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NRCS DAM RISK ASSESSMENTS

Sites 6 and 8

Eddy and Chaves Counties, New Mexico



project background

Cottonwood – Walnut Creek watershed, drains east to the Pecos River

Purpose – to rank NRCS dams for potential rehabilitation projects

Sites 6 and 8 are single purpose flood retarding structures built by the NRCS in the 1980s





agenda / scope of work

Conduct inspections of dams to assess condition

Analyze in SITES – including verification of input parameters (as-built dimensions, watershed characteristics, precipitation)

Perform breach analysis in HEC-RAS

Prepare breach inundation exhibit

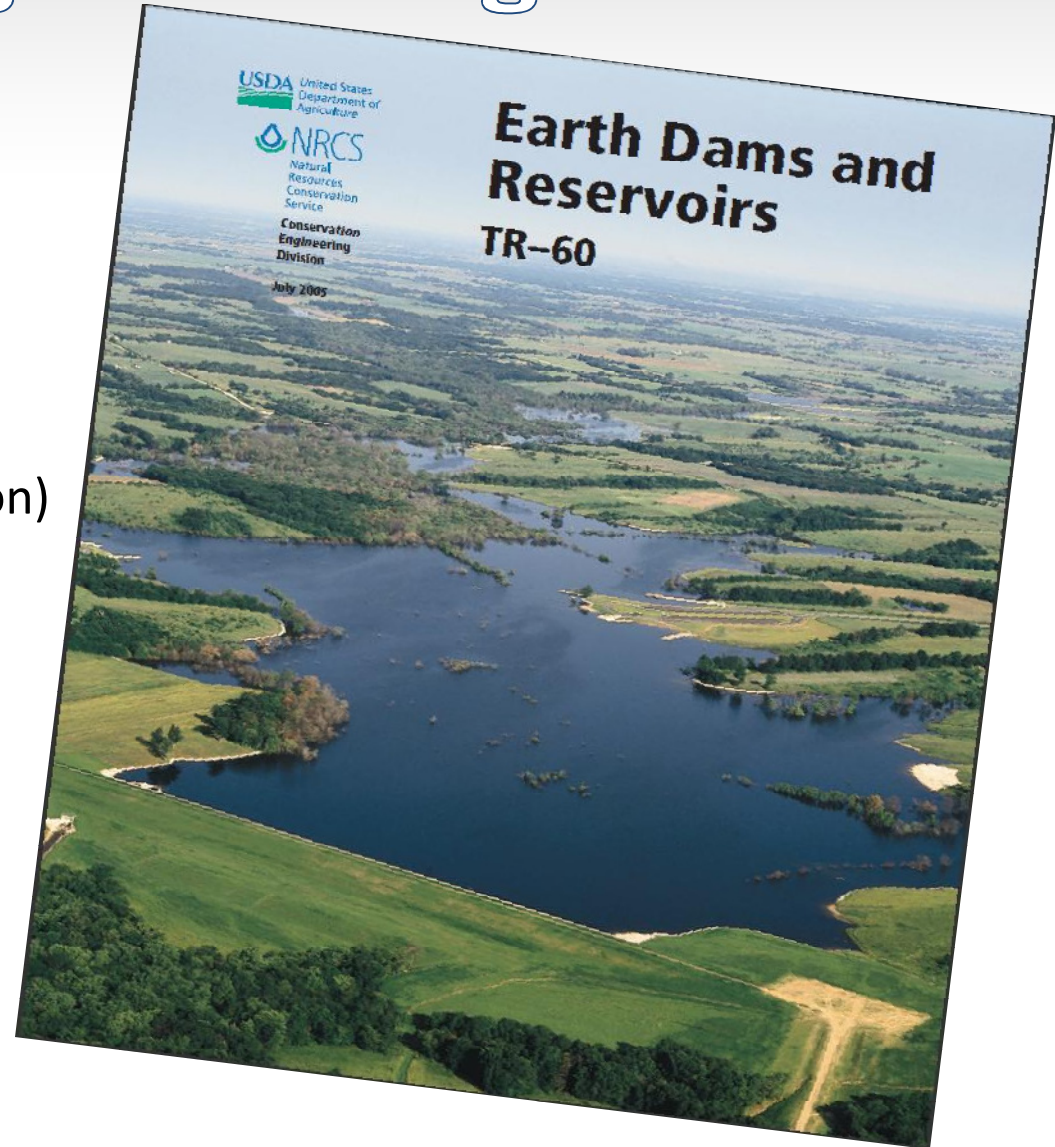
Complete risk profile spreadsheet – “Evaluation of Potential Rehabilitation Projects”

