
TRUCKEE MEADOWS

FLOOD DAMAGE REDUCTION AND ECOSYSTEM RESTORATION PROJECT

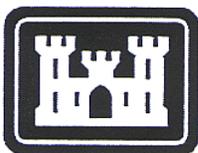
FLOOD DAMAGE REDUCTION ALTERNATIVES DESIGN PAPER

Attachment 4:

Quality and Cost Estimate Summaries for Flood Damage Reduction Alternatives (Alternatives 1 – 3)

Contract No.: DACW05-01-D-0018

Prepared for:



**US Army Corps
of Engineers**
Sacramento District

September 2002

Prepared



TABLE 1
Alternative 1 - Levees and Floodwalls with 2,800 cfs Additional Downstream Flows
Estimate of Total First Costs

Feature Code	Description	Unit	Quantity	Unit Cost	Total Cost
01	Lands and Damages				
	Land Acquisition - Levees and Floodwalls	Lump Sum	1	\$44,512,929	\$44,513,000
	Land Acquisition - Mustang Ranch Detention Facility	Lump Sum	0	\$3,493,360	\$0
	Land Acquisition - Huffaker Hills Detention Facility	Lump Sum	0	\$600,000	\$0
	Land Acquisition - Borrow and Disposal Sites	Lump Sum	1	\$11,502,089	\$11,502,000
	Severance Damages	Lump Sum	1	\$5,348,308	\$5,348,000
	Relocations (Businesses)	Lump Sum	1	\$3,750,000	\$3,750,000
	Administrative Costs	Lump Sum	1	\$9,240,000	\$9,240,000
	Subtotal				\$74,353,000
	Contingency and Unlisted Items (20%)				\$14,871,000
	Subtotal for Lands and Damages				\$89,224,000
02	Relocations				
	Rock Boulevard Bridge Replacement	Lump Sum	0	\$9,113,223	\$0
	Mc Carran Boulevard Bridge Relocation	Lump Sum	1	\$9,192,296	\$9,192,296
	Lowering Pembroke Drive	Lump Sum	0	\$103,473	\$0
	Floodproofing in area north of Boynton Slough	Lump Sum	0	\$2,065,000	\$0
	Subtotal				\$9,192,296
	Contingency and Unlisted Items (20%)				\$1,838,500
	Subtotal for Relocations				\$11,030,796
06	Fish and Wildlife Facilities				
	Mitigation	Lump Sum	1	\$14,896,765	\$14,897,000
	Subtotal				\$14,897,000
	Contingency and Unlisted Items (20%)				\$2,979,400
	Subtotal for Lands and Damages				\$17,876,400
09	Channels and Canals				
	North Truckee Drain Re-Alignment	Lump Sum	0	\$10,969,192	\$0
	Boyton Slough Channel Enclosure/Box Culvert	Lump Sum	1	\$3,886,864	\$3,886,864
	Channel Benching	Lump Sum	0	\$32,848,075	\$0
	Subtotal				\$3,886,864
	Contingency and Unlisted Items (20%)				\$777,400
	Subtotal for Channels and Canals				\$4,664,264
11	Levees and Floodwalls				
	Mobilization and Demobilization	Lump Sum	1	\$200,000	\$200,000
	Levees	Lump Sum	1	\$22,528,364	\$22,528,364
	Floodwalls	Lump Sum	1	\$17,803,954	\$17,803,954
	Seepage Mitigation - Relief Wells	Lump Sum	1	\$4,382,923	\$4,382,923
	Seepage Mitigation - Cutoff Walls	Lump Sum	1	\$17,593,346	\$17,593,346
	Seepage Mitigation - Seepage Berm	Lump Sum	1	\$5,747,189	\$5,747,189
	Seepage Mitigation - Drainage Blanket	Lump Sum	1	\$197,821	\$197,821
	Seepage Mitigation - Impervious Berm	Lump Sum	0	\$0	\$0
	Disturbed Area (Clearing Grubbing/Seeding)	Lump Sum	1	\$1,227,114	\$1,227,114
	Subtotal				\$69,680,710
	Contingency and Unlisted Items (20%)				\$13,936,000
	Subtotal for Levees and Floodwalls				\$83,616,710
15	Floodway Control and Diversion Structures				
	Huffaker Hills Detention Facility	Lump Sum	0	\$4,250,882	\$0
	UNR Farms Detention Facility Inlet and Outlet Structures	Lump Sum	0	\$929,535	\$0
	Mustang Ranch Detention Facility Diversion Structure	Lump Sum	0	\$925,000	\$0
	Subtotal				\$0
	Contingency and Unlisted Items (20%)				\$0
	Subtotal for Floodway and Diversion Structures				\$0
18	Cultural Resource Preservation				
	Cultural Resources	Lump Sum	1	\$993,000	\$993,000
	Subtotal				\$993,000
	Contingency and Unlisted Items (20%)				\$198,600
	Subtotal for Cultural Resource Preservation				\$1,191,600
	SUBTOTAL				\$207,603,770
30	Planning, Engineering, and Design	Lump Sum	1	\$14,206,000	\$14,206,000
31	Construction Management	Lump Sum	1	\$9,470,000	\$9,470,000
	TOTAL FIRST COSTS				\$231,279,770

TABLE 2
Alternative 1 - Levees and Floodwalls with 2,800 cfs Additional Downstream Flows
Estimate of Total Annual Costs

COST AMORTIZATION	
Total First Cost	\$231,279,770
Interest During Construction (6 5/8)	\$40,229,872
Total First Investment	\$271,510,000
Amortized Annual Costs (6 5/8 over 50 years)	\$18,746,041
Annual O&M Costs Including 20% Contingency	\$1,071,705
Total Annual Costs	\$19,818,000

