higher cost to reduce future maintenance issues. This area has a history of projects being proposed, constructed and then failing. In 1958 the USACE proposed a major spillway which was replace with the much smaller pipe which is more of a drawdown structure which may contributed to the failure that occurred in the early 60's which resulted in a new spillway. There was also a failure in the early 80's in which a new spillway was built on the east side of the dam which of course failed in 2007. The project would be proposed that

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includes extra measure such as sheetpile and engineer based rock sizes so maintenance would be greatly reduced in the future.

3. Sediment removal is not part of the project but is a key discussion point. If the City has no plans for sediment removal as part of this project or in the future, it appears overtime the 600 foot wide pool shown on the late 1950 maps will become less than 200 feet wide with a maximum depth during normal flow years around 2 feet. This depth could increase to maybe 4 feet during flood events as a result of scouring of the river bed. Based on a survey done this fall, if the dam is completed next year at the current spillway elevation, the maximum water depth under the bridge would be just over 5 feet in the channel and 3 feet in the floodplain at the bridge.
4. If sediment removal is not considered now or in the future, over time the system with the dam will migrate to more of a river-like system and begin to match the dam out system. Many of the issues such as fishing, ATV use, etc. will be the same whether the dam remains or is removed if this is allowed to occur.

If the dam is removed the following assumptions were made for the one alternative to remove the dam.

1. There would be a need to be scour protection under the Highway 62 Bridge for the main flow channel and the solution would need to be approved by MnDOT. The proposed project would realign the main channel of the river west in between the first set of piers, reduce the

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channel bed about 2.5 feet below its current elevation (which is 1 foot below the design bed elevation and 2.5 feet below current bed elevation), and provide riprap protection of the channel between the piers. This option would also help protect the abutments of the bridge which appear to be too steep for current design practices.

2. There would be a need for protection of the bank on the east side of the river from the Highway 62 Bridge upstream about 2600 feet past the apartments and the several homes along River Road. The proposed project would be to provide a 6 to 1 slope from the current back yards into the river which would be protected with natural bank protection methods. The mitigation in the floodplain would be done by removing fill from the areas to the west. This may also require some training of the river to make sure it is located near the island in the middle of the floodplain and well away from the homes.
3. Property issues can be addressed if the dam is removed.
4. Sediment removal is not an issue.
5. DNR funding not used on the cost of the dam removal could be used for construction projects to protect the bridge and homes upstream of the bridge.

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#### 4.0 Permitting

The required permits and approvals vary depending on which alternative is selected. The following is a list of permits which may be applicable:

- MN DNR Protected Waters Permit
- MN DNR Dam Safety Permit
- USACE Section 404 Permit
- MN PCA Section 401 Certification
- MN PCA Site Disposal Permit
- MN PCA NPDES Construction Stormwater Permit

#### 5.0 Project Issues

Input from City Staff, the stakeholders group, and the public resulted in the identification of more than 40 issues related to keeping or removing the dam.

A listing and brief discussion of these issues are included in **Appendix C**.

The issues ranged from critical engineering issues such as the impact of the dam removal on the integrity of the Highway 62 bridge to potential activity-based impacts such as ATV use in the area. The challenge was to determine which of these issues were critical in the decision-making process for the City Council and thus warranted detailed discussions. The stakeholders were given the task to identify those key issues.

SEH prioritized these issues by determining which issues were critical to the alternative being chosen, which issues did not apply to the alternative, and which ones were neutral and thus had equal weight whether the dam function remained or not. The stakeholders were then asked to rank the issues from the highest priority to the least. Finally, each stakeholder was asked to provide input about whether these issues were a critical element in selecting

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their preferred option. This information was tabulated and is provided in **Appendix C**. From this information, the key issues were identified and categorized as an engineering issue (site construction), an ecological issue (impact on vegetation, fish and wildlife), or a related issue (project impacts outside the actual construction project). Each of these categories are discussed in detail in the following sections.

## **5.1 Engineering**

### **5.1.1 Dam Safety**

The major safety issue has been the hydraulic roller effect of the dam, also known as the 'drowning machine.' Removal of the dam would eliminate the hydraulic roller effect. Any other option, whether it is a rehabilitation of the existing dam or the construction of a new control structure, will require a design that eliminates the hydraulic roller effect.

### **5.1.2 Structural**

A site visit of the dam and review of the construction plans was made. It was determined that the existing structure will ----- not meet the factor of safety standards for sliding and overturning stability. Although the Wenck Structural Assessment Report states that the concrete is in good condition, it also states that additional evaluations of the structure would need to be completed in order to determine if it meets the dam safety requirements for structure stability. The concrete that is visible on the surface of the spillway is in fair condition. This concrete is an overlay placed on the earlier constructed dam. No information is available about the older structure beneath the overlay but based on the age, it is likely a timber crib with rock fill. The presence of piling or extent of the foundation could not be confirmed. The structural analysis would only be needed if the dam is not removed

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(Alternatives 1 and 3) and would be part of the final construction project plans.

## **5.2 Ecology**

### **5.2.1 Fish Passage**

The dam (prior to failure) is considered an obstruction to fish passage and a migration barrier to aquatic life. The Des Moines River is known to harbor walleye, smallmouth bass, and other desirable game species that rely on migration and effective fish passage as part of their ecology and seasonal movements. Dam removal or construction of a rock-riffle system would allow effective and complete fish passage.