Identify potential rehabilitation alternatives



governing technical guide

NRCS TR-60 (Latest Edition)





site 6 details

53 feet high

8,600 feet long

Tributary area of 49 square miles

4,620 acre-feet of total storage capacity

48 inch dia. concrete-lined steel
Principal Spillway

PSW Riser (Inlet)





inspection photos (site 6)

Principle Spillway Outlet





inspection photos (site 6)

Structural Auxiliary Spillway



Pockmarks





inspection photos (site 6)

View from the Top





site 8 details

61 feet high

8,800 feet long

Tributary area of 60 square miles

13,700 acre-feet of total storage capacity

54 inch dia. RCP Principal Spillway

PSW Riser (Inlet)





inspection photos (site 8)

Channel Downstream of PSW





inspection photos (site 8)

Subsidence





inspection photos (site 8)

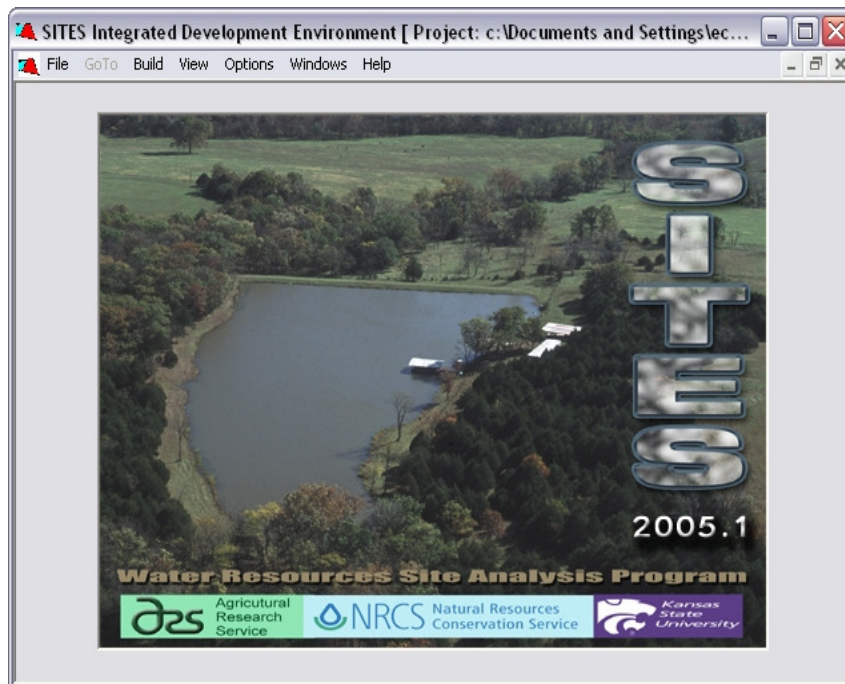
View of Drainage Basin



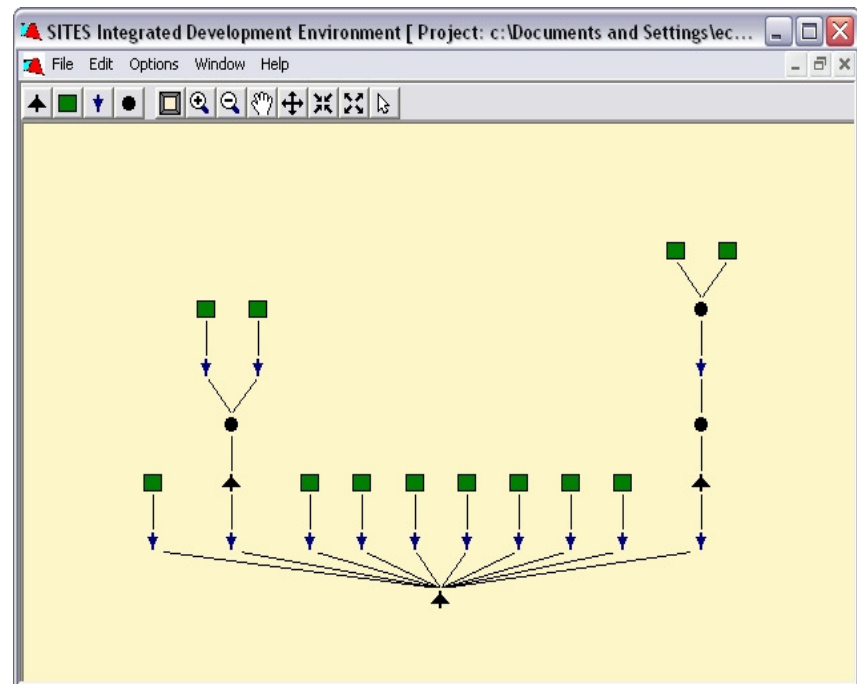


SITES

Home Screen



Schematic