Assumptions for Tables 1 and Table 2 for Alterantive 1:

- *** Cost estimate does not include costs for downstream restoration needed to attenuate increased flood flows downstream.*
- *** Fish and Wildlife Facilities costs for mitigation are estimated at 15% of total cost for accounts 02, 09, and 11.*
- *** Cultural Resource costs are estimated at 1% of total cost for accounts 02, 09 and 11.*
- *** Planning Engineering and Design is estimated at 12% of total cost for accounts 02, 06, 09, 11 and 18.*
- *** Construction Management is estimated at 8% of total cost for accounts 02, 06, 09, 11 and 18.*

TABLE 3

**Alternative 2 - Levees, Floodwalls, and Detention Basins with No Increase in Downstream Flows
Estimate of Total First Costs**

Feature Code	Description	Unit	Quantity	Unit Cost	Total Cost
01	Lands and Damages				
	Land Acquisition - Levees and Floodwalls	Lump Sum	1	\$44,569,235	\$44,569,000
	Land Acquisition - Mustang Ranch Detention Facility	Lump Sum	1	\$3,493,360	\$3,493,000
	Land Acquisition - Huffaker Hills Detention Facility	Lump Sum	1	\$600,000	\$600,000
	Land Acquisition - Borrow and Disposal Sites	Lump Sum	1	\$11,502,089	\$11,502,000
	Severance Damages	Lump Sum	1	\$5,348,308	\$5,348,000
	Relocations (Businesses)	Lump Sum	1	\$3,750,000	\$3,750,000
	Administrative Costs	Lump Sum	1	\$9,240,000	\$9,240,000
	Subtotal				\$78,502,000
	Contingency and Unlisted Items (20%)				\$15,700,000
	Subtotal for Lands and Damages				\$94,202,000
02	Relocations				
	Rock Boulevard Bridge Replacement	Lump Sum	0	\$9,113,223	\$0
	Mc Carran Boulevard Bridge Relocation	Lump Sum	1	\$9,192,296	\$9,192,296
	Lowering Pembroke Drive	Lump Sum	0	\$103,473	\$0
	Floodproofing in area north of Boynton Slough	Lump Sum	0	\$2,065,000	\$0
	Subtotal				\$9,192,296
	Contingency and Unlisted Items (20%)				\$1,838,500
	Subtotal for Relocations				\$11,030,796
06	Fish and Wildlife Facilities				
	Mitigation	Lump Sum	1	\$22,100,089	\$22,100,000
	Subtotal				\$22,100,000
	Contingency and Unlisted Items (20%)				\$4,420,000
	Subtotal for Lands and Damages				\$26,520,000
09	Channels and Canals				
	North Truckee Drain Re-Alignment	Lump Sum	1	\$10,969,192	\$10,969,192
	Boyton Slough Channel Enclosure/Box Culvert	Lump Sum	0	\$3,886,864	\$0
	Channel Benching	Lump Sum	0	\$32,848,075	\$0
	Subtotal				\$10,969,192
	Contingency and Unlisted Items (20%)				\$2,193,800
	Subtotal for Channels and Canals				\$13,162,992
11	Levees and Floodwalls				
	Mobilization and Demobilization	Lump Sum	1	\$200,000	\$200,000
	Levees	Lump Sum	1	\$19,501,696	\$19,501,696
	Floodwalls	Lump Sum	1	\$35,824,151	\$35,824,151
	Seepage Mitigation - Relief Wells	Lump Sum	1	\$3,915,873	\$3,915,873
	Seepage Mitigation - Cutoff Walls	Lump Sum	1	\$21,423,505	\$21,423,505
	Seepage Mitigation - Seepage Berm	Lump Sum	1	\$5,770,477	\$5,770,477
	Seepage Mitigation - Drainage Blanket	Lump Sum	1	\$197,821	\$197,821
	Seepage Mitigation - Impervious Berm	Lump Sum	1	\$7,978,501	\$7,978,501
	Disturbed Area (Clearing Grubbing/Seeding)	Lump Sum	1	\$1,699,597	\$1,699,597
	Subtotal				\$96,511,620
	Contingency and Unlisted Items (20%)				\$19,302,000
	Subtotal for Levees and Floodwalls				\$115,813,620
15	Floodway Control and Diversion Structures				
	Huffaker Hills Detention Facility	Lump Sum	1	\$4,250,882	\$4,250,882
	UNR Farms Detention Facility Inlet and Outlet Structures	Lump Sum	1	\$929,535	\$929,535
	Mustang Ranch Detention Facility Diversion Structure	Lump Sum	1	\$925,000	\$925,000
	Subtotal				\$6,105,417
	Contingency and Unlisted Items (20%)				\$1,221,100
	Subtotal for Floodway and Diversion Structures				\$7,326,517
18	Cultural Resource Preservation				
	Cultural Resources	Lump Sum	1	\$1,473,000	\$1,473,000
	Subtotal				\$1,473,000
	Contingency and Unlisted Items (20%)				\$294,600
	Subtotal for Cultural Resource Preservation				\$1,767,600
	SUBTOTAL				\$269,823,525
30	Planning, Engineering, and Design	Lump Sum	1	\$21,075,000	\$21,075,000
31	Construction Management	Lump Sum	1	\$14,050,000	\$14,050,000
	TOTAL FIRST COSTS				\$304,948,525

TABLE 4
Alternative 2 - Levees, Floodwalls, and Detention Basins with No Increase in Downstream Flows
Estimate of Total Annual Costs

