5 Strategies and Plan of Action

Iowa's 2010 plan for dam mitigation is a compilation of strategies and action items integrating a series of new approaches as decisions are made about increasingly decrepit infrastructure. These goals address multiple needs mitigation projects will need to meet.

Goal One: Address local and statewide needs by addressing failing dams before they fail

- Avoid potential loss of life from flood or harmful rapid releases of sediment downstream after dam breaches
- Listen carefully to stakeholder concerns and clearly identify problems early in the process
- Coordinate with Iowa DNR dam safety program to identify structural problems
- Focus on solving community problems with cost-effective river restoration techniques using local, federal, state, private, and non-governmental assistance
- Thoroughly vet project designs to mitigate infrastructure, sediment, or ecological problems

Goal Two: Mitigate threats to recreational public and liabilities to dam owners

- Reduce public liability at state-owned low-head dams via warning signage, appropriate launch / landing / portage trail development outlined in Chapter 6 of the 2010 water trails development manual
- Use structural mitigations such as removal or conversion to rapids to further reduce public liability at state-owned low-head dams
- Reduce frequency of Iowa deaths at human-made dams on Iowa's navigable streams through education, warnings, and structural dam mitigation
- Enhance river navigation and diverse recreation including angling, innertubing, or whitewater recreation

Goal Three: Enhance fish and mussel integrity and reduce biological harm

- Enhance effects for river connectivity for overall river species abundance.
- Consider targeted species recovery / recolonization in specific project areas
- Counter spread of aquatic invasive species such as Asian carps and zebra mussels

Goal Four: Maximize public funds by uniting fish passage, safety, and recreational navigation goals and resources in dam mitigation projects

- Require communication and structured listening approaches from first phase forward to ensure project is as responsive as possible to local needs
- Aid public understanding via examples that have solved multiple problems using diverse revenue sources

Table 5-a: Relative factors to determine mitigation function; 1' to 15' high structures*

Mitigation approach	"Drowning machine" reduction	Potential for upstream flood damage reduction	Social / economic function of dam and impoundment retained or stabilized	Aquatic connectivity / fish passage achieved	Sediment transport normalized / pool habitat improved	Economic development enhanced	Avoids potential project site constr. access and control problems	Relative typical design cost	Relative typical constr. costs	Relative 30-year maint.
Removal with stream restoration	●●●●●	●●●●●		●●●●●	●●●●●	●●●●●	●●	$$$	$-$$	none
Simple or staged removal	●●●●●	●●●●		●●●●●	●●●●●	●●●●●	●●●●	$$	$	$
Rock arch rapids	●●●●●	●	●●●●●	●●●●●	●	●●●●●	●●●●	$$	$$	none
Grouted rock arch rapids	●●●●●	●	●●●●●	●●●●●	●	●●●●●	●●●●	$$	$$	$$
Crest reduction with rock arch rapids	●●●●●	●●●●	●●●	●●●●●	●●●●	●●●●●	●●●●●	$	$	none
Whitewater course	●●●●●	●●●●	●●●●●	●●●●	●	●●●●●	●●●●	$$	$$$	$$$
Safety-only structures	●●●●●		●●●●●				●●●●●	$$$	$$$	$$
Side-channel passage (boat or fish)	●	●●	●●●●●	●●●●		●●	●●	$$$	$$$	$ - $$
Partial channel passage (boat or fish)	●	●	●●●●●	●●●●	●●●●●	●●●●●	●●●●	$$$	$$$	$-$$

* Factors for taller structures are more individualized and cost factos may change significantly by site. Site issues and relative importance of each factor will change from project to project.