SITES

Hydrologic Analysis: Four Scenarios

Scenario 1: 100-Year PSW

Principal Spillway (PSW) analysis using 100-yr, 24-hr and 100-yr, 10-day

Scenario 2: 6-hr FBH

Freeboard Hydrograph (FBH) analysis using Probable Maximum Precipitation (PMP)

Scenario 3: 24-hr FBH

Freeboard Hydrograph (FBH) analysis using Probable Maximum Precipitation (PMP)

Scenario 4: 72-hr FBH

Freeboard Hydrograph (FBH) analysis using Probable Maximum Precipitation (PMP)



SITES

Hydrologic Analysis: Four Scenarios (Site 6)

Scenario 1: 100-Year PSW

Inflow Peak = 13,462 cfs

Outflow Peak = 333 cfs

Freeboard = -1.49 ft

Scenario 2: 6-hr FBH

Inflow Peak = 54,463 cfs

Outflow Peak = 128,198 cfs

Freeboard = -1.72 ft

Scenario 3: 24-hr FBH

Inflow Peak = 107,169 cfs

Outflow Peak = 103,058 cfs

Freeboard = -0.22 ft

Scenario 4: 72-hr FBH

Inflow Peak = 141,097 cfs

Outflow Peak = 53,319 cfs

Freeboard = +3.03 ft



SITES

Hydrologic Analysis: Four Scenarios (Site 8)