COST AMORTIZATION	
Total First Cost	\$304,948,525
Interest During Construction (6 5/8)	\$53,044,156
Total First Investment	\$357,993,000
Amortized Annual Costs (6 5/8 over 50 years)	\$24,717,142
Annual O&M Costs Including 20% Contingency	\$ 1,245,860
Total Annual Costs	\$ 25,963,000

Assumptions for Tables 3 and Table 4 for Alternative 2:

*** *This alternative does not increase peak flood flows downstream and thus does not require downstream restoration. The cost estimates presented above represent the total flood damage reduction alternative costs for this reach of the Truckee River from Highway 395 to Vista.*

*** *Fish and Wildlife Facilities costs for mitigation are estimated at 15% of total cost for accounts 02, 09, 11 and 15.*

*** *Cultural Resource costs are estimated at 1% of total cost for accounts 02, 09, 11 and 15.*

*** *Planning Engineering and Design is estimated at 12% of total cost for accounts 02, 06, 09, 11, 15 and 18.*

*** *Construction Management is estimated at 8% of total cost for accounts 02, 06, 09, 11, 15 and 18.*

TABLE 5
Alternative 3 - Channel Benching (Community Coalition) Alternative
Estimate of Total First Costs

Feature Code	Description	Unit	Quantity	Unit Cost	Total Cost
01	Lands and Damages				
	Land Acquisition - Levees and Floodwalls	Lump Sum	1	\$44,568,300	\$44,568,000
	Land Acquisition - Mustang Ranch Detention Facility	Lump Sum	1	\$3,493,360	\$3,493,000
	Land Acquisition - Huffaker Hills Detention Facility	Lump Sum	1	\$600,000	\$600,000
	Land Acquisition - Borrow and Disposal Sites	Lump Sum	1	\$11,502,089	\$11,502,000
	Severance Damages	Lump Sum	1	\$5,348,196	\$5,348,000
	Relocations (Businesses)	Lump Sum	1	\$3,750,000	\$3,750,000
	Administrative Costs	Lump Sum	1	\$9,240,000	\$9,240,000
	Subtotal				\$78,501,000
	Contingency and Unlisted Items (20%)				\$15,700,000
	Subtotal for Lands and Damages				\$94,201,000
02	Relocations				
	Rock Boulevard Bridge Replacement	Lump Sum	1	\$9,113,223	\$9,113,223
	Mc Carran Boulevard Bridge Relocation	Lump Sum	1	\$9,192,296	\$9,192,296
	Lowering Pembroke Drive	Lump Sum	1	\$103,473	\$103,473
	Floodproofing in area north of Boynton Slough	Lump Sum	1	\$2,065,000	\$2,065,000
	Subtotal				\$20,473,992
	Contingency and Unlisted Items (20%)				\$4,094,800
	Subtotal for Relocations				\$24,568,792
06	Fish and Wildlife Facilities				
	Mitigation	Lump Sum	1	\$18,517,155	\$18,517,000
	Subtotal				\$18,517,000
	Contingency and Unlisted Items (20%)				\$3,703,400
	Subtotal for Lands and Damages				\$22,220,400
09	Channels and Canals				
	North Truckee Drain Re-Alignment	Lump Sum	1	\$10,969,192	\$10,969,192
	Boyton Slough Channel Enclosure/Box Culvert	Lump Sum	0	\$3,886,864	\$0
	Channel Benching	Lump Sum	1	\$32,848,075	\$32,848,075
	Subtotal				\$43,817,267
	Contingency and Unlisted Items (20%)				\$8,763,500
	Subtotal for Channels and Canals				\$52,580,767
11	Levees and Floodwalls				
	Mobilization and Demobilization	Lump Sum	1	\$200,000	\$200,000
	Levees	Lump Sum	1	\$9,363,963	\$9,363,963
	Floodwalls	Lump Sum	1	\$17,319,864	\$17,319,864
	Seepage Mitigation - Relief Wells	Lump Sum	1	\$3,360,169	\$3,360,169
	Seepage Mitigation - Cutoff Walls	Lump Sum	1	\$1,333,832	\$1,333,832
	Seepage Mitigation - Seepage Berm	Lump Sum	1	\$899,266	\$899,266
	Seepage Mitigation - Drainage Blanket	Lump Sum	1	\$186,721	\$186,721
	Seepage Mitigation - Impervious Berm	Lump Sum	0	\$0	\$0
	Disturbed Area (Clearing Grubbing/Seeding)	Lump Sum	1	\$742,243	\$742,243
	Subtotal				\$33,406,058
	Contingency and Unlisted Items (20%)				\$6,681,000
	Subtotal for Levees and Floodwalls				\$40,087,058
y	Floodway Control and Diversion Structures				
	Huffaker Hills Detention Facility	Lump Sum	1	\$4,250,882	\$4,250,882
	UNR Farms Detention Facility Inlet and Outlet Structures	Lump Sum	0	\$929,535	\$0
	Mustang Ranch Detention Facility Diversion Structure	Lump Sum	1	\$925,000	\$925,000
	Subtotal				\$5,175,882
	Contingency and Unlisted Items (20%)				\$1,035,200
	Subtotal for Floodway and Diversion Structures				\$6,211,082
18	Cultural Resource Preservation				
	Cultural Resources	Lump Sum	1	\$1,234,000	\$1,234,000
	Subtotal				\$1,234,000
	Contingency and Unlisted Items (20%)				\$246,800
	Subtotal for Cultural Resource Preservation				\$1,480,800
	SUBTOTAL				\$241,349,897
30	Planning, Engineering, and Design	Lump Sum	1	\$17,658,000	\$17,658,000
31	Construction Management	Lump Sum	1	\$11,772,000	\$11,772,000
	TOTAL FIRST COSTS				\$270,779,897