Figure 5-b: Planning and design phases for mitigating publicly owned dams

A. Project application

1. Dam owner files letter of intent with Iowa DNR
2. Acknowledgement
3. Review project versus priorities
4. Project queued or or denied.
5. Develop project agreement

B. Notifications

1. US Fish and Wildlife Service fish passage program
2. DNR Fisheries Management Unit Biologist
3. DNR Dam Safety
4. DNR Engineering survey project request
5. Potential partners

C. Data collection

1. Existing upstream / downstream fishery data
2. Develop aerial base map of project area
3. Calculate stage-discharge recurrence data at nearest gauging station (s)
4. Geological papers related to river or its region

D. Early review

1. Request dam safety inspection reports (DNR Dam Safety)
2. Infrastructure functions review (Local / state engineers)
3. Environmental review (DNR Sovereign Lands)
4. Early public listening via project open house, web survey, or other techniques.
5. Cultural review (SHPO)
6. Floodplains / FEMA flood area review (DNR Floodplains)
7. Identify and collect potentially affected infrastructure data (upstream well logs, bridge pier/ abutment plans, etc.)
8. Identify pricing / quality of stone available

PHASE 1: Exploratory Report

Constraints and opportunities are identified that will guide goal setting, field work, and design parameters.

Report discussed and approved by dam owner before signing and moving to phase 2.

1. Exploratory

E. Field survey

1. Morphological / engineering survey
2. Photograph
3. Engage dam owner or local volunteer to record stage at submergence flow level
4. Note condition of dam
5. Mussel reconnaissance
6. Depth of refusal probing in impoundment and ID bed materials
7. Identify potential downstream erosion areas
8. **Potentially needed:**
   - fish assemblage
   - full aquatic community
   - full mussel survey
   - archaeological review
   - HEC RAS model
   - federal EA or EIS
   - wetland delineation

F. Assessment

1. Quantify potential sediment release at crest elevations and compare to annual sediment load estimate for stream
2. Identify additional needs for stream restoration
3. Process data for stage analysis and shear stress, maximum particle size mobilized, and other parameters

G. Evaluate alternatives

1. **All projects** mitigate for safety hazards, avoid harmful sediment releases, and improve or have little effect on upstream flood conditions
2. **Most projects** require fish passage and improved angling opportunities at the project site
3. **All projects balance** the following needs:
   - respect of local needs
   - stability
   - cost
   - flood reduction
   - infrastructure function
   - invasive species prevention
   - rare species protection
   - recreation
   - navigation
   - habitat improvements
   - stream restoration
   - tourism / economic development

Phase 2: Project Determination

Report with template application or early conceptual drawing(s) and rough costs are reviewed and publicly discussed. Reactions are considered. Partners and dam owners agree on direction before moving to phase 3.

2. Project Determination

H. Preliminary design

1. Preliminary design and cost estimate developed by qualified stream restoration professional and/or engineer
2. Approved by dam owner and project partners; funding sought
3. Preliminary design shared on project Web site

I. Permit submission

1. Submit preliminary design to regulators
2. Always includes joint application to DNR Floodplains, Sovereign Lands and USACE for Section 404
3. May be subject to Section 106 environmental / cultural review
4. Local floodplain permit may be required

J. Implementation

1. Adjust toward final construction design throughout permit process.
2. Assemble final funds
3. Structure bid process
4. Construct project

Monitoring Report

Survey and report on stability after bankfull flood.

3. Design and Implementation

Dams with strong potential in combined mitigation benefits

Dams with overlap safety / navigational and biological connectivity benefits

Tier 1 Overlap:

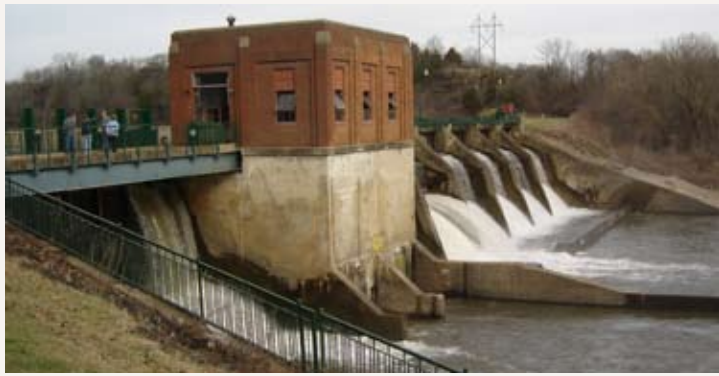
Dams meeting 75th percentile or greater for safety and biological categories (See Table 5-2, next page).

Tier 2 Overlap:

Dams meeting 50th percentile or greater for safety and biological categories (See Table 5-3, next page).