### **5.2.2 Wildlife**

Dam removal is anticipated to result in minor changes to wildlife, primarily waterfowl, and their habitats. Species of waterfowl that depend on pool habitats may avert to other abundant open water and pool habitats in the region. Conversely, dam removal may also reduce the attractant value for Canada geese, often creating nuisance wildlife issues. Given that the pool behind the Windom Dam is similar to the remaining sections of the Des Moines River, these changes are anticipated to be negligible for waterfowl and other wildlife populations. The newly exposed embankments will provide ideal conditions for the establishment of riparian habitat, in-stream habitat, and foraging habitats for wading birds, waterfowl, and other wildlife. The small size of the pool and the changes from the proposed dam removal are anticipated to result in a small or non-detectable shift in the assemblage of wildlife species that inhabit the area.

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Dam removal is anticipated to have a positive effect on wildlife by re-establishing pre-construction conditions. These conditions are consistent with the ecosystems along the remaining sections of the Des Moines River and other neighboring areas. Dam removal may also be an effective control and management solution for nuisance species of wildlife, in particular Canadian geese. Removal of the dam may result in the diversion of Canada geese to other abundant open water habitats in the area.

### **5.2.3 Aquatic Species**

The removal of the dam will result in a net gain benefit for aquatic life through two primary processes; 1) removal of an obstruction to the dispersal and movement of aquatic organisms, and 2) the re-establishment of natural habitats that are best suited for a river system. Removal of the dam will eliminate a barrier to fish passage, and to dispersal upstream of other aquatic organisms, including several state listed species of mussel that have been documented in the Des Moines River. Removal of the dam will restore the original in-stream habitat conditions that were present prior to the construction of the dam and eliminate the less desirable pool habitats. The newly established habitats will be more suitable for native and desirable species of fish, create new habitats for mussels, and eliminate sources of turbidity and standing water that make for less desirable habitat conditions.

### **5.3 Related Issues**

A summary table of project issues as they relate to each of the alternatives is presented in **Appendix C**. A brief description of the major issues is included below.

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### **5.3.1 Sediment accumulation**

If the dam remains and the sediment is trapped, over time the entire pool area will fill with sediment and the pool will become a higher river with some shallow water areas. A small and shallow pool will likely remain near the dam. It was estimated that if sediment is not removed to increase the size of the pool, the normal depth would stabilize at around 2 feet during normal flow conditions and could scour out to four feet during flood events and then return to two feet in depth over time. Sediment removal is not proposed as part of the project.

With the dam out, the sediment will be deposited in floodplains and small pools, and the channel will maintain its course with a normal bed load. The charrette team concluded that the current channel has already stabilized in most, if not all, sections of the river. Therefore, additional sediment movement downstream is unlikely if the dam is permanently removed. In the future, most of the sediment sources would be caused by bank erosion, which is a natural function of the river and is consistent with most sections of the West Des Moines River.

### **5.3.2 Highway 62 Bridge**

The Charrette Team reviewed the plans for the Highway 62 bridge and also visited the site. During this visit, they observed a one inch tension crack at the east abutment (grouted riprap) likely caused by a drop in water levels resulting from dam failure. The piling has been driven to a depth of 25 feet below the bottom of the channel bottom. Some riprap may be needed under the bridge to minimize scour and stabilize the east bridge abutment.

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MnDOT responded to the City in January 2008 about the potential impacts of the dam removal on the Highway 60 Bridge and Highway 62 Bridge. In a letter to the City, MnDOT concluded that there could be minor impacts to the Highway 60 Bridge and there was a concern of potential impacts to the Highway 62 Bridge during the 500-year event.

SEH staff followed up with a call to Mn/DOT in order to better understand the potential issues. The letter states that the Highway 62 bridge is barely stable during a 500-yr event. The scour potential during the 500-yr event is down to six feet of remaining piling embedment depth. The criteria for stability is five feet. However, it is unknown if the dam was taken into consideration for the scour analysis.

Based on the conversation with MnDOT and a review of the plans, SEH concluded that removal of the dam would not change the conclusions of the scour analysis. The assumed ground elevation on the original plans is one foot above the proposed new channel elevation. If the scour analysis was done with the revised elevation, it would still provide the minimum protection depth for a 500-year storm event. However, with the proposed channel modification, the bottom depth of the river near the piers would actually be higher than the assumed ground elevation shown on the plans. With either option, there is a potential for maintenance needs at the bridge, which may include scour protection and abutment stabilization. A review of the scour analysis would be required by Mn/DOT if the pool is ultimately eliminated and if necessary redo the analysis based on the final ground elevation under the bridge.

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### 5.3.3 Flooding

The Flood Insurance maps and the associated hydraulic model were reviewed by the team. Based on the available information, it appears that during high flows, the dam has no impact on flood levels in Windom. Based on the Flood Insurance Study (FIS) maps, the flood elevations upstream of the Highway 60 bridge appear to be partially controlled by the bridge.

As indicated by the FIS maps and historic accounts, the park routinely floods. There is the possibility of minor modification to the flow paths during lower flows to limit park damage. However, during large major floods the park will be flooded whether the dam is there or not. Once a final option is chosen, it would be beneficial to analyze the elevation and flow patterns through the park during low flows. This would help to reduce the flooding as much as possible for events that are not be considered major floods. It does appear that none of the alternatives would reduce or increase flood profiles for the 100-year or 500-year events which are mapped by FEMA.

Historical Flows for the reach can be obtained from the United States Army Corps of Engineers, Rock Island District who operate a gage station near the golf course. This information provides historical data on the occurrence of flooding events and their impact on the final project. The table below provides a listing of the top eight flood events since 1969. Based on this information, it appears that the probability of large flood events has increased over the last 20 years. If this trend continues, the potential for dam failure may increase, along with the costs to maintain the structure or repair bank stabilization issues. Since there appears to be a strong correlation between past dam failures and high flows, the project costs will be higher to assure the

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structure is stable. A review of past projects indicates that more expensive options have been proposed. However, due to funding or other concerns, these projects were not constructed and may have contributed to past failures at the site.

