Small Flood Risk Management Project Hatch, NM

Appendix J
Civil Engineering

December 2016
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1 - SITE DEVELOPMENT

1.1 Introduction

A new dam will be provided to protect the Village of Hatch, New Mexico, from flooding. Three dam alternatives were analyzed, each providing protection associated with different design capacities. The recommended dam alternative is sized for a 0.2% annual chance exceedance flood event; and is referred to as “Dam C” or “the dam” in the following portions of this write-up. Dam C will detain a storage capacity of 283 acre-feet (AF). This storage capacity consists of a 30 AF sediment pool and 253 AF of water. Dam C is approximately 4191 feet in length and contains a roller compacted concrete spillway and apron, and concrete outlet works. Access roads are required on both sides of the dam and ramps will be constructed to access the top of the dam from these roads. Fencing encloses the reservoir and gates are provided as needed for access to the new dam. A new trapezoidal channel transports runoff from nearby Spring Canyon Dam to Dam C’s reservoir. A new storm drain line is provided to collect and remove standing water located outside the proposed dam area. Drawings illustrating new Dam C project features are included in this appendix as Exhibit A. An existing waterline will be removed and relocated, as it is currently situated within the dam’s reservoir area. See Section 1.5 of this write-up for more detailed site development information.

Due to ongoing design, the Dam C embankment section has changed since the time of the Agency Technical Review (ATR). This write-up and referenced Dam C quantities reflect the current design conditions.

1.2 Existing Conditions

The project site is located at Hatch in the south-central portion of the New Mexico, approximately 37 miles north of the City of Las Cruces, New Mexico. The proposed dam is situated within an open field located on the south side of the town.

Several existing features are located within the proposed footprint of the dam and reservoir. An existing waterline is located within the eastern end of the proposed dam’s reservoir area. The water line crosses the field in the northeast-southwest direction. An existing spoil levee, approximately 700 feet in length, is located near the easternmost portion of the proposed dam embankment.

Several existing features are located outside the footprint of the dam and reservoir, some of which may be impacted to accommodate new dam construction. An existing sanitary sewer lift station is located near the proposed dam’s northwest embankment footprint (near dam station 23+00A). A 15 foot clearance is provided between the lift station boundary fencing and the closest dam embankment toe. An existing overhead power line runs parallel with the south side of Chonte Road. An existing power pole will be located near the northernmost embankment of the proposed dam. The Rodey Lateral and the Colorado Drain are located northeast of the proposed new dam.
1.3 Survey

The existing conditions topographic mapping illustrated on the Dam C drawings (Exhibit A, this appendix) is based on mapping obtained from the Doña Ana County Flood Commission. The Doña Ana County Flood Commission mapping was generated from a topographic survey conducted in 2004. The horizontal datum is NAD83 and the vertical datum is NAVD 88. Map coordinates are NM State Plane, Central Zone, U.S. feet. North arrow and bearings are based on grid coordinates. Elevations are in feet and contours are at 1 foot intervals. Distances are grid distances. The grid-to-ground scale factor is 0.99990909.

1.4 Demolition and Relocations

The waterline (referenced in Section 1.2 of this write-up) will be removed and relocated (as part of the dam construction contract) to accommodate new dam construction. The existing Rodey Lateral embankments (located northeast of the proposed dam) will be removed and replaced as required to install the new dam’s outlet works conduit. To accommodate new construction, the proposed borrow area (the dam’s reservoir area) will require clearing and grubbing to remove all organic material from the site. The existing spoil levee (referenced in Section 1.2 of this write-up) will be removed in its entirety as part of the new dam construction contract. If removed earth material meets associated specification requirements, it will be utilized as fill for new dam construction; if it does not meet associated requirements it will become waste material and removed from the construction site. It is unclear whether the existing power pole (referenced in Section 1.2 of this write-up) will have to be relocated, until a current planimetric/topographic/utility survey is obtained.

1.5 Site Development

1.5.1 Dam Section

Dam C is approximately 4191 feet in length with a 20 foot crest width (typically at elevation 4075.60) and 1V:3H exterior side slopes. Dam C is approximately 22.6 feet high at its highest point (near the outlet works). A double barrel box culvert is located below the east end of the dam, to allow flows from Spring Canyon Channel to enter. The typical dam section consists of a central semi-impervious earth core (10 feet wide at top) surrounded by random fill material; soil cement layer side slopes at reservoir side; gravel layer (6 inches thick) side slopes at non-reservoir side; a 20 foot wide by 6 inch thick soil cement cap (at top of dam); and an inspection trench. At higher sections of the dam (from station 17+00A to 32+75A), a sub-surface drainage blanket and toe drain system (refer to the Geotechnical Appendix) are located at the bottom of the non-reservoir dam embankment.

The dam section near Spring Canyon Channel has a crest elevation of 4078.5 and soil cement side slopes at both sides of the dam. The higher crest elevation at this location is provided to ensure that the probable maximum flood (PMF) from Spring Canyon Channel does not enter Dam C by overtopping its crest. The soil cement at the non-reservoir side of the dam is provided as erosion protection to accommodate the Spring Canyon Channel/culvert overtopping described
1.5.2 Dam Spillway

A 350 foot wide spillway (with a crest elevation of 4067.7) is centered at station 35+13.40A of the dam alignment and is constructed of roller compacted concrete (RCC). The sides of the spillway (from spillway crest to top of dam) are also constructed of RCC and have a 1V:1H exterior side slope. The dam section immediately upstream of the spillway has RCC extending 2 feet below the spillway crest and soil cement below this. The dam section immediately downstream of the spillway is constructed entirely of RCC, and has a 40 foot long RCC apron.