Filtering factors

hydroelectric dams, asian carp barrier dams, large impoundment dams, over 15' tall, over 200' wide, already being mitigated, social / practical issues



Not a priority. Dams that may otherwise have met first tier analysis were filtered out. The Lakehurst Dam is both a power-generating dam, and likely protects the Maquoketa River from Asian carp infestation. Therefore, it was filtered out of the listings.

Tier 1

ID	Dam_Name
But-4	Shell Rock Mill Dam
Cer-18	Jackson Avenue Dam
Cer-5	Fourth Street Dam
Cer-7	East Park Slide Dam
Cer-8	Rock Glen Dam
Cer-9	Pennsylvania Avenue Dam
Del-3	Manchester Dam
Dub-2	Cascade Falls Dam
Flo-2	Charles City Beauty Dam
Flo-4	Rockford Dam
Fra-2	Harriman Park Dam
Jac-2	Prairie Creek Ford
Jon-3	Mon-Maq Dam
Lin-4	Palisades-Kepler Dam
Lyo-2	City Park East Channel Dam
Lyo-6	City Park Big Ford
Web-4	Clare Gaging Dam
Web-5	Lizard Creek Mill Dam
Web-6	Trestle Weir
Win-2	Upper Dam
Win-3	Weist Mill Dam
Woo-3	4th Street Dam

Tier 2

ID	Dam_Name
Bla-3	Park Avenue Dam
Bla-4	Sixth St. Dam
Bla-7	Pioneer Park Structure/Water Line
Bre-1	Frederika Dam
Bre-2	Waverly Dam
Buc-2	Littleton Mill Dam
Buc-3	Independence Low Dam
Cer-11	12th Street Dam
Cer-13	Illinois Street Dam
Chi-1	Buckley Rock Dam Ford
Del-2	Quaker Mill Dam
Ham-3	Webster City Dam
Hum-5	Corn Belt Power Dam
Jon-2	Oxford Mills Dam
Lin-5	Troy Mills Dam
Lin-7	Buffalo Creek Park Dam
Lyo-1	Rock Rapids Dam
Sto-6	East River Valley Park / 13th St. Dam
Web-1	Ft. Dodge Hydro Dam
Web-2	Little Dam
Woo-5	Dace Avenue Dam
Wor-2	Northwood Dam

Limitations of GIS-based process

These listings apply broad, statewide datasets for use by agency staff to assist in technical assistance and funding priorities. See Appendix B and Appendix C for details on the process used. A listing indicates of agency support for potential projects, and areas where outreach may be effective for local projects. In no way are the owners of the above dams required to take any immediate actions. More specific information can be incorporated that could reduce priorities for the listed dams, or could help other dams become a higher priority.

Table 5-b: 75th percentile and greater for both safety / navigational and biological categories

ID	Dam_Name
But-4	Shell Rock Mill Dam
Cer-18	Jackson Avenue Dam
Cer-5	Fourth Street Dam
Cer-7	East Park Slide Dam
Cer-8	Rock Glen Dam
Cer-9	Pennsylvania Avenue Dam
Del-3	Manchester Dam
Dub-2	Cascade Falls Dam
Flo-2	Charles City Beauty Dam
Flo-4	Rockford Dam
Jac-1	Lakehurst Dam
Jon-3	Mon-Maq Dam
Lin-4	Palisades-Kepler Dam
Lyo-2	City Park East Channel Dam
Lyo-6	City Park Big Ford
Web-4	Clare Gaging Dam
Web-5	Lizard Creek Mill Dam
Web-6	Trestle Weir
Win-1	Lower Dam
Win-2	Upper Dam

Filtering, and other priorities

Structures filtered out in the process may still offer benefits if a project is pursued. However, factors will need to be examined on a case-by-case basis as projects come forward from communities. Evidence of changed conditions—such as decommissioning of a hydroelectric facility, Asian carp moving up a barrier dam—will be taken into account as projects are presented.

While this plan emphasises combined priorities, there will also be project areas where combined priorities are not sensible. On small, non-navigable streams there are needs for fish passage at small dams and culverts, which will be pursued with appropriate assistance and funding. Conversely, where fish passage is to be discouraged due to invasive species issues, safety-only priorities may be considered. At large dams where river-wide solutions would be impractical, partial channel solutions may be considered. Revenues appropriate to each aspect of the mitigation should be commensurate to the in the solution. For example, in the case of highly recreational projects, local funding or economic development revenues should comprise part of the project.