Stage	Year
24.70	7/20/1969
21.90	4/04/1984
21.57	4/27/2001
21.37	3/30/1997
21.10	5/12/1993
19.77	7/07/1993
19.70	6/16/2007
19.50	5/05/2006

#### 5.3.4 Groundwater

Some homeowners near the pool have needed sump pumps in order to keep their basements dry. Since the failure of the dam and the loss of the historic pool, there have been indications of a lower water table through reports that residential sump pumps have not been running as frequently.

The rural water supply wells are located a few miles upstream of the dam. An observation at the County Highway 14 bridge near the golf course indicated that the water elevation may be down only a couple of feet. There is no indication that the loss of the pool has affected the rural water supply.

A monitoring well is also located near the County Highway 14 bridge. The data from this monitoring well indicates that the groundwater levels at this location are responsive to precipitation amounts. The monitoring well and precipitation data are located in **Appendix D**.

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### **5.3.5 Recreation**

Without a water pool, there will be a transformation from small lake-based recreational activities to riverine-based recreational activities. With the pool in place, access will be an issue since most of the pool is bounded by private land. This is due to the sediment build-up that has limited access in many areas. In the areas with access, the shallow water may limit use. In the public access area in Island Park, access to the river has been cut-off by sediment and plant growth. Whether the pool remains or not, it appears there will be challenges to maintain the area as a water-based recreational area.

### **5.3.6 Boating and Fishing**

Boat fishing is not a major interest in the historic pool area. Even if the dam remains, access is an issue because the only boat ramp upstream of the dam does not currently reach deep water during normal pool stage. Additional excavation of the sediment may be needed to make the area a viable fishing and boating area for outboard motor boats.

Some local residents fish from shore along the Des Moines River. With the pool in place, fishing from shore becomes less viable around the pool as sediment accumulates and water depths become more shallow.

Local residents have also ice fished in some of the pool areas. Thicker ice associated with a pool would allow for better ice fishing conditions.

However, water depths below the ice would continue to decrease as sediment accumulates in the pool, making ice fishing less viable.

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### **5.3.7 Canoeing**

The Des Moines River is conducive to canoeing because it lacks difficult rapids. The presence of a spillway dam requires canoers to portage around the obstruction in order to safely navigate the river. A rock riffle dam would be difficult for a canoe to navigate during periods of low flow.

### **5.3.8 Maintenance**

Required maintenance is dependant on the alternative selected. Likely maintenance activities include:

- Sediment removal
- Replacing riprap/boulders
- Debris removal
- Bank stabilization inspection and repairs
- Recreational amenities maintenance (boat ramps, docks, trails, etc.)

An estimate of future maintenance costs is included in the cost estimate for each of the final four alternatives. The key to the maintenance program is whether City Staff can complete the program or if an outside agency or consultant will be required. For example, for dam safety requirements, the DNR may complete the inspection and require repairs and thus the City has no control. If the dam is removed, then maintenance and inspection responsibilities will shift to the protection of the structures next to the river.

### **5.3.9 Slope Stability**

Some of the slopes along the historic reservoir are of questionable stability and could fail, regardless of the pool being in or out. With the pool out, the range of water levels can change within a shorter period of time, which could accelerate slope failures. Stabilization of certain key areas will be needed,

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but the type of solution will depend on the pool being in or out. For the pool out, the solution was assumed to be construction of 6 to 1 side slopes from the back property line into the floodplain. The area filled by the floodplain would be mitigated in floodplain areas to the west. With the dam out, the bridge abutment will be protected by training the river to go through the center of the bridge and away from the east abutment. This will allow for a flatter slope under this abutment. For the west abutment of the bridge the slope stability could be fixed by increasing the slope. With the dam out many areas adjacent to the pool would now be several hundred feet away from the main channel and thus vegetation can be established to provide natural bank protection. Based on current maps it appears that only about 2600 feet upstream of the Highway 62 Bridge would be directly impacted by the dam removal and thus a cost to provide bank protection in this area was included in the dam removal project costs.

#### **5.3.10 Public Safety**

The major safety issue has been the roller effect of the dam. If the dam is removed, the roller safety issue is removed. Since there is already a river system in a park setting (area downstream of the dam), changing the area from a dam pool to a river system would remain very consistent and appear not to increase any safety issues from the Highway 62 bridge downstream. Upstream, there could be potential safety issues during flood events for the dam removal alternatives. Changes to the emergency response and warning system may be required due to the much wider floodplain for floods in the area upstream of the Highway 62 bridge.

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## **6.0 Potential Studies**

Environmental Assessment

Hydraulic and Scour Analysis

Geotechnical Investigation and Analysis

Structural Analysis

## **7.0 Data Needs**

Surveying will need to be completed during the final design phase.

## **8.0 Costs**

### **8.1 Construction Costs**

### **8.2 Funding Opportunities**

The largest potential funding source for Windom will likely be the DNR. A description of the applicability for DNR funding is below. Additional potential funding sources have been identified in **Appendix E**.

#### **DNR Dam Safety**

Grant funding from the DNR Dam Safety division will be available as long as the project demonstrates the elimination of the hydraulic roller effect and meets the standard engineering design requirements.

#### **DNR Ecological Resources**

The DNR Ecological Resources division will determine their contribution based on the promotion of fish passage and restoration of the natural riverine system.