Scenario 1: 100-Year PSW

Inflow Peak = 17,306 cfs

Outflow Peak = 759.7 cfs

Freeboard = +1.26 ft

Scenario 2: 6-hr FBH

Inflow Peak = 118,240 cfs

Outflow Peak = 96,352 cfs

Freeboard = -2.71 ft

Scenario 3: 24-hr FBH

Inflow Peak = 98,682 cfs

Outflow Peak = 85,666 cfs

Freeboard = -1.74 ft

Scenario 4: 72-hr FBH

Inflow Peak = 56,441 cfs

Outflow Peak = 35,916 cfs

Freeboard = +2.96 ft



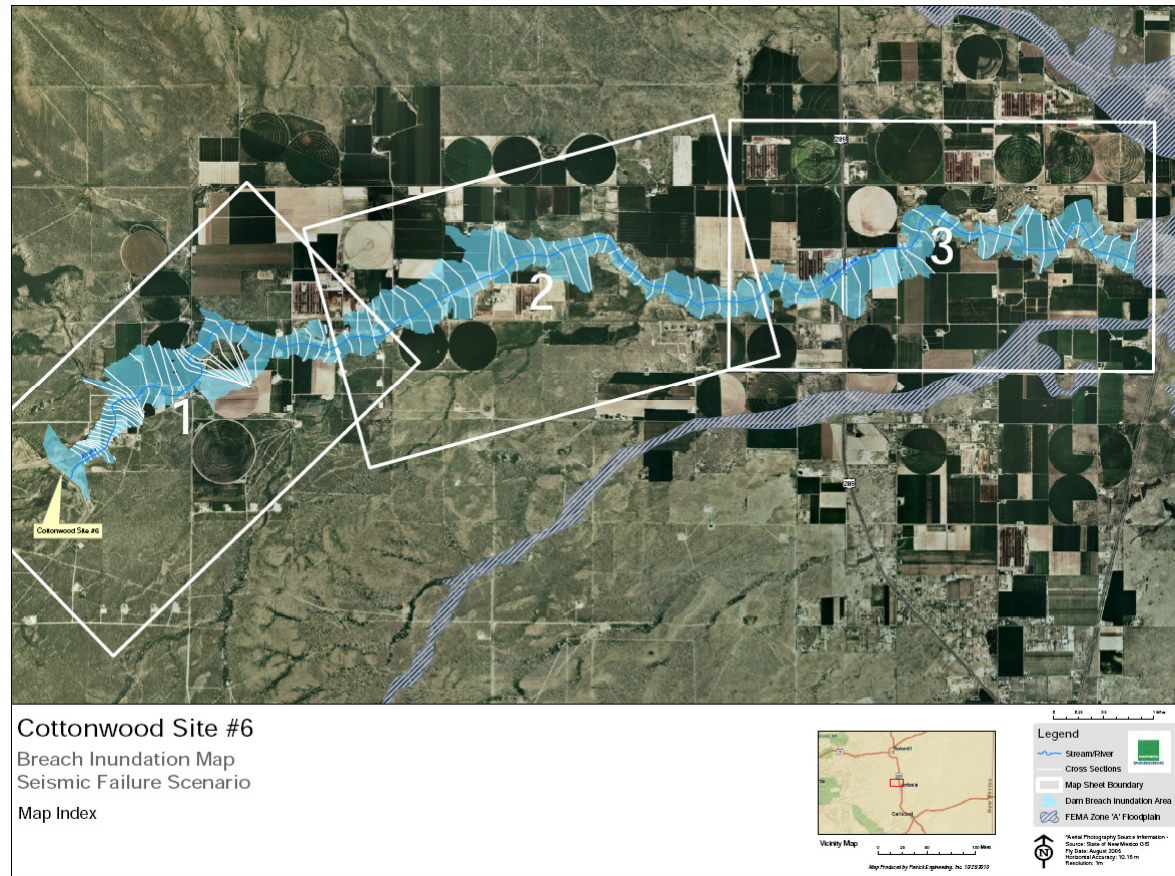
breach inundation mapping

Dam Breach Hydraulic
Modeling:
HEC-RAS Unsteady Model

Inundation Area Mapping:
HEC-GeoRAS and ArcGIS

Estimate Persons at Risk
(PAR):