Table 5-c: 50th Percentile and greater for both safety / navigational and biological categories

ID	Dam_Name
Bla-1	Cedar Falls Dam/Center St. Dam
Bla-2	Clay Hole
Bla-3	Park Avenue Dam
Bla-4	Sixth St. Dam
Bla-7	Pioneer Park Structure/ Water Line
Bre-1	Frederika Dam
Bre-2	Waverly Dam
Buc-2	Littleton Mill Dam
Buc-3	Independence Low Dam
Buc-4	Independence Mill Dam
Buc-5	Quasqueton Dam
But-1	Greene Dam
But-3	Heery Woods Park Dam
But-4	Shell Rock Mill Dam
Cer-11	12th Street Dam
Cer-13	Illinois Street Dam
Cer-18	Jackson Avenue Dam
Cer-5	Fourth Street Dam
Cer-6	Lagoon Diversion Dam
Cer-7	East Park Slide Dam
Cer-8	Rock Glen Dam
Cer-9	Pennsylvania Avenue Dam
Chi-1	Buckley Rock Dam Ford
Chi-2	Cedar Lake Dam
Del-2	Quaker Mill Dam
Del-3	Manchester Dam
Del-4	Pin Oak Park Dam
Del-5	Lake Delhi Dam
Dub-2	Cascade Falls Dam
Flo-1	Main Street Dam
Flo-2	Charles City Beauty Dam
Flo-3	Nora Springs Dam
Flo-4	Rockford Dam
Flo-5	Marble Rock Dam
Ham-3	Webster City Dam
Har-1	Alden Dam
Har-2	Iowa Falls Dam
Har-3	Steamboat Rock Dam
Hen-1	Oakland Mills Dam
Hum-5	Corn Belt Power Dam
Iow-1	Amana Millrace Diversion Dam
Jac-1	Lakehurst Dam
Jas-1	Wagaman Mill Dam
Joh-1	Iowa River Power Company Dam
Joh-2	Burlington Street Dam
Joh-3	Rapid Creek Gaging Dam
Joh-7	Coralville Dam
Jon-1	Anamosa Dam
Jon-2	Oxford Mills Dam
Jon-3	Mon-Maq Dam
Lin-2	C Street Roller Dam
Lin-3	5-in-1 Bridge & Dam
Lin-4	Palisades-Kepler Dam
Lin-5	Troy Mills Dam
Lin-6	Pinicon Ridge Park Dam
Lin-7	Buffalo Creek Park Dam
Lyo-1	Rock Rapids Dam
Lyo-2	City Park East Channel Dam
Lyo-3	Klondike Mill Dam
Lyo-6	City Park Big Ford
Mit-1	Stacyville Dam
Mit-2	Otranto Mill Dam
Mit-3	St. Ansgar Mill Dam
Mit-4	Mitchell Mill Dam
Mit-5	Interstate Power Dam/ Old power Dam
Mit-7	Rock Creek Village Ford
Mit-8	Rock Creek Village Dam
Mon-2	Bed Grade Control Structure
Mon-3	Bed Grade Control Structure
Sto-6	East River Valley Park / 13th St. Dam
Wap-1	Market Street Dam
Web-1	Ft. Dodge Hydro Dam
Web-2	Little Dam
Web-4	Clare Gaging Dam
Web-5	Lizard Creek Mill Dam
Web-6	Trestle Weir
Win-1	Lower Dam
Win-2	Upper Dam
Woo-5	Dace Avenue Dam
Wor-1	Fertile Mill Dam
Wor-2	Northwood Dam
Wri-1	Goldfield Dam

Action Items for Dam Mitigation

This plan addressed goals by achieving the following outcomes:

- Responded to legislation by developing goals, strategies, and template approaches to mitigate public hazard and other problems with dams on major rivers statewide.
- Developed an updated inventory of dams on major rivers in Iowa.
- Formed sensible dam mitigation strategies based on listening closely stakeholders.
- Focused on on developing solutions to problems for both dam owners and the broader public.
- Developed conceptual templates that collectively address numerous situations encountered at small dam sites.