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**8.3 Long Term Costs**  
Maintenance

rsn

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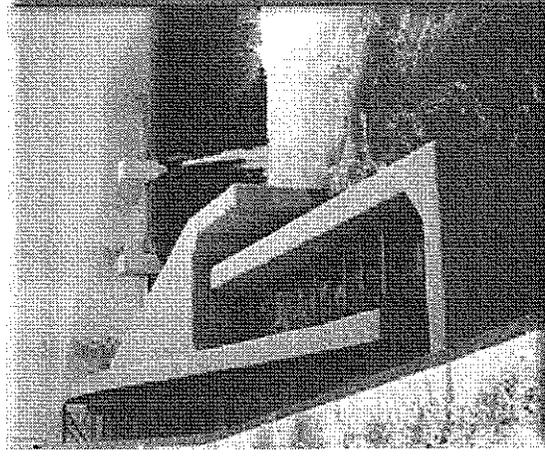
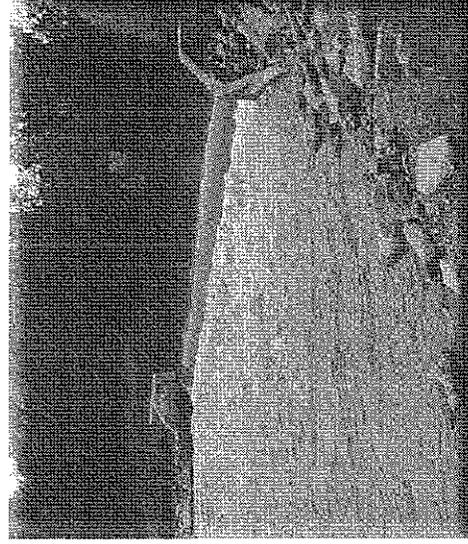
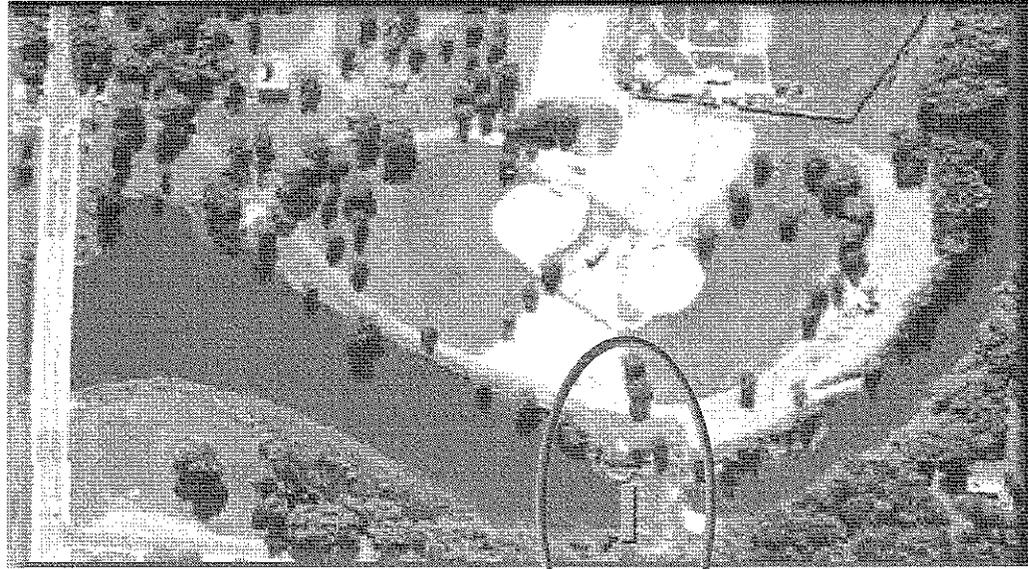
## **Appendix A**

Alternative Concept Images

# Des Moines River Dam Feasibility Study

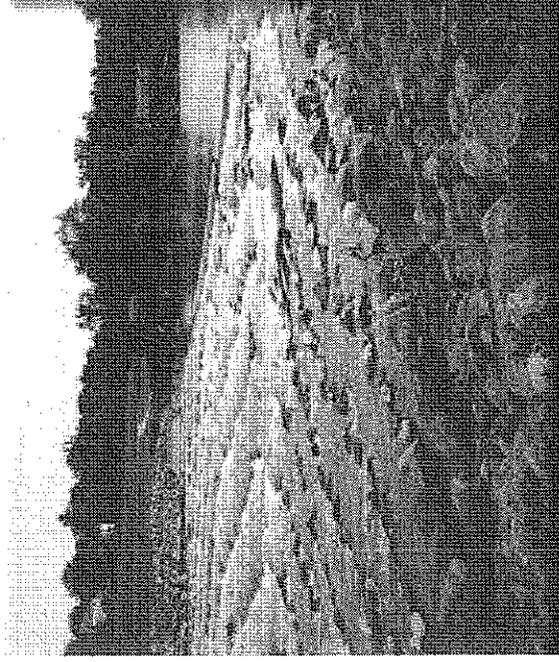
Windom, Minnesota

## Alternative 1 - Dam Function Retained Repair Existing Dam and Add Spillway



- Add a wide concrete spillway east and next to the current dam
- Include a concrete fish passage
- Eliminate the downstream roller impact with large rocks
- Install a pipe and upstream outlet structure to allow drawdown of water