TABLE 6
Alternative 3 - Channel Benching (Community Coalition) Alternative
Estimate of Total First Costs

COST AMORTIZATION	
Total First Cost	\$270,779,897
Interest During Construction (6 5/8)	\$47,100,707
Total First Investment	\$317,881,000
Amortized Annual Costs (6 5/8 over 50 years)	\$21,947,664
Annual O&M Costs Including 20% Contingency	\$900,589
Total Annual Costs	\$22,848,000

Assumptions for Tables 5 and Table 6 for Alternative 3:

- *** *Cost estimate does not include costs for downstream restoration needed to attenuate increased flood flows downstream.*
- *** *Fish and Wildlife Facilities costs for mitigation are estimated at 15% of total cost for accounts 02, 09, 11 and 15.*
- *** *Cultural Resource costs are estimated at 1% of total cost for accounts 02, 09, 11 and 15.*
- *** *Planning Engineering and Design is estimated at 12% of total cost for accounts 02, 06, 09, 11, 15 and 18.*
- *** *Construction Management is estimated at 8% of total cost for accounts 02, 06, 09, 11, 15 and 18.*

TABLE 7
Cost Estimates for Lands and Damages (Feature Code 01)

Description	Alternative 1 <i>Levees and Floodwalls with 2,800 CFS Additional Downstream Flows</i>	Alternative 2 <i>Levees and Floodwalls with No Increase in Downstream Flows</i>	Alternative 3 <i>Channel Benching Alternative</i>
Real Estate Acquisition - Highway 395 to Vista	\$ 44,512,929 ⁽¹⁾	\$ 44,569,235 ⁽²⁾	\$ 44,568,300 ⁽⁵⁾
Real Estate Acquisition - Huffaker Hills Detention Facility	\$ -	\$ 3,493,360 ⁽³⁾	\$ 3,493,360 ⁽³⁾
Real Estate Acquisition - Mustang Ranch Detention Facility	\$ -	\$ 600,000 ⁽⁴⁾	\$ 600,000 ⁽⁴⁾
Real Estate Acquisition - Borrow and Disposal Sites	\$ 11,502,089 ⁽⁶⁾	\$ 11,502,089 ⁽⁶⁾	\$ 11,502,089 ⁽⁶⁾
Severance Damages	\$ 5,341,551 ⁽¹⁾	\$ 5,348,308 ⁽²⁾	\$ 5,348,196 ⁽⁵⁾
Relocations	\$ 3,750,000 ⁽¹⁾	\$ 3,750,000 ⁽²⁾	\$ 3,750,000 ⁽⁵⁾
Administrative Costs	\$ 9,240,000 ⁽¹⁾	\$ 9,240,000 ⁽²⁾	\$ 9,240,000 ⁽⁵⁾
Total Costs	\$ 74,346,569	\$ 78,502,992	\$ 78,501,945
<i>Notes:</i>			
<i>(1) Costs based on Real Estate Costs for Alternative 1 from In-Progress Review Report for Reno-Sparks- Truckee Meadows Flood Damage Reduction and Environmental Restoration Alternatives Report, November 2000 .</i>			
<i>(2) Costs based on Real Estate Costs for Alternative 3 from In-Progress Review Report for Reno-Sparks- Truckee Meadows Flood Damage Reduction and Environmental Restoration Alternatives Report, November 2000.</i>			
<i>(3) Unit real estate costs based on Truckee Meadows Office Report, May 1991. Based on estimated inundation area of approximately 270 acres.</i>			
<i>(4) Required area of 120 acres at estimated \$5,000 per acre.</i>			
<i>(5) Costs based on Real Estate Costs for Alternative 4 from In-Progress Review Report for Reno-Sparks- Truckee Meadows Flood Damage Reduction and Environmental Restoration Alternatives Report, November 2000 .</i>			
<i>(6) Real estate costs based on Truckee Meadows Office Report, May 1991. Three borrow and disposal sites were identified with the following areas: 26.7 acres, 384.6 acres and 66.7 acres.</i>			

TABLE 8
Quantities and Cost Estimates for Relocations (Feature Code 02)

Relocations: Rock Boulevard Bridge (Truckee River)				
Description	Unit	Quantity	Unit Cost	Total Cost
Removal of Bridge	LS	1	\$ 614,788	\$ 614,788
Excavation	CY	3,297	\$ 41	\$ 135,143
Backfill	CY	2,521	\$ 32	\$ 80,362
Roadway Features	sq ft	26,277	\$ 41	\$ 1,078,517
Concrete	CY	4,603	\$ 687	\$ 3,163,566
Reinforcing Steel	tons	498	\$ 1,542	\$ 768,038
Concrete Piles	lin ft	2,016	\$ 725	\$ 1,460,403
Mobilization	LS	1	\$ 768,785	\$ 768,785
WPCP and Treatment System	LS	1	\$ 649,068	\$ 649,068
Utilities	LS	1	\$ 394,552	\$ 394,552
Total				\$ 9,113,223
<i>Note: Rock Boulevard Bridge cost based on as-built data and costs for Center Street Bridge replacement</i>				

Relocations: Mc Carran Boulevard Bridge (Truckee River)				
Description	Unit	Quantity	Unit Cost	Total Cost
Removal of Bridge	LS	1	\$ 620,122	\$ 620,122
Excavation	CY	3,326	\$ 41	\$ 136,316
Backfill	CY	2,543	\$ 32	\$ 81,059
Roadway Features	sq ft	26,505	\$ 41	\$ 1,087,875
Concrete	CY	4,643	\$ 687	\$ 3,191,016
Reinforcing Steel	tons	502	\$ 1,542	\$ 774,702
Concrete Piles	lin ft	2,033	\$ 725	\$ 1,473,075
Mobilization	LS	1	\$ 775,456	\$ 775,456
WPCP and Treatment System	LS	1	\$ 654,700	\$ 654,700
Utilities	LS	1	\$ 397,976	\$ 397,976
Total				\$ 9,192,296
<i>Note: Mc Carran Boulevard Bridge cost based on as-built data and costs for Center Street Bridge replacement</i>				