Many goals were met and tasks accomplished in the two-year effort to develop this plan. Important tasks remain, however. The following list prioritizes this work:

Tasks for the Short-Term (by 2014):

- Findings of this plan should be incorporated into mitigation efforts of the DNR and communicated among bureaus (specifically, floodplains, fisheries, wildlife, law enforcement, and parks bureaus) and to other state and federal agencies.
- Priorities and approaches will be adopted in funding guidelines and applicable administrative rules for the low-head public hazard program and communicated with other state and federal funders.
- As existing projects are completed, communicate findings of plan and potential for collaboration with potential priority dam owners.
- Collaborate with DNR floodplains / dam safety and fisheries to require sediment stabilization protocols in case of dam failure at appropriate dams.
- Develop phased planning, technical assistance, and funding assistance approaches from individual projects; develop reports that will help policy makers assess project-by-project benefits and costs in funding decisions.

Long-Term Tasks (3 to 10 years):

- Document and monitor project areas for stability and biological response, and compare effectiveness of techniques over a long term.
- New structures will continue to be needed to address needs such as grade stabilization or stream crossings. Reach out to and provide education for engineers to incorporate stable projects that enhance biological connectivity and the latest ecologically friendly techniques wherever sensible.
- Study Asian carp success to better understand which streams they are likely to severely impact, and potentially weigh against advantages to connectivity to the Missouri and Mississippi rivers for those less likely to have severe impacts.
- Solidify requirements and approaches for fish passage and navigational improvements at larger dams and at barriers on smaller streams.

Conclusions

Solving Dam Problems: The 2010 Plan for Dam Mitigation *carves new directions regarding mitigation of common problems dams can cause on Iowa major waterways. It integrates and visually communicates the ideas and needs of many Iowans, while balancing those with ecological needs. It demonstrates viable alternatives to infrastructure that in many cases is literally falling apart. This plan forms flexible early strategies for mitigation projects resulting in public benefits of statewide importance, using techniques likely to find local acceptance at a range of costs. Taken along with warning signage, education, and portage trail guidelines identified in "Developing Water Trails in Iowa", a comprehensive set of strategies for fatality reduction, ecological connectivity, and other problem mitigation at major river dams now exists.*

Major rivers are challenging places to work. A successful dam mitigation effort will develop through the efforts of many volunteers, as well as local, state and federal agency staff.

Dams often represent strong emotional attachments and sometimes are a major source of community identity. Each mitigation effort needs to respect that by listening carefully to local concerns and needs without pre-supposing exact outcomes.

In all cases related to dams, professional guidance at the project level is advised. Complex projects relating to dam modification or removal, often require both social and hydrologic inquiry and attention. The right experts may be skilled planners or facilitators, stream restoration professionals, and / or engineers. As multiple steps, ongoing project management, and permtis are required, an experienced planner or coordinator can be essential for pulling a vision together into a completed project.

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Appendix A: Raw Responses to Dam Owner's Survey

Question	Response option	Total Responses*
How Acceptable is the Condition of the Dam?	Very Acceptable	49
	Somewhat Acceptable	51
	Somewhat Unacceptable	28
	Very Unacceptable	20
	Not Sure	22
	Other	7
Do You Believe your Dam…	Provides a Barrier to Fish Movement	Yes - 93
		No - 53
	Provides a Barrier to Navigation & Recreational Use	Yes - 82
		No - 66
	Reduces Biological Diversity in the Stream	Yes - 39
		No - 96
	Affects the Nearby Water Table Elevation	Yes - 48
		No - 88
How Open Are You to Considering a Modification?	Very Open	55
	Somewhat Open	31
	Probably Not Open	14
	Definitely Not Open	18
	I Need More Info	32
	Don't Know	11
	Other	2