ArcGIS, ArcMap, and US
Census data





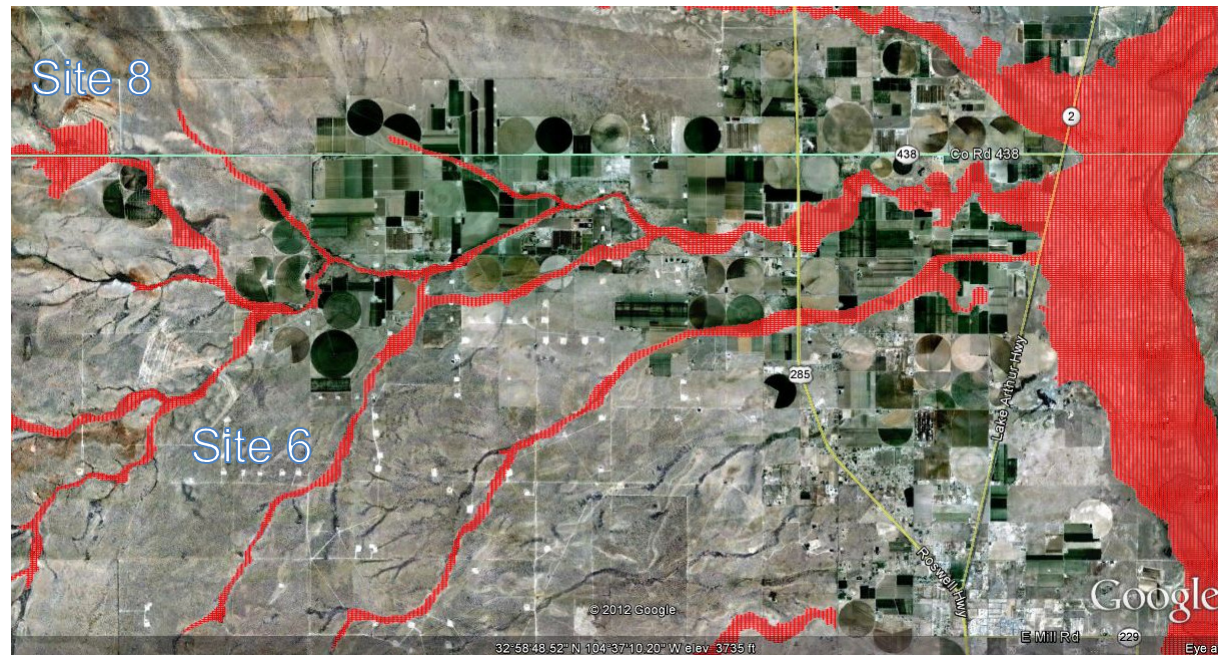
dam breach hydraulic modeling

Breach wave limits:

- Max depth $\leq 1'$
- Velocity ≤ 1 fps

Anticipate wave will propagate over entire length of model (~ 19 miles) to Pecos River