Relocations: Lower Pembroke Drive				
Description	Unit	Quantity	Unit Cost	Total Cost
Removal of existing roadway	LS	1	\$ 20,000	\$ 20,000
Excavation	CY	790	\$ 12	\$ 9,480
Roadway Surfacing	SF	21,331	\$ 3	\$ 63,993
Traffic Control	LS	1	\$ 10,000	\$ 10,000
Total				\$ 103,473

Relocations: Floodproofing for area east of Mc Carran Boulevard and immediately north of Boynton Slough				
Description	Unit	Quantity	Unit Cost	Total Cost
Floodproofing of Single Family Residences	Each	59	\$ 35,000	\$ 2,065,000
Total				\$ 2,065,000
<i>Note: Estimated unit cost for floodproofing a single family residence (structure raise) from U.S. Army Corps of Engineers Flood Proofing Committee</i>				

TABLE 9
Quantities and Cost Estimates for Channels and Canals (Feature Code 09)

Channels and Canals: North Truckee Drain Re-Alignment				
Description	Unit	Quantity	Unit Cost	Total Cost
Clearing and Grubbing	AC	5.9	\$ 3,000	\$ 17,700
Excavation	CY	125,163	\$ 12	\$ 1,501,956
Backfill	CY	39,698	\$ 10	\$ 396,980
Reinforced Concrete	CY	8,914	\$ 350	\$ 3,119,900
Concrete - Channel Lining	CY	2998	\$ 80	\$ 239,840
Total				\$ 5,276,376

Channels and Canals: Boyton Slough Channel Enclosure/Box Culvert				
Description	Unit	Quantity	Unit Cost	Total Cost
Clearing and Grubbing	AC	1.7	\$ 3,000	\$ 5,100
Excavation	CY	5,447	\$ 12	\$ 65,364
Backfill	CY	2,724	\$ 10	\$ 27,240
Reinforced Concrete	CY	10,829	\$ 350	\$ 3,790,010
Erosion Control Seeding	AC	1.7	\$ 2,500	\$ 4,250
Total				\$ 3,886,864

Channels and Canals: Truckee River (Greg Street to Vista) Channel Benching				
Description	Unit	Quantity	Unit Cost	Total Cost
Clearing and Grubbing	AC	170.7	\$ 3,000	\$ 512,100
Excavation	CY	2,654,068	\$ 12	\$ 31,848,816
Erosion Control Filter Fabric	SY	30,204	\$ 2	\$ 60,409
Erosion Control Seeding	AC	170.7	\$ 2,500	\$ 426,750
				\$ -
Total				\$ 32,848,075

Note: Channel benching designs and costs based flood damage reduction objectives only. The above channel benching cost estimate does not incorporate ecosystem restoration components proposed for benched area.

TABLE 10

Quantities and Cost Estimates for Levees and Floodwalls (Feature Code 11) for Alternative 1 - Levees and Floodwalls with 2,800 cfs Additional Downstream Flows

Structure Type	Description	Unit	Quantity	Unit Cost	Cost per Material Type	Total Cost per Structure Type
Floodwall	Wall Rein. Concrete	CY	53,687	\$ 350	\$ 18,790,537	\$ 22,528,364
	Wall Sand Fill	CY	14,276	\$ 20	\$ 285,515	
	Wall Face Trmt.	CY	4,411	\$ 10	\$ 44,109	
	Excavation	CY	136,222	\$ 16	\$ 2,179,547	
	Backfill	CY	68,259	\$ 18	\$ 1,228,656	
Levee	Base Excavation	CY	241,789	\$ 12	\$ 2,901,471	\$ 17,803,954
	Levee Fill Volume	CY	654,189	\$ 18	\$ 11,775,403	
	Erosion Control	SY	1,477,072	\$ 2	\$ 2,954,144	
	Aggregate	CY	10,809	\$ 16	\$ 172,936	
Relief Well	# of Wells	Each	386	\$ 10,000	\$ 3,855,595	\$ 4,382,923
	Aggregate Base	CY	7,497	\$ 16	\$ 119,950	
	Collection Ditch Concrete	CY	3,084	\$ 80	\$ 246,717	
	Collection Ditch Excavation	CY	16,066	\$ 10	\$ 160,661	
Cutoff Wall	Cutoff Wall Slurry Volume	CY	139,813	\$ 120	\$ 16,777,512	\$ 17,593,346
	Impervious Fill Volume	CY	32,633	\$ 25	\$ 815,834	
Seepage Berm	Earth Fill Volume	CY	385,600	\$ 10	\$ 3,856,005	\$ 5,747,189
	Filter Fabric Area	SY	542,726	\$ 1	\$ 542,726	
	Drain Rock Volume	CY	89,897	\$ 15	\$ 1,348,458	
Drainage Blanket	Drain Rock Volume	CY	7,913	\$ 15	\$ 118,693	\$ 197,821
	Aggregate Base Course	CY	1,978	\$ 16	\$ 31,651	
	Filter Fabric Area	SY	47,477	\$ 1	\$ 47,477	
Impervious Berm	Impervious Fill Volume	CY	0	\$ 25	\$ -	\$ -
Disturbed Area	Clearing and Grubbing	ACRE	223	\$ 3,000	\$ 669,335	\$ 1,227,114
	Erosion Control Seeding	ACRE	223	\$ 2,500	\$ 557,779	