* of 163 surveys completed

Question	Response option	Total Responses*
Current Stream use	Agricultural Purposes	16
	Fishing	115
	Boating	68
	Swimming	42
	Hunting	37
	Other Land-based Recreation	82
	Don't Know	5
	None	23
	Other	30
Benefits Dam Provides at Area of Stream	River Crossing	15
	Utility/Pipeline Protection	12
	Stream Channel Stabilization	37
	Water Supply	18
	Flood Control	19
	Enhanced Water Quality	45
	Aeration	25
	Wildlife Habitat	48
	Fish & Aquatic Habitat	73
	Historic Value	45
	Visual Interest	59
	Fishing	91
	Hunting	18
	Agricultural Purposes	7
	Upstream Impoundment	59
	Hydropower Generation	9
	None	7
	Don't Know	7
	Other	17
Why Was the Dam Originally Constructed - What Was Its Purpose?	Stream Bed Stabilization	31
	Hydropower Generation	33
	Fishing and Recreation Purposes	27
	Hunting Recreation	6
	Habitat	15
	Agricultural Use	3
	Mill or Business Function	39
	Flood Control	13
	Create Impoundment Upstream	34
	Don't Know	17
	Other	34
What Problems May Possibly Exist With Your Dam?	Upstream Siltation	74
	Debris Collection at High Water	66
	Stream and/or Channel Erosion	45
	None	21
	Don't Know	18
	Other	22

* of 163 surveys completed

Appendix B: Dams ranking high in relative risk analsyis

75th percentile and greater

ID	Dam_Name
Bla-3	Park Avenue Dam
Pol-1	Center Street Dam (Des Moines)
Joh-2	Burlington Street Dam
Joh-1	Iowa River Power Company Dam
Lin-4	Palisades-Kepler Dam
Lin-2	C Street Roller Dam
Bla-1	Cedar Falls Dam/Center St. Dam
Jon-3	Mon-Maq Dam
Iow-1	Amana Millrace Diversion Dam
Jon-1	Anamosa Dam
Buc-5	Quasqueton Dam
Lin-5	Troy Mills Dam
Boo-2	Boone Waterworks Dam
Del-4	Pin Oak Park Dam
Bla-4	Sixth St. Dam
Dal-3	Adel Island Park Dam
Bre-2	Waverly Dam
Wap-1	Market Street Dam
Har-1	Alden Dam
Web-2	Little Dam
Hum-5	Corn Belt Power Dam
Bla-2	Clay Hole
Pol-2	Scott Street Dam
Flo-1	Main Street Dam
Mit-3	St. Ansgar Mill Dam
Mit-2	Otranto Mill Dam
Flo-2	Charles City Beauty Dam
Har-2	Iowa Falls Dam
Web-1	Ft. Dodge Hydro Dam
Buc-4	Independence Mill Dam
Har-3	Steamboat Rock Dam
Flo-3	Nora Springs Dam
Boo-1	Fraser Dam
But-4	Shell Rock Mill Dam
Buc-3	Independence Low Dam
Lin-3	5-in-1 Bridge & Dam
Lin-6	Pinicon Ridge Park Dam
Pol-5	Fleur Drive Dam
Mit-4	Mitchell Mill Dam
Chi-2	Cedar Lake Dam
Buc-2	Littleton Mill Dam
Dal-1	Redfield Dam
Sto-6	East River Valley Park / 13th St. Dam
Del-5	Lake Delhi Dam
Jac-1	Lakehurst Dam
Lyo-3	Klondike Mill Dam
Flo-5	Marble Rock Dam
But-1	Greene Dam
Flo-4	Rockford Dam
But-3	Heery Woods Park Dam
Wor-2	Northwood Dam
Web-6	Trestle Weir
How-3	Lidtke Mill Dam
Woo-5	Dace Avenue Dam