## Alternative 3 - Dam Function Retained Rock Riffle Dam Over Existing Dam

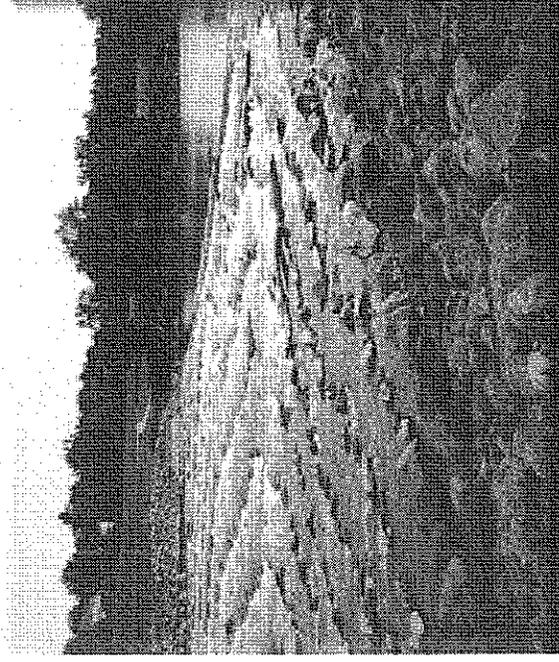
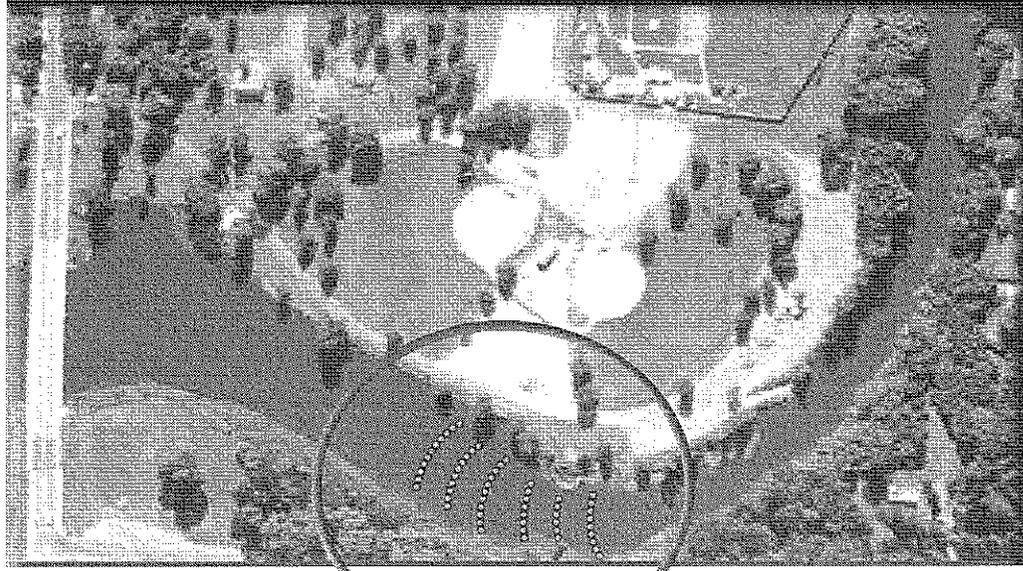


- Retain the existing dam
- Remove wing walls and construct the rock riffle dam over the current dam.
- Provide an outlet pipe with an upstream outlet structure to allow drawdown of pool water.
- Provides natural fish passage

# Des Moines River Dam Feasibility Study

Windom, Minnesota

## Alternative 4 - Dam Function Retained Upstream Rock Riffle Dam



- Remove the existing dam
- Construct first set of stream riffles near the current dam with the top of the dam about 200 feet upstream.
- Provide an outlet pipe with an upstream outlet structure to allow drawdown of pool water
- Provides natural fish passage

# Des Moines River Dam Feasibility Study

Windom, Minnesota

Alternative 7 - Dam Function Removed  
Remove the Dam and Stabilize Channel



- Remove the dam
- Provide some minor bank stabilization

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## **Appendix B**

Public Survey Results

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## **Appendix C**

### Project Alternatives Ranking Chart

## **Project Issues - Summarized**

### **Attractive water feature (pool)**

The key to being an attractive water feature is the benefits it can provide to the local residents and the proximity of other maybe more desirable water bodies. More study may be required, but based on the DNR information from their website, there are other larger more significant lakes within ½ hour drive of Windom and thus if the pool remains it would appear to be a very local destination area. Also, based on the proposed uses of the pool, it would not be available for some of the higher end uses such as larger boats for both fishing and recreational use such as water skiing. The access is also limited now which again reduces its use as destination water body for those outside Windom. As the only water body in Windom it could be attractive, but as regional water body would not be considered an attractive water feature. The other key concern to maintain it as a attractive water feature is the sediment build-up that has occurred and will occur in the future. It appears of left in its current state without any sedimentation removal plan, the pool would be just a wide river in this location which again impacts it perception of an attractive water feature.

### **Attractive water feature (river)**

In its current state, the river is not an attractive water feature, but could be with the restoration of the floodplain, addition of riffles in the river for fish habitat, additional trail construction and access points to and from the river. This will however required funding outside what is current allocated for the project (except the riffle installation which appears to be part of the project funding). It is recommended that a more comprehensive planning study be done to determine what could be the best future uses of the floodplain in this area if it is converted to a river and greenway system.

### **Bank stability**

The pool does provide stability to the banks of the river through a major portion of the community. The main benefit is that the water fluctuation in the river increase by about 6 to 8 feet during a typical highwater event. This problem has occurred in several rivers in the state of Minnesota. There are engineering solutions to the problems which include bank protection and drainage system behind the bank protection to make sure the area does not remain saturated and thus is more stable. A detailed study may be needed if visual inspection of each property does not warrant satisfactory cost estimate to mitigate the loss of the pool. The apartment complex was a key focus point and was reviewed by the Charrette team. They noticed there has been efforts to protect the area already even with the pool in and this area may have problems whether there is a dam or not. If the dam is removed, it would be beneficial to provide a more stable engineered system to protect bank area next to key structures if necessary. Since these are impacted by the dam removal, it may be possible to use the DNR dam removal funds to stabilize these areas.