TABLE 11

Quantities and Cost Estimates for Levees and Floodwalls (Feature Code 11) for Alternative 2 - Levees Floodwalls, and Detention Basins with No Increase in Downstream Flows

Structure Type	Description	Unit	Quantity	Unit Cost	Cost per Material Type	Total Cost per Structure Type
Floodwall	Wall Rein. Concrete	CY	45,554	\$ 350	\$ 15,944,075	\$ 19,501,696
	Wall Sand Fill	CY	12,781	\$ 20	\$ 255,610	
	Wall Face Trmt.	CY	3,882	\$ 10	\$ 38,823	
	Excavation	CY	126,859	\$ 16	\$ 2,029,750	
	Backfill	CY	68,524	\$ 18	\$ 1,233,439	
Levee	Base Excavation	CY	381,741	\$ 12	\$ 4,580,887	\$ 35,824,151
	Levee Fill Volume	CY	1,437,923	\$ 18	\$ 25,882,610	
	Erosion Control	SY	2,553,472	\$ 2	\$ 5,106,944	
	Aggregate	CY	15,857	\$ 16	\$ 253,710	
Relief Well	# of Wells	Each	340	\$ 10,000	\$ 3,403,965	\$ 3,915,873
	Aggregate Base	CY	7,278	\$ 16	\$ 116,443	
	Collection Ditch Concrete	CY	2,994	\$ 80	\$ 239,502	
	Collection Ditch Excavation	CY	15,596	\$ 10	\$ 155,963	
Cutoff Wall	Cutoff Wall Slurry Volume	CY	171,583	\$ 120	\$ 20,589,973	\$ 21,423,505
	Impervious Fill Volume	CY	33,341	\$ 25	\$ 833,532	
Seepage Berm	Earth Fill Volume	CY	396,644	\$ 10	\$ 3,966,439	\$ 5,770,477
	Filter Fabric Area	SY	513,858	\$ 1	\$ 513,858	
	Drain Rock Volume	CY	86,012	\$ 15	\$ 1,290,180	
Drainage Blanket	Drain Rock Volume	CY	7,913	\$ 15	\$ 118,693	\$ 197,821
	Aggregate Base Course	CY	1,978	\$ 16	\$ 31,651	
	Filter Fabric Area	SY	47,477	\$ 1	\$ 47,477	
Impervious Berm	Impervious Fill Volume	CY	319,140	\$ 25	\$ 7,978,501	\$ 7,978,501
Disturbed Area	Clearing and Grubbing	ACRE	309	\$ 3,000	\$ 927,053	\$ 1,699,597
	Erosion Control Seeding	ACRE	309	\$ 2,500	\$ 772,544	

TABLE 12

Quantities and Cost Estimates for Levees and Floodwalls (Feature Code 11) for Alternative 3 - Channel Benching (Community Coalition) Alternative

Structure Type	Description	Unit	Quantity	Unit Cost	Cost per Material Type	Total Cost per Structure Type
Floodwall	Wall Rein. Concrete	CY	21,311	\$ 350	\$ 7,458,692	\$ 9,363,963
	Wall Sand Fill	CY	6,358	\$ 20	\$ 127,158	
	Wall Face Trmt.	CY	1,893	\$ 10	\$ 18,933	
	Excavation	CY	66,389	\$ 16	\$ 1,062,217	
	Backfill	CY	38,720	\$ 18	\$ 696,962	
Levee	Base Excavation	CY	196,546	\$ 12	\$ 2,358,552	\$ 17,319,864
	Levee Fill Volume	CY	689,026	\$ 18	\$ 12,402,465	
	Erosion Control	SY	1,212,338	\$ 2	\$ 2,424,677	
	Aggregate	CY	8,386	\$ 16	\$ 134,170	
Relief Well	# of Wells	Each	289	\$ 10,000	\$ 2,891,456	\$ 3,360,169
	Aggregate Base	CY	6,664	\$ 16	\$ 106,617	
	Collection Ditch Concrete	CY	2,741	\$ 80	\$ 219,293	
	Collection Ditch Excavation	CY	14,280	\$ 10	\$ 142,802	
Cutoff Wall	Cutoff Wall Slurry Volume	CY	10,386	\$ 120	\$ 1,246,331	\$ 1,333,832
	Impervious Fill Volume	CY	3,500	\$ 25	\$ 87,501	
Seepage Berm	Earth Fill Volume	CY	43,867	\$ 10	\$ 438,666	\$ 899,266
	Filter Fabric Area	SY	131,600	\$ 1	\$ 131,600	
	Drain Rock Volume	CY	21,933	\$ 15	\$ 329,000	
Drainage Blanket	Drain Rock Volume	CY	7,469	\$ 15	\$ 112,032	\$ 186,721
	Aggregate Base Course	CY	1,867	\$ 16	\$ 29,875	
	Filter Fabric Area	SY	44,813	\$ 1	\$ 44,813	
Impervious Berm	Impervious Fill Volume	CY	0	\$ 25	\$ -	\$ -
Disturbed Area	Clearing and Grubbing	ACRE	135	\$ 3,000	\$ 404,860	\$ 742,243
	Erosion Control Seeding	ACRE	135	\$ 2,500	\$ 337,383	

TABLE 13

Quantities and Cost Estimates for Floodway Control and Diversion Structures (Feature Code 15)