Breach wave extended to Pecos River FEMA Zone A Floodplain





dam breach hydraulic modeling

HEC-Geo RAS Description

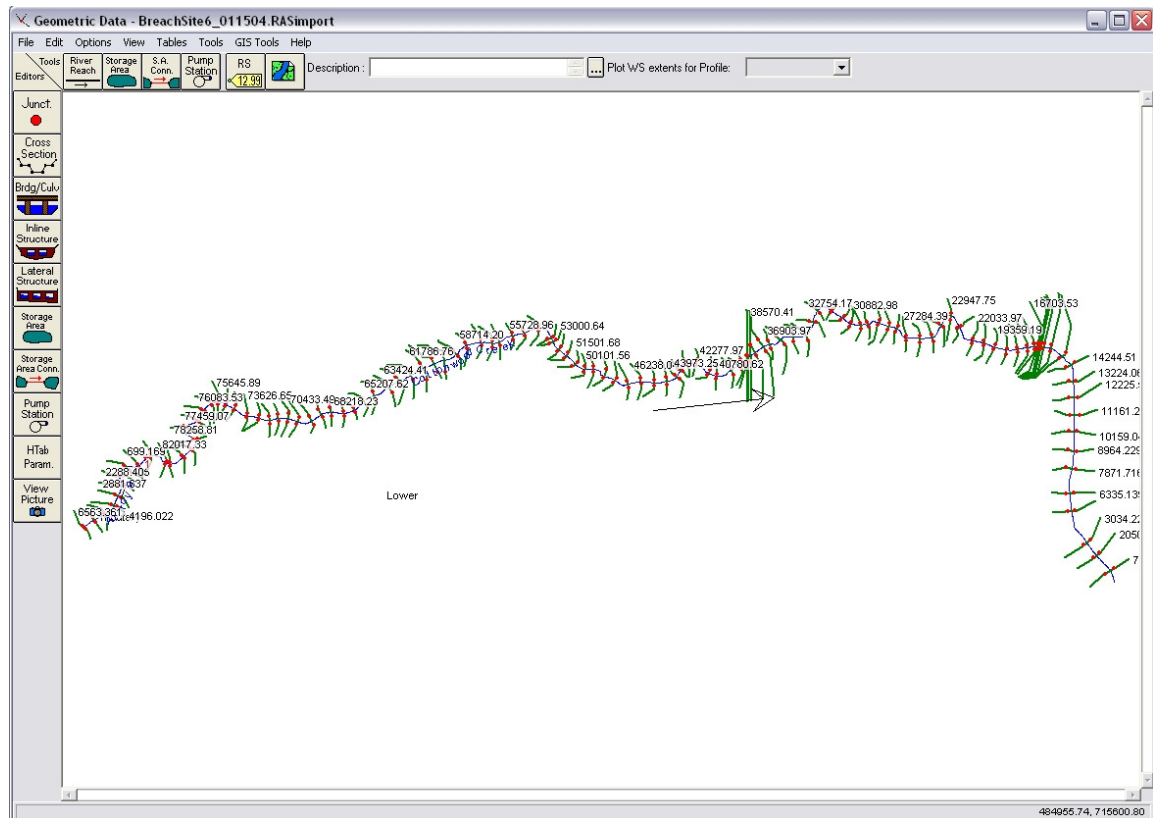
HEC-RAS modeling

Three Failure Scenarios:

1. Hydrologic

2. Static

3. Seismic





dam breach hydraulic modeling: theoretical peak breach discharge

Variables

Q_{\max} = the peak breach discharge, cfs

B_r = breach factor, acre

V_s = reservoir storage at the time of failure, acre-ft

H_w = depth of water at the dam at the time of failure, ft

A = cross-sectional area of embankment at the assumed location of breach, ft²

2. For depth of water at the dam at the time of failure where $H_w < 103$ ft

$$Q_{\max} = (1,100)B_r^{1.35} \quad \text{where } B_r = \frac{(V_s)(H_w)}{A}$$

but not less than $Q_{\max} = (3.2)H_w^{2.5}$ nor more than

$$Q_{\max} = (65)H_w^{1.85}$$

Site 6 Theoretical Peak Breach Discharge =
43,077 cfs

Site 8 Theoretical Peak Breach Discharge =
87,479 cfs



dam breach hydraulic modeling: HEC-RAS unsteady model

Calibration of Dam Breach Parameters:

- Side slope
- Bottom width
- Formation time

Model Stabilization:

- Interpolated Cross Sections
- Initial flow values
- Calculation time period



inundation area mapping

Water surface profile
generated from HEC-RAS used
to determine inundation limits
from digital terrain model
using HEC-GeoRAS

Shape file created in GIS to
represent inundated area

PAR Estimate:
US Census data





evaluation of potential rehabilitation projects

Summary

(Consequences) tab
Others tabs include:

- Failure & Risk Indexes (loss of life)
- Static Failure Index
- Hydrologic Failure Index
- Seismic Failure Index