### **Bridge Maintenance (Highway 62)**

With either option there is a potential for maintenance costs at the bridge. For the dam out alternatives, pier protection measure added would become part of the bridge inspection program to assure there is no scour occurring at the bridge. Also, the river flows in the late summer and fall are at a such a low level it provides a visual inspection of any significant scour of the bridge on an annual basis. If this scour were to occur with a dam in place, the higher water elevation could prevent the visual inspection of the piers. In the future a more expensive underwater exploration may be required.

### **Bridge scour (Highway 62)**

The Charrette Team reviewed the plans for the Highway 62 bridge and also visited the site. The SEH team concluded that the piers have been set at a depth there would be no damaging to the bridge if the dam is removed. If the dam is removed, there may be a need for some additional

riprap under the bridge so the scour protection meets current pier protection standards for bridges over rivers. The protection would be similar to that at the Highway 60 Bridge. MnDOT did indicate in a letter to the City they had a concern at the Highway 62 bridge for the 500-year floods.

### **Channel Restoration**

The assumption is that channel restoration may be a factor if the dam is removed. The key to the channel restoration will be whether or not funding is available to do more than install some rock riffles. If funding can be obtained, there are several options directly related to restoration of the channel such as upland habitat improvement, wetland restoration, re-meandering the river in a different locations and conversion of the floodplain to parkland.

### **Flooding**

The Flood Insurance maps were reviewed by the team. Based on all available information it appears that during high flows the dam has no impact on flood levels in Windom. It also appears the elevations of the river upstream of the Highway 62 bridge are controlled by the bridge opening. In conversation with the DNR, they also believe this to be the case. It was thus assumed for major flood events, there would be no impacts upstream of the Highway 62 bridge whether the dam remains or not. Also, historical records of flows from the USACE area available to review historic major flood events to evaluate any potential changes.

### **Improve upstream fish habitat**

With all alternatives that provide fish passage, there is a potential to improve the upstream fish habitat as more fish are able to move upstream. This does assume that the fish species numbers will increase in the pool if a dam is built. The fish species may already existing upstream and the real issue is habitat improvement and not fish passage. Thus there could be limited funding for a short riffle dam if it does not directly improve fish habitat. It will allow the fish to migrate upstream, but if there is not habitat upstream to go to, the fish passage may have limited value. There appears to be more DNR support for creation of riffles in a river system like Appleton, where several additional fish habitat areas can be created. It appears that a dam with a fish passage will have some benefit but does not have a strong value to improve upstream habitat unless additional upstream measures are undertaken to increase habitat.

### **Groundwater – local shallow wells**

The golf course currently uses ponds and wells for irrigation on their property to water the golf course. Besides the golf course, there may residents that have shallow wells along the river that could be impact by a long term lowering of the dam pool. A more detailed groundwater study would need to be undertaken if this becomes a critical issue. The depth of the wells would need to be reviewed as a preliminary check to determine if the wells will continue to provide adequate water supply. This information would provide some insight into the aquifer being used and thus whether the dam removal would be an impact. If dam removal has an impact, it may be necessary to include a cost to re-drill the wells deeper or hook up any private water system to the City water system. These cost could be included as part of the dam removal costs. With the dam in, the surface water table would be what it was at historically in this area so there should not be an issue with the wells.

### **Maintenance**

Maintenance cost will vary depending on the alternative chosen. In general, if the dam remains and the spillway is designed and construction correctly, there is limited maintenance cost except annual inspections and some minor repairs which should be easy to complete. If a riffle is built, there is always a potential for the rocks to move. The proposed project is planned to include some initial higher cost options such as sheetpile protection to limit the future maintenance costs. If maintenance is required, it may be more difficult to do if equipment can not reach the location where maintenance is required. If the dam is removed, there may be some bank stabilization maintenance. It was assumed the riffle have the potential for the highest maintenance costs.

### **Safety**

The major safety issue has been the roller effect of the dam. If the dam is removed the roller safety issue is removed. All alternatives with a dam in assumed the roller effect would be eliminated. Since there is already a river system in a park setting (area downstream of the dam), changing the area from a dam pool to a river system would appear not to increase any safety issues from the Highway 62 bridge downstream since the system would be very consistent. Upstream there could be potential safety issues during flood events for the dam removal alternatives. Changes to the emergency response and warning system for floods in the area upstream of the Highway 62 bridge due to the much wider floodplain may be required.

### **Sediment accumulation/Sediment removal**

Sediment is a major issue and has been historically a problem and won't disappear whether the dam is in or out. If the dam remains then the pool will act as a sediment trap and areas behind the dam will continue to fill and the pool volume continue to shrink. There is a strong possibility that without a sediment removal plan, the entire pool will fill with sediment and the system will become a low river one below the dam and a high river one above the dam with a very small pool of water. If the dam is removed the sediment will continue downstream. If the city is not committed to a future sedimentation removal plan then the need for the dam is greatly reduced since the pool for any significant water body will be gone.

### **Wildlife population**

There would be some change in the wildlife habitat from a pool environment to a river environment. However, the more diverse the environment the better it is and thus supports a wider range of wildlife. In the area of Windom, there are several open water bodies and thus there is not a need pure need for additional open water habitat. Thus it would be more of a local interest to attract water fowl. With the dam out and a planned restoration program, there is the opportunity to increase the variety of habitat with open meadows, wooded areas, backwater open water ponds, prairie areas, etc and thus the variety of wildlife would increase.

