Today’s Presentation

Purpose
• Provide a broad overview of the complexities of the Mouse River system, the record flood of 2011, the basin-wide approach to the Mouse River Enhanced Flood Protection Project, and recent design efforts.

Outline
• Overview of the Mouse River Watershed
• Recap of the Flood of 2011
• Review Recent Engineering Efforts in Urbanized and Rural Areas
• Lessons Learned
• Q&A
The Mouse (Souris) River originates in and returns to Canada.

Mouse (Souris) River Basin Reservoirs

- 3 Saskatchewan Reservoirs (Rafferty, Boundary, and Alameda)
- 1 US Reservoir (Lake Darling)
Reservoir Storage and Other Measures in the Flood Control Acts of 1965 and 1986 Brought 5,000 cfs (100-yr) Capacity at Minot, ND

2011 Flood Timeline - March

- 3/3 - Broadway Bridge given a 52 percent chance of reaching flood stage (1,549)
- 3/11 - "Right now we're continuing to release about 1,100 cfs from Lake Darling and don't plan to make any changes in the foreseeable future." Corps' water control office in St. Paul, Minn.

Previous Record - 9,350 CFS (1976)
100-yr Flood - 5,000 CFS
1549 (Broadway)
**2011 Flood Timeline - March**

- 3/25 - NWS Flood Outlook shows a big jump in Souris River predictions, increasing the possibility of reaching flood stage at Broadway Bridge from 52 percent to 82 percent.

**2011 Flood Timeline - April**

- 4/1 - City begins preliminary plans for protection against 7,000 cfs
- 4/12 - Corps announces target flow of 5,000 cfs at the Boy Scout Bridge – Above Minot.
- 4/26 - Flow at Boy Scout Bridge reaches 5,440 cfs
2011 Flood Timeline - May

- 5/2 - Rafferty Dam reaches season high of 1,816 feet, 8 feet over previous high and only 2 feet below overflow.
- 5/2 - Boundary Reservoir within 2 1/2 inches of spilling

Previous Record - 9,350 CFS
(1976)

100-yr Flood - 5,000 CFS –
1549 (Broadway)

2011 Flood Timeline - May

- 5/5 - NWS cautions that there is still a lot of unknowns in regard to the amount of water that may come down the Souris from Canada. Releases from Saskatchewan dams totals 4,900 cfs
- 5/11 - Saskatchewan releases total 8,472 cfs.

Previous Record - 9,350 CFS
(1976)

100-yr Flood - 5,000 CFS –
1549 (Broadway)
2011 Flood Timeline - May

- 5/12 - "Rafferty is full. Boundary is full. Long Creek is running high and Alameda will be full. Lake Darling is expected to fill. When you add them all up, the cumulative is that it's pretty ugly." Alan Schlag, NWS.

- Previous Record - 9,350 CFS (1976)

- 100-yr Flood - 5,000 CFS - 1549 (Broadway)

- 5/19 - NWS issues Flood Watch 1 to 2 inches of rain possible.
- 5/20 - City workers begin erecting barriers along 4th Ave NE for possible 7,000 cfs.
- 5/25 - Dike improvement under way in Minot to protect against 9,000 cfs.
2011 Flood Timeline - June

- 5/28 - Saskatchewan Watershed Authority increases outflows from Saskatchewan dams in response to rainfall.
- 6/1 - Rainfall causes Des Lacs River to rise 7 feet at Foxholm in 24 hours

Previous Record - 9,350 CFS (1976)

100-yr Flood - 5,000 CFS - 1549 (Broadway)

2011 Flood Timeline - June

- 6/1 - NWS Flood Outlook calls for 1,555 feet at Broadway Bridge with 9,400 cfs.
- 6/1 - An estimated 10,000 Minot residents begin mandatory evacuation

Previous Record - 9,350 CFS (1976)

100-yr Flood - 5,000 CFS - 1549 (Broadway)
2011 Flood Timeline - June

- 6/6 - Broadway Bridge reading 1,551.8 feet at 7,100 cfs, Lake Darling releasing 6,000 cfs.
- 6/6 - Minn evacuees allowed to return home.

Previous Record - 9,350 CFS (1976)

100-yr Flood - 5,000 CFS – 1549 (Broadway)

- 6/9 - Lake Darling releases upped to 7,500 cfs.
- 6/10 - Releases from Saskatchewan dams total 5,130 cfs
- 6/17-6/21 – Large Saskatchewan Rainfall
- 6/19 - Saskatchewan releasing at 15,885 cfs.
2011 Flood Timeline - June

- 6/20 - Lake Darling releasing 8,600 cfs, Saskatchewan dams releasing 23,760 cfs
- 6/20 - Mandatory evacuations ordered again in Minot
- 6/22 - Sirens sound to evacuate all Minot flood zones

Previous Record - 9,350 CFS (1976)
100-yr Flood - 5,000 CFS – 1549 (Broadway)

2011 Flood Timeline - June

- 6/24 – Lake Darling releasing 26,000 cfs, Broadway Bridge forecast now 1,564.5 feet, water begins flowing into city.
- 6/25 - Crest of 1,561.8 feet reached at Broadway Bridge, boil order issued for Minot water supply.