Flood Control and Diversion Structures: Huffaker Hills Detention Structure				
Description	Unit	Quantity	Unit Cost	Total Cost
Clearing and Grubbing	ACRE	3	\$ 6,718	\$ 20,154
Excavation unclassified	CY	40,000	\$ 10	\$ 403,080
Excavation (waste)	CY	2,500	\$ 5	\$ 13,436
Construction access road	JOB	1	\$ 67,180	\$ 67,180
Foundation Cleanup	SY	2,000	\$ 17	\$ 33,590
Grouting curtain	LF	24,000	\$ 30	\$ 709,421
Concrete Piles 2' diameter 50' long verticle	LF	5,000	\$ 35	\$ 174,668
Concrete Piles 2' diameter 75' long angled	LF	7,500	\$ 40	\$ 302,310
Embankment- backfill	CY	28,000	\$ 3.5	\$ 97,814
Embankment - RCC	CY	37,000	\$ 43	\$ 1,590,822
Formed Concrete	CY	70	\$ 349	\$ 24,454
Reinforcing Steel	LB	14,000	\$ 0.8	\$ 11,286
Rip Rap Erosion Protection	TON	20,000	\$ 27	\$ 537,440
Bedding Material	TON	1,000	\$ 16	\$ 16,123
Concrete Pipe 48" RCC	LF	120	\$ 228	\$ 27,409
Box Culvert	EACH	1	\$ 20,154	\$ 20,154
Miscellaneous Items	JOB	1	\$ 67,180	\$ 67,180
Care and Diversion of Water	JOB	1	\$ 134,360	\$ 134,360
			Total	\$ 4,250,882
<i>Notes:</i>				
<i>(1) - Quantities and unit costs based on Truckee Meadows Office Report, May 1991</i>				

Flood Control and Diversion Structures: UNR Farms Detention Facility Inlet Structure, Outlet Structure and Low Level Outlet				
Description	Unit	Quantity	Unit Cost	Total Cost
Clear and Grub	AC	2	3000	\$ 6,000
Excavation	CY	1,778	12	\$ 21,336
Bedding Material	CY	463	6	\$ 2,778
Formed Concrete	CY	1,778	350	\$ 622,300
Reinforcing Steel	LBS	355,556	\$ 0.65	\$ 231,111
Rip Rap	CY	1,070	43	\$ 46,010
			Total	\$ 929,535
<i>Notes:</i>				
<i>(1) - Quantities from Truckee Meadows, Nevada Reconnaissance Reevaluation Report, August 1997.</i>				

Flood Control and Diversion Structures: Mustang Ranch Detention Facility Inlet Structure, Outlet Structure and Low Level Outlet				
Description	Unit	Quantity	Unit Cost	Total Cost
Inlet Structure and Outlet Structures	1	LS	\$ 925,000	\$ 925,000
			Total	\$ 925,000
<i>Notes:</i>				
<i>(1) - Costs based on Truckee Meadows, Nevada Reconnaissance Reevaluation Report, August 1997 for University of Nevada, Reno Farms Inlet and Outlet Structures</i>				

TABLE 14
Quantities and Cost Estimates for Operation and Maintenance of Flood Damage Reduction Features

Alternative 1 - Operation and Maintenance				
Description	Unit	Quantity	Unit Cost	Total Cost
Levees and Floodwalls - O&M	Miles	21	\$ 5,400	\$ 112,819
Levees and Floodwalls - major replacement	Miles	21	\$ 21,500	\$ 449,187
Seepage Remediations - Relief Well - O&M	Each	386	\$ 480	\$ 185,069
Seepage Remediations - Relief Well - major replacement	Each	4	\$ 10,000	\$ 38,556
Seepage Remediations - Seepage Berm	Acre	112	\$ 750	\$ 84,100
Seepage Remediations - Drainage Blanket	Acre	10	\$ 750	\$ 7,357
Boynton Slough Channel Enclosure-Box Culvert	LS	1	\$ 16,000	\$ 16,000
			Total	\$ 893,088

Alternative 2 - Operation and Maintenance				
Description	Unit	Quantity	Unit Cost	Total Cost
Levees and Floodwalls - O&M	Miles	26	\$5,400	\$ 140,289
Levees and Floodwalls - major replacement	Miles	26	\$21,500	\$ 558,556
Seepage Remediations - Relief Well - O&M	Each	340	\$480	\$ 163,390
Seepage Remediations - Relief Well - major replacement	Each	3	\$10,000	\$ 34,040
Seepage Remediations - Seepage Berm	Acre	106	\$750	\$ 79,627
Seepage Remediations - Drainage Blanket	Acre	10	\$750	\$ 7,357
Seepage Remediations - Impervious Berm	Acre	31	\$750	\$ 22,958
North Truckee Drain Re-Alignment	LS	1	\$16,000	\$ 16,000
Huffaker Hills Detention Facility	LS	1	\$16,000	\$ 16,000
			Total	\$ 1,038,216

Alternative 3 - Operation and Maintenance				
Description	Unit	Quantity	Unit Cost	Total Cost
Levees and Floodwalls - O&M	Miles	15	\$5,400	\$ 79,379
Levees and Floodwalls - major replacement	Miles	15	\$21,500	\$ 316,046
Seepage Remediations - Relief Well - O&M	Each	289	\$480	\$ 138,790
Seepage Remediations - Relief Well - major replacement	Each	3	\$10,000	\$ 28,915
Seepage Remediations - Seepage Berm	Acre	27	\$750	\$ 20,393
Seepage Remediations - Drainage Blanket	Acre	9	\$750	\$ 6,944
Benching	Acre	171	\$750	\$ 128,025
North Truckee Drain Re-Alignment	LS	1	\$16,000	\$ 16,000
Huffaker Hills Detention Facility	LS	1	\$16,000	\$ 16,000
			Total	\$ 750,491