### **Amenity**

Based on the surveys it appears that whether the dam is in or out additional feature could be added to make the area an amenity. With the dam out new trails could be construction in areas that use to be under water, some riffles could be created similar to Appleton to create habitat based flow areas in the river that use to be pooled water areas, ect. If the dam is left in sediment removal may be required to increase this area as an amenity since it appears without the sediment removal in the future, the pool area may return to a river system but at a higher level then if the dam was in place.

### **Snowmobiling/ATV**

If the pool remains then there will be more public access to snowmobile and ATV areas since the pool area would be larger because the amount of public land reduces if ownership becomes to the center of the river. If a larger scale overall recreational plan is undertaken it would be possible to create snowmobile and ATV trails that could be used in this corridor by the public to offset the loss reduced water pool surface area. Also, there may be an opportunity to purchase the floodplain areas through a grant program and increase the size of the park.

### **Boat Fishing/Recreational Power Boating**

Without a pool of water there appears there would be no fishing from a boat and thus if boat fishing is a major factor, the dam would have to remain. Based on the surveys that were returned, it appears that boat fishing is not a major interest. Even if the dam remains, access would be an issue since the only current boat ramp upstream of the dam does not currently reach deep water during normal pool stage. Additional excavation of the sediment appears to be needed to make the area a viable fishing area for outboard motor boats.

### **Canoeing**

Canoeing type would be impacted by the dam removal since the area would go from a constant

low velocity pool area which is easy to canoe in all year to a river area which may limit canoeing. Depth of the river will be a factor in canoeing if the dam is removed. If it is determined river canoeing can be done during most of the year, then additional places to put in canoes upstream may be of value to provide short duration to all day excursions. If the dam is removed the system will be safer then with the dam in since there will not be a six to ten foot drop for a canoe to navigate over. Even with riffle options, there is a potential for over tipping as the canoe goes through the riffles at various flows.

#### **Fish passage**

All options considered some type of fish passage except leave the dam options as is with a spillway that is not fish passage friendly. The major problem with not considering a fish passage would be that part of the funding would be in jeopardy. If there is no dam, then fish passage is not an issue or needed. Funds would be allocated for more fish habitat improvement with in the river itself.

#### **Groundwater – wet basements**

One of the benefits of the dam removal is that it does reduce the long term water elevations of the river upstream of the dam. If homes adjacent to the pool have areas of their homes below or near the pool elevation they may be required to have sump pumps to make sure there is not basement damage. With the pool gone, this effect is greatly reduced and there may only be water problems during periods where the river is high due to river flood conditions. For a significant amount of time during the year, the water elevation would be at level that would reduce or eliminate use of sump pumps.

#### **More land available for public use**

If the dam is removed additional land will be available since major parts of the floodplain will not have permanent water over it. This will also allow access to the island that has been created by sediment build upstream of Highway 62. It appears the floodplain areas will become private property but due to its limited use it may be possible to purchase this land for a large park area upstream of the Highway 62 bridge all the way to the golf course. This would become a significant park area which could be used for several activities in the future.

#### **Park Flooding**

Based on the flood insurance maps the Island Park floods. There would be some possibility of minor modification to the flow paths during lower flows to limit park damage, but during large major floods the park will go underwater whether the dam is there or not. Once a final option is chosen, it would be beneficial to look at the elevation and flow patterns through park during low flows to reduce the flooding as much as possible from flow events that would not be considered major flood events.

#### **Shore Fishing**

With or without the dam this can be maintained. If the dam remains as a riffle dam it would create three fishing environments at the park. The calm pools downstream of the dam caused by backwater from the Highway 60 scour protection, the riffle areas and the pool upstream. If the dam is removed the fishing will be primary river based fishing and without some additional habitat creation could reduce fishing opportunities in the park. If fishing is a main activity in the park, and the dam is removed, then additional funding should be sought to provide habitat that is beneficial to fishing and is also accessible by the public.

#### **Trail System**

If the dam remains the only place for a trail system would be the island areas that were caused by the sedimentation. Access to the trail could be an issue since land is privately owned on the north side of Highway 62. If the dam is removed the land may become private land and thus would need to be purchased for a trail. Whether the dam remains or not there would be option for a trail system north of the Highway 62 bridge and thus this factor has equal weight whether or not the dam.

#### **Tubing**

With a river system there could be tubing from the bridge at the golf course to the park. With a dam this is not a possibility. The potential problem would be most of the area would go through private property which may be an issue if the land is not purchased as a park. Thus there may be a need to have stopping points on the west bank if this is a planned activity. During the late summer there may also be a problem with not enough water to tube down the river.

#### **Water quality**

Because of the sediment loads upstream of Windom, the water in the pool from the dam would not be of high quality. There is a potential benefit of the dam and pool as sediment trap and thus has the potential to improve the water quality downstream of Windom. If the dam remains and the sediment continues to be trapped, over time the entire pool area will fill with sediment and the pool will for the most part just be a higher river. With the dam out the upstream sediment will pretty much pass through Windom and thus the quality of the river water will be variable throughout the year depending on the sediment loads from the watershed which varies throughout the year as the agricultural land used changes from tilled fields, to crops with chemicals, to harvested fields.