New Record – 27,400 CFS (2011)
Previous Record - 9,350 CFS (1976)
100-yr Flood - 5,000 CFS – 1549 (Broadway)
The Minot Project was designed to convey 5,000 cfs
The community saw 27,400 cfs
Minot Damages Alone

- 4,100 homes were flooded
  - 3,100 homes extensively damaged or lost
  - 1 in 10 homes with flood insurance
- 11,000+ individuals displaced
- 6 Minot public schools severely damaged
  - 2 schools complete losses
  - 1,200 students displaced
  - 200+ businesses damaged
  - 51 park buildings damaged
- 5 baseball fields damaged
- 29 zoo buildings damaged
- Roosevelt pool and bathhouse lost
- Oak Park splash pad and mechanical building lost
- 12 churches damaged
- 20+ water system breaks
- 12 of 27 sanitary lift stations inundated with water
- 13 (all) water wells inundated with water
- 6 river pump stations damaged
- 30 to 40 sink holes from ground water
- 3 pedestrian bridges damaged
- 2 highway/street bridges damaged
- 277 street lights damaged
- 16 electrical feed points damaged
- 1,000 traffic signs damaged
- 51 miles of roads, sewer and water lines damaged
- 33 miles of storm sewers damaged

Extensive Damage Outside of Minot

- Burlington
- Sawyer
- Velva
- Mouse River Park
- Rural Subdivisions (Ward County)
- 165 Farms, Ranches
- Crop Damages
- Hay Meadow Losses
- Long Term Yield Impacts
- Livestock
- County Road Systems

- Initial and Sustained Damages Throughout the Basin were in Excess of $1 Billion
- Structural Damage Primarily Caused by High Water
- Agricultural Damage Caused by High Water and Sustained Reservoir Discharges
Development of the Preliminary Engineering Reports (PER)

Residents within the valley needed information to make personal decisions (i.e. should I rebuild?)

Initial focus was on urban areas (Minot, Burlington, Sawyer, Velva, Mouse River Park)

PER Development – Urban Reaches

Initial study timeline was condensed to 5 months
Project Features

- 22 miles of levees
- 3 miles of flood walls
- 30 transportation (road and rail) closures

Project Features

- 2 high flow bypasses
Project Cost – Urban Areas

$820 million - Urban
- $543 million Minot (66%)
- $149 million upstream (18%)
- $128 million downstream (16%)

$180 million – Rural

$1 Billion total

The Initial Focus in Minot

Anticipated Regulatory (FEMA) Floodplain (April 2018)
The Initial Focus in Minot

Construction Stage 1.5 – Phases Currently In Design or Under Construction

The Initial Focus in Minot

Construction Stage 1.5 – Future Phases
The Initial Focus in Minot

Anticipated Regulatory (FEMA) Floodplain Following Construction Stage

Approximately 3,250 less structures impacted

Water Treatment Plant
MINOT WATER TREATMENT PLANT HAZARD MITIGATION PROJECT

Minot Water Treatment Plant Overview

18 MGD Conventional Lime-Softening Water Treatment Plant
- Serves Minot area and surrounding communities
- Potable water source for Minot Air Force Base
- Several Rural Water Systems served directly and through NAWS

NAWS System – Regional Significance
- NAWS Project Conceptualized in late 1980s
- Goal - high quality, reliable water supply to Minot and surrounding communities to replace existing poor quality sources (50,000 Minot Residents)
- Federal and Local funding administered by the North Dakota State Water Commission
Flood Impacts to the Minot Water Treatment Plant

System Contamination
- Direct flood water contamination of finished water reservoir causes NDOH to issue boil order
- Other Primary Standards violations
  - Upgrades to treat surface water not complete
- After several days of high water, flood erosion caused pipeline rupture(s)
- City used divers and operator personnel in an attempt to locate and isolate leaks
- Leaks isolated by closing valves under flood waters
- Narrowly avoided vacuum condition in system
- Flooded areas isolated until waters receded
- Months long operation to lift boil order through zoned flushing and sampling
Major Project Features

1,720 linear feet of concrete floodwalls
- 5,960 cubic yards of concrete (600+ truck loads)
- 1.1 million pounds of rebar

2 new temporary roadway closure structures at 16th Street SW and Water Treatment Plant Road (12th Street SW)

Earthen tieback levees

Storm Water pump station to keep “wet side wet” and “dry side dry”

Ultra Violet treatment and river intake relocation

$25M (75-15-10)

Visualizing the future
Project Before and After

Project Before and After
Phases MI-2 & MI-3
Napa Valley & Forest Road
Phases MI-2 & MI-3 Overview
Napa Valley & Forest Road Statistics

- 10,000 LF Earthen Levee
- Average Feature Height 14’
- Maximum Feature Height 23’
- 7,500 LF Seepage Collection Trench
- 45,000 gpm Pump Station
- 10,000 LF Recreational Trail
- 17 Access Ramps

MREFPP Phase 2 & 3 -
Napa Valley and Forest Road Segments
Project Costs

• $25M - Water Treatment Plant (ongoing)
• $50M - Phase MI-2 & MI-3, Napa Valley/Forest Road (begin Spring 2017)
• $65M - Phase MI-1, 4th Avenue Floodwalls (begin summer 2017)
• $140M - Only $400M to go

www.mougeyriverplan.com for more information, 3D renderings, etc.

Lessons Learned During a Flood Fight

Involve USACE
Lessons Learned During a Flood Fight

Hire experienced consultants

THANK YOU