50th to 74th percentile

ID	Dam_Name
Woo-2	6th Street Dam
Woo-4	11th Street Dam
Woo-6	Dam at the Mouth
Sto-7	Veenker Golf Course Ford
Woo-3	4th Street Dam
Sto-5	Lincolnway Gaging Dam
Dal-2	Adel North Dam
Cer-11	12th Street Dam
Cer-13	Illinois Street Dam
Del-2	Quaker Mill Dam
Del-3	Manchester Dam
Joh-7	Coralville Dam
Fay-2	Maynard Dam
Emm-3	South Riverside Park Dam
Win-3	Weist Mill Dam
Sto-3	Sleepy Hollow/Hannum's Mill
Hen-1	Oakland Mills Dam
Mit-5	Interstate Power Dam/Old power Dam
Wor-1	Fertile Mill Dam
Bla-7	Pioneer Park Structure/Water Line
Del-1	Backbone Lake Dams
Jon-2	Oxford Mills Dam
All-1	Mississippi Lock and Dam 9
Win-2	Upper Dam
Win-1	Lower Dam
Hum-2	Reasoner Dam
Hum-1	Rutland Dam
Fay-9	Wacouma Mill Dam
Bue-1	Linn Grove Dam
Jas-1	Wagaman Mill Dam
Lyo-1	Rock Rapids Dam
How-1	Vernon Springs Dam
Mit-1	Stacyville Dam
Chi-1	Buckley Rock Dam Ford
Cer-8	Rock Glen Dam
Osc-1	Ashton Dam
Bre-1	Frederika Dam
Mon-2	Bed Grade Control Structure
Mon-3	Bed Grade Control Structure
Gut-1	Lenon Mill Dam
Fay-4	Clermont Dam
Lyo-2	City Park East Channel Dam
Wri-1	Goldfield Dam
Obr-1	Sheldon Waterworks Dam
Cer-7	East Park Slide Dam
Cer-9	Pennsylvania Avenue Dam
Ham-3	Webster City Dam
Cly-2	Elkader Little Dam
Web-4	Clare Gaging Dam
Cer-6	Lagoon Diversion Dam
Cer-5	Fourth Street Dam
Lyo-6	City Park Big Ford
Lin-7	Buffalo Creek Park Dam
Joh-3	Rapid Creek Gaging Dam

Risk factors were developed after analyzing 1998 to present fatalities at dams and examining other available data. Factors weighted and analyzed using GIS modeling, including relative usage statistics from the 2009 Iowa Rivers and River Corrdiors Recreation survey conducted by Iowa State University's Center for Agriculture and Rural Development. Dams in the low-head, breached, low-head, large impoundment, and ford categories were analyzed (211 total stuctures).The following factors were used:

- Proximity to population centers, (>100,000, 2 pts; >35,000, 1 pt)
- Known fatalities (>5, 3 pts; >3, 2 pts; 1 to 3, 1 pt)
- Height (2' to 15', 2 pts; >15', 1)
- Type (Low-head, 3pts; Breached low-head, 2 pts; Large Impoundment or seasonal low-head, 1)
- Near university / college (50-mile radius, 2 pts; 10-mile radius, 1 pt)
- On designated or in-progress water trail (1 pt)
- River usage survey, total # visits (>1,000 1 pt; >350 .5pt)
- River usage survey, in-water visits including fish/boat/canoe/swim (>700 3 pts; >349, 2pts)

Note that this type of broad-brush statistical analysis does not account for individual site factors, such as hydraulic retention, site design, education, and other factors that may play a role in actual risk. Also, known fatality data may be limited for many dams.

Appendix C: Dams with biological priority potential, unfiltered list

75th percentile and greater

ID	Dam_Name
Jon-3	Mon-Maq Dam
Del-5	Lake Delhi Dam
Mit-4	Mitchell Mill Dam
Cer-13	Illinois Street Dam
Wri-1	Goldfield Dam
Cer-9	Pennsylvania Avenue Dam
Web-5	Lizard Creek Mill Dam
Dub-2	Cascade Falls Dam
Cer-18	Jackson Avenue Dam
Del-4	Pin Oak Park Dam
Mit-3	St. Ansgar Mill Dam
Lin-6	Pinicon Ridge Park Dam
Del-3	Manchester Dam
Cer-11	12th Street Dam
Mit-5	Interstate Power Dam/Old power Dam
Lyo-2	City Park East Channel Dam
Ham-3	Webster City Dam
Web-4	Clare Gaging Dam
Lin-7	Buffalo Creek Park Dam
Cer-4	East Park Dam
Joh-2	Burlington Street Dam*
Mit-2	Otranto Mill Dam
Jac-1	Lakehurst Dam*
But-1	Greene Dam
Flo-4	Rockford Dam
Web-6	Trestle Weir
Flo-5	Marble Rock Dam
How-3	Lidtke Mill Dam
Del-2	Quaker Mill Dam
Bla-7	Pioneer Park Structure/Water Line
Win-1	Lower Dam*
Lyo-1	Rock Rapids Dam
Cer-8	Rock Glen Dam
Cer-7	East Park Slide Dam
Cer-6	Lagoon Diversion Dam
Cer-5	Fourth Street Dam
Lyo-6	City Park Big Ford
Joh-3	Rapid Creek Gaging Dam
Jas-1	Wagaman Mill Dam
Cer-19	Pierce Avenue Dam
Lin-4	Palisades-Kepler Dam
Lin-2	C Street Roller Dam
Wap-1	Market Street Dam
Flo-1	Main Street Dam
Flo-2	Charles City Beauty Dam
Flo-3	Nora Springs Dam
But-4	Shell Rock Mill Dam
Har-3	Steamboat Rock Dam
Chi-2	Cedar Lake Dam
But-3	Heery Woods Park Dam
Wor-2	Northwood Dam
Hen-1	Oakland Mills Dam *
Win-2	Upper Dam
Mit-1	Stacyville Dam