**TABLE 15
UNIT COSTS FOR FIRST COST (CONSTRUCTION) ESTIMATES**

Cost Account	Description	Unit	Unit Price
	Item		(\$)
Floodwall	Reinforced Concrete	CY	\$ 350
	Base Excavation	CY	\$ 16
	Sand Backfill	CY	\$ 20
	Structure Backfill	CY	\$ 18
	Wallface Water Treatment	SY	\$ 10
Levee	Bottom Levee Excavation	CY	\$ 12
	Import Fill (Embankment)	CY	\$ 18
	Aggregate Base (AB)	CY	\$ 16
	Erosion Control-Geotextile Fabric	SY	\$ 2
	Riprap Slope Protection	CY	\$ 30
Relief Wells	Relief Well	EA	\$ 10,000
	Aggregate Base (AB)	CY	\$ 16
	Collection Ditch Concrete	CY	\$ 80
	Collection Ditch Excavation	CY	\$ 10
Cutoff Wall	Cutoff Wall Slurry	CY	\$ 120
	Impervious Fill	CY	\$ 25
Seepage Berm	Import Fill	CY	\$ 10
	Filter Fabric	SY	\$ 1
	Drain Rock	CY	\$ 15
Drainage Blanket	Drain Rock	CY	\$ 15
	Aggregate Base (AB)	CY	\$ 16
	Filter Fabric	SY	\$ 1
Impervious Berm	Impervious Fill	CY	\$ 25
Construction Footprint	Clearing and Grubbing	ACRE	\$ 3,000
	Erosion Control Seeding	ACRE	\$ 2,500
Relocations	Excavation	CY	\$ 12
	Roadway Surfacing	SF	\$ 3
Floodway Control and Diversion Structures	Clearing and Grubbing	ACRE	\$ 3,000
	Excavation	CY	\$ 12
	Bedding Material	CY	\$ 6
	Formed Concrete	CY	\$ 350
	Reinforcing Steel	LBS	\$ 0.65
	Rip Rap	CY	\$ 43
Channels and Canals	Clearing and Grubbing	CY	\$ 3,000
	Benching Excavation	CY	\$ 12
	Excavation	CY	\$ 12
	Slope Protection	CY	\$ 43
	Rip Rap	CY	\$ 10
	Reinforced Concrete	CY	\$ 350
	Backfill	CY	\$ 10
	Erosion Control Seeding	ACRE	\$ 2,500
	Concrete - Channel Lining	CY	\$ 80
	Erosion Control-Geotextile Fabric	SY	\$ 2

**TABLE 16
UNIT COSTS FOR OPERATION AND MAINTENANCE COST ESTIMATES**

	Cost Account	Description	Unit	Unit Price (\$)
Containment Features	Floodwall & Levee	Operation and Maintenance ⁽¹⁾	Mile	\$ 5,400
		Major Replacement ⁽²⁾	Mile	\$ 21,500
	Seepage Remediation - Relief Wells	Operation and Maintenance ⁽³⁾	EA	\$ 480
		Major Replacement ⁽⁴⁾	EA	\$ 10,000
	Seepage Remediation - Seepage Berm	Operation and Maintenance ⁽⁵⁾	AC	\$ 750
	Seepage Remediation - Drainage Blanket	Operation and Maintenance ⁽⁵⁾	AC	\$ 750
	Seepage Remediation - Impervious Berm	Operation and Maintenance ⁽⁵⁾	AC	\$ 750
	Seepage Remediation - Cutoff Wall	No additional O&M costs are anticipated where the cutoff wall is constructed		
Bridge and Roadway Modifications	Rock Boulevard Bridge Widening	No additional O&M costs are anticipated above those for existing bridge		
	Mc Carran Boulevard Bridge Widening	No additional O&M costs are anticipated above those for existing bridge		
	Rock Boulevard Bridge Widening	No additional O&M costs are anticipated above those for existing roadway		
Channel Modification	Benching	Operation and Maintenance ⁽⁵⁾	AC	\$ 750
	North Truckee Drain Re-Alignment	Operation and Maintenance ⁽⁶⁾	EA	\$ 16,000
	Extension of Airport Culvert	Operation and Maintenance ⁽⁶⁾	EA	\$ 16,000
Storage/ Detention	UNR Farms Detention Facility	Primary components of this alternative are levees and seepage mitigation features. O&M costs for these features are included above under levees and seepage remediation costs		
	Huffaker Hills Detention Facility	Operation and Maintenance ⁽⁶⁾	EA	\$ 16,000
	Mustang Ranch Detention Facility	Primary components of this alternative are levees and seepage mitigation features. O&M costs for these features are included above under levees.		
Floodplain Management	Floodproofing	No additional O&M costs are anticipated for floodproofed structures		
<p><i>Notes:</i></p> <p>⁽¹⁾ Floodwall and levee operation and maintenance unit costs based on Truckee Meadows, Nevada Reconnaissance Reevaluation Report, August 1997.</p> <p>⁽²⁾ Floodwall and levee major replacement unit costs based on Truckee Meadows, Nevada Reconnaissance Reevaluation Report, August 1997.</p> <p>⁽³⁾ Costs of well observations and well O&M estimated as 8 person hours per year @ \$60 per hour per well</p> <p>⁽⁴⁾ Cost of replacing 50% of wells by year 50 at 6-5/8 % interest rate</p> <p>⁽⁵⁾ Cost for inspection, mowing, spraying, and other maintenance activities for seepage remediation surfaces and benched areas</p> <p>⁽⁶⁾ Costs of facility maintenance estimated at 80 hours per year @ \$200 per hour+C12 which includes equipment and labor costs</p>				