#### **Greenway**

There was some support for planned restoration of the river corridor if the dam is removed, but even with the dam in place it appears the island upstream of the Highway 62 bridge may remain and thus could be used as part of river corridor plan. We don't think this is a major factor in whether the dam remains or not. Either way we would recommend a regional trail study is done to see what land is available and whether it can be used for trails. If it becomes private land with the dam removed, it may be beneficial to look for funding to purchase land or easements next to the river on the west side to assure future trail access in this location. If the trail is a major factor and it cannot be done due to land acquisition requirements with the dam removed then the dam remaining may be a benefit. A search of the DNR database was done to determine the availability of other recreational lakes in the area. There are several additional opportunities such as Cottonwood Lake within driving range of the lake. What was not researched was the availability of river based or greenway recreation activities such as trail. Transformation from a water based recreation activity to river based, if done with some planning, could provide more potential activities than the dam and pool.

#### **Ice Thickness**

With a lake the ice is thicker, however the area could be converted into manicured snowmobile or ATV trails which do not rely on ice. The thicker ice would allow for ice fishing which would not be possible with a river system. Although a point of discussion, it appears this is not a major factor in whether or not the dam remains.

#### **Mosquitoes**

This is linked to the issue of water puddles. If the water puddles issue can be resolved then the habitat for mosquitoes will also be reduced. If the dam is removed it would be beneficial to work with the local experts and identify potential breeding areas and then eliminate them through channelization or re-vegetation.

#### **Stagnant Water**

Because there are remnants of old flow channels in the system, there will be areas that after highwater will become shallow water pools and may become stagnant. If the dam is removed, these areas would need to be evaluated to determine if additional channelization is required to eliminate this problem. These could also be converted to wetland areas and which creates more diversity to the river environment.

#### **Weed growth**

This will be a problem with the dam in or dam out since even with the dam the sediment accumulation as created areas that have been overgrown with weed already. The area will be in transition no matter which option is picked and weed growth can be a potential issue. This was one of the questions in the survey and many that responded did not think it was a major issue.

One to the primary future recommendation would be a planning study to determine the best use of the area for recreational purposes, land ownership, and final restoration requirements. This will be an issue for any alternative so should not be a major factor in the decision process.

#### **Riverfest**

The residents would have to determine the impact of the dam being in or out on Riverfest. This was one question asked on the survey and over 70% of the respondent indicated it did not matter whether the dam was in place or not. It thus appears that events would have to be modified to fit a non-dam environment but appears it would not be a problem to do. The event is titled Riverfest which implies there is a river environment and thus without the dam it would be more of a river based event.

#### **Fire hazard in floodplain**

If the dam is removed there is a strong possibility the large vegetated areas will become privately owned. This would make them the responsibility of the property owner and thus it would be in their best interest to reduce the fire hazard. If the dam remains and the large island is not removed, then there is some ownership question and reduction of the area as a fire hazard may need to be done by the City and thus may require a maintenance program which currently does not exist.

#### **Permitting**

The permit requirements will depend on the final option chosen. It is anticipated that DNR, MPCA, USACE permits will be required. Since the project type being done is consistent with several similar projects in Minnesota the permit agencies are aware of the requirements and thus should be able to clearly determine what is needed to be done to meet their requirements.

#### **Boat launch**

The current boat launch upstream of the dam has been made inaccessible by the vegetation growth and would require additional sediment removal to make it functional again if the dam pool remains. If the dam is removed the boat ramp appears not to serve a purpose, unless the river is re-meandered to it. It is also not necessary if the dam is removed since the downstream boat ramp can be used for river access if needed. If the dam remains and the pool is functional there may be a safety reason to restore the use of the ramp with some sediment removal. In the event boats are needed for an emergency upstream of the dam, this would be the logical place for a boat ramp.

#### **Sediment Load Downstream of Dam**

There is some debate whether sediment in a river system is good. If a river already has a heavy sediment load it is less likely to look for other sources of sediment (banks) to make up the sediment load the water can carry. With the dam in the sediment is greatly reduced prior to going downstream of the dam and thus additional bank erosion could be occurring. If the dam is removed this may reduce some of the bank erosion. Whether the dam is in or out it appears some type of erosion protection will be required downstream of the current dam.

#### **Flowage easements/land ownership**

This was addressed by the City Attorney. It appears that if the dam is removed there is a strong possibility that the land owners adjacent to the river would now own to the center of the channel. For those on the west side of the river upstream of the Highway 62 bridge, there could be an increase in property depth by 400 feet. This will be floodplain and have limitations on its use. One consideration would be to obtain funding for the purchase of the property and make it an extension of island park. If the dam remains and the sediment continues to increase land areas and reduce pool area then the land ownership question becomes a little more difficult since areas that use to be underwater and are owned by the state, now become islands or areas that are accessible to property owners.

#### **Headcutting/bank sloughing**

This is a potential problem throughout the entire reach of the river even in areas not impacted by the dam. If the pool remains the bank areas will be more stable. However, with the dam

removed there are mitigation action that could be done to greatly reduce or eliminate future problems. As part of the habitat restoration money, the main channel could be re-meandered further away from the steeper banks next to the homes. Vegetation would then establish in the flood areas between the homes and river channel that would stabilize the banks. The banks can also be protection with riprap or similar with adequate drainage to make sure the area does not remain saturated other then when it is at highwater.

### **Timing**

As part of the Charrette team meeting a do nothing option was discussed. The purpose of this discussion was to determine how urgent the project is. It appears the system has for the most part stabilized and can go through another summer with out a total dam failure. The other issue that has been brought up is why not fill the failure on the east side of the dam now. It appears that in the early 80's a rock spillway was built in this location which of course failed. If the area is refilled and high flows again occur there is a good chance that it will also fail, so spending any money on a temporary fix would appear not to be justified if the dam is stable. Any temporary fix need to be 100% funded by the City. If there is an advantage of not doing a temporary fix, it is the sediment load for this year will pass through the system and thus there will be not be any changes to the available pool area if the dam is restored.