50th to 74th percentile

ID	Dam_Name
Chi-1	Buckley Rock Dam Ford
Bre-1	Frederika Dam
Cer-10	Linn Grove Park Dam*
How-6	Saratoga Dam
Bre-5	Sweet Marsh Dam
Bla-5	Heritage Farm Crossing
Bla-3	Park Avenue Dam
Joh-1	Iowa River Power Company Dam
Iow-1	Amana Millrace Diversion Dam
Buc-5	Quasqueton Dam
Lin-5	Troy Mills Dam
Bla-4	Sixth St. Dam
Jon-1	Anamosa Dam*
Bre-2	Waverly Dam
Web-2	Little Dam
Har-1	Alden Dam
Hum-5	Corn Belt Power Dam
Har-2	Iowa Falls Dam
Web-1	Ft. Dodge Hydro Dam
Buc-4	Independence Mill Dam
Lin-3	5-in-1 Bridge & Dam
Buc-3	Independence Low Dam
Buc-2	Littleton Mill Dam
Lyo-3	Klondike Mill Dam
Joh-7	Coralville Dam
Jon-2	Oxford Mills Dam
Wor-1	Fertile Mill Dam
Fay-7	Lake Oelwein Dam
Buc-1	Fairbank Dam
How-2	Lylah's Marsh Dam
Chi-4	North Washington Mill Dam
Chi-3	Chickasaw Mill Dam
Fra-2	Harriman Park Dam
Mit-8	Rock Creek Village Dam
Fra-3	Robinson Park Dam
Flo-6	Rock Creek Ford
Mit-7	Rock Creek Village Ford
Mit-10	Jersey Avenue Weir
Buc-6	Fontana Lake Dam
She-2	North Panama Dam
Pag-1	Clarinda Dam
But-7	Big Marsh Diversion Dam
Web-8	Williams Drive Dam
Kos-11	Buffalo Creek Dam
She-6	Bruch Weir
She-4	Panama High Tress Weir
She-5	F-32 Weir
Fra-1	Beed's Lake Dam
Wor-3	Elk Creek Game Mgmt Dam 1
Fay-8	Low Flow Bridge
Bla-1	Cedar Falls Dam/Center St. Dam
Bla-2	Clay Hole
Sto-6	East River Valley Park / 13th St. Dam
Woo-5	Dace Avenue Dam

*Asian carp barrier dams to be filtered out during later step.

Factors were weighted and analyzed using GIS modeling. Dams in the low-head, breached, low-head, large impoundment, and ford categories were analyzed (211 total stuctures).The following factors were used:

- Biological impairment, 303 listed segment, (2 pts)
- Within 15 miles of sampled SGGN mussel(s) (2 pts)
- Downstream of zebra mussel investation (2 pts)
- Fish species presence-absence analysis, difference in # present upstream (>15, 3 pts; 10-14, 2 pts; 5-9; 1 pt)
- Segment downstream of dam has >29 species (1 pt)
- Catfish recovery potential (1 pt)
- Use none or unknown (2 pts)

Because this method depends on exisitng data, it heavily favors dams in segments of rivers where signifcant fish and mussel samping has occurred . Additional monitoring could result in other dams becoming higher priorities. In addtion, some deteriorated or breached dams on this listing, with closer inspection, may already be regularly passing fish, elminating their priority status.