	A	B	C	D	E	F	G	H	I	J	
1	EVALUATION OF POTENTIAL REHABILITATION PROJECTS										
2	STATE	NM	DAM	Cottonwood- Walnut Creek Site 6		BY	BS/ADJ	DATE	3/10/11		
3	YEAR BUILT		1986	DESIGN HAZARD CLASS		C	DRAINAGE AREA		49.44	mi ²	
4	WORK PLAN DATE			CURRENT HAZARD CLASS			DAM HEIGHT		53	ft	
5	sht 1 of 5		CONSEQUENCES OF DAM FAILURE							ver 100101	
6	POTENTIAL DAM FAILURE:										
7	Total Failure Index								155	A	
8	POTENTIAL LOSS OF LIFE:										
9	Maximum Population-at-Risk [PAR]								(number)	41	B
10	Total Risk Index									44	C
11	POTENTIAL LOSS OF PROPERTY:										
12	Identify major community affected by breach and rate impact as High (H), Medium (M), Low (L) or None(blank)										
13	Community Artesia								(H,M,L,-)	L	D
14	Number of homes, businesses, major buildings								(number)	13	E
15	POTENTIAL LIFELINE DISRUPTION:										
16	Water supply, identify community disrupted by dam failure, and estimate number/amount										
17	Municipal sole source						None	Users	(number)		F
18	Supplemental source						None	Users	(number)		G
19	Irrigation water						None	Storage	(Ac-Ft)		H
20	POTENTIAL INFRASTRUCTURE DISRUPTION:										
21	Transportation system crossings, identify major crossing rendered unusable by dam failure, and estimate number										
22	Major/Interstate		NM 285 & 82				Roads	(number)	2	I	
23	Secondary/County		Co Rd 483				Roads	(number)	1	J	
24	POTENTIAL ADVERSE IMPACTS ON THE ENVIRONMENT:										
25	Describe impacts and rate each as High (H), Medium (M), Low (L), or None (blank)										
26	Threatened & endangered species		Pecos Bluntnose Shiner					(H,M,L,-)	L	K	
27	Sensitive riparian areas		None					(H,M,L,-)		L	
28	Contaminated reservoir sediment		None					(H,M,L,-)		M	
29	Wetland and wildlife habitat		Pecos River					(H,M,L,-)	L	N	
30	Other							(H,M,L,-)		O	
31	POTENTIAL ADVERSE SOCIAL IMPACTS:										
32	Describe impacts and rate each as High (H), Medium (M), Low (L) or None(blank)										
33	Known cultural resources		None					(H,M,L,-)		P	
34	Historic preservation issues		None					(H,M,L,-)		Q	
35	Socially disadvantaged communities		None					(H,M,L,-)		R	
36	POTENTIAL ADVERSE ECONOMIC IMPACTS:										
37	Average annual benefits attributed to this dam, updated workplan value								(\$)		S
38	Changes in benefits since workplan; Increase(I), No change(NC), Decrease(D)								(I,NC,D)		T
39	Low income families impacted								(number)	2	U
40	INPUT BY STATE DAM SAFETY AGENCY:										
41	State dam safety order issued for repair, modification, removal issued, Yes(Y), No(N)								(Y,N)	N	V
42	State Dam Safety Agency Priority, High(H), Medium(M), Low(L), None(blank)								(H,M,L,-)		W
43	OTHER CONSIDERATIONS:										
44	Identify any other considerations and rate as High(H), Medium(M), Low(L) or None(blank)										
45									(H,M,L,-)		X
46									(H,M,L,-)		Y



rehabilitation alternatives

Site 6: Six Rehabilitation Options

Option 1: Raise structural auxiliary spillway crest

Option 2: Provide additional storage

Option 3: Increase principal spillway capacity

Option 4: Raise the top of dam

Option 5: Lower earthen auxiliary spillway crest

Option 6: Widen structural auxiliary spillway crest

Site 8: Three Rehabilitation Options

Option 1: Raise the top of dam

Option 2: Lower auxiliary spillway crest

Option 3: Widen auxiliary spillway crest



questions?