1.5.3 Dam Outlet Works

The dam outlet works (located near dam station 32+33A) are constructed of concrete and will convey reservoir flows into the Colorado Drain. The outlet works will be approximately 307 feet in length and consist of an intake tower, a gatewell structure, a rectangular conduit with manhole access (located approximately two thirds of the way down the conduit length), and a retaining wall with concrete and wire wrapped riprap aprons at the downstream end of the conduit. Finished grades at the outlet works intake tower will be excavated approximately 6 feet below existing grades to accommodate the tower and reservoir invert elevation at this location.

1.5.4 Dam Reservoir

The random fill material needed for the construction of the new dam will come from borrow located within the dam’s reservoir area. New grades within the dam’s reservoir area have a low point (approximately elevation 4053) adjacent to the outlet works intake tower and slope upward (at approximately 1%) into the reservoir area in a radial fashion for a distance of approximately 900 feet. If the reservoir area is excavated to the design capacity of 283 acre-feet, approximately 16% of the needed random fill material will be imported (with the current dam and spillway configuration). If the reservoir area is excavated to the maximum extent feasible (beyond the 283 acre-feet design capacity), some soil waste will be generated. Existing sub-surface soil conditions limit the amount of excavation within the reservoir area to a maximum dam storage capacity of approximately 305 acre-feet. The difference between excavation and fill material quantities will be optimized during the Plans and Specification design stage to balance associated volumes. Refer to the Geotechnical Appendix for potential project borrow sites, should they be needed.

1.5.5 Spring Canyon Channel

A new trapezoidal channel will collect/divert flows from Spring Canyon and convey them into the new dam’s reservoir. The new trapezoidal channel is approximately 1,319 feet in length and has 1V:3H side slopes. The trapezoidal channel transitions to a double barrel concrete box culvert (located below the east dam embankment) to allow flows from Spring Canyon Channel to enter the dam. Downstream of the box culvert (interior to the dam), the channel transitions back to trapezoidal and extends to the excavation area associated with the dam’s reservoir. Each barrel of the culvert is 5’ high by 9’ wide.
The culverts and channel are sized to allow flows below the 0.2% annual chance exceedance flood event to enter the dam. The channel and box culvert system have a minimum capacity of 870 cubic feet per second. Flows in excess of this flood event will pool upstream of the culvert, overtop the northeast side of the channel (at the non-reservoir side of the dam), and pass to the northeast. Armoring of the non-reservoir side of the dam at this location, and the channel configuration (higher southwest side slopes) and integral apron (at northeast channel side slope) are designed to protect these structures during channel overtopping events.

1.5.5.1 Channel Sections Upstream of Intersecting Dam Embankment

The upstream end of Spring Canyon Channel (approximately a 150 foot long portion) is constructed of RCC to accommodate the higher velocities associated with the steeper channel invert slope located here. The portion of the channel between the upstream RCC section and the transition to box culvert at the dam is constructed of soil cement. The typical soil cement channel section at this location has a 10 foot wide invert and has side slopes that are 5.5 feet high. The typical channel section transitions to a soil cement apron section that has: 8 foot high southwest side slopes; 6’ high northeast side slopes; and a 25’ wide apron (constructed integral with top of the northeast side slope). The channel apron section is located just upstream of the box culvert; is approximately 200 feet long; and accommodates the hydraulic conditions associated with the overtopping of the channel at this location. Refer to the Dam C project drawings (included in the Civil Engineering Appendix, as Exhibit A) for detailed Spring Canyon Channel section information.

1.5.5.2 Channel Sections Downstream of Intersecting Dam Embankment

The typical channel section downstream of the box culvert (at the dam) has a 20 foot wide invert and has side slopes that are 5 feet high. This section transitions as required to accommodate a 100 foot wide by 50 foot long apron at the downstream end of the channel within the dam reservoir. Approximately the upstream half of this section of channel is constructed of soil cement. The downstream half, from the soil cement portion to the apron within the reservoir, is constructed of riprap. Riprap sections are 2 feet thick, over a 6 inch thick layer of bedding material and filter fabric. To dissipate energy from channel flows before they enter the reservoir, large diameter riprap is utilized at the downstream portion of the channel, the transition to the apron, and at the apron itself. Refer to the Dam C project drawings (included in the Civil Engineering Appendix, as Exhibit A) for detailed Spring Canyon Channel section information.

1.5.6 Maintenance Roads

A new road will be provided on each side of the new dam (for operation and maintenance purposes) and two ramps are provided to access the top of the dam.

1.6 Access and Staging Area

Construction access to the project site will be from Chonte Road, which connects directly to 6th street, which in turn connects to New Mexico State Highway 26. Chonte Road is located north of the proposed dam. From Chonte Road, construction access will be from Recuerdos Road and
then Tepache Road. Both roads are located on the west side of the proposed dam. The Contractor’s Staging Area will be located on the south side of the excavation associated with the proposed dam’s reservoir area.

1.7 Grading

The site is graded as required to drain local runoff away from the new dam embankments. The dam’s reservoir area is graded as required to divert all surface runoff to the outlet works intake structure; and as required to provide the dam’s design storage capacity. The footprint of the new dam will be cleared and grubbed of all organic material and then compacted to accommodate the new earth embankment (dam). The access roads on either side of the dam embankment are graded to provide a level driving surface.

1.8 Erosion Protection

Soil cement will protect the dam crest and the side slopes at the reservoir side of dam. Gravel material (6 inches thick) will serve as erosion protection at the side slopes of the non-reservoir side of dam. Additional erosion protection is provided on the side slopes of the non-reservoir side of the dam, via soil cement, where Spring Canyon Channel intersects the dam. Roller compacted concrete will serve as erosion protection at the dam spillway and associated downstream apron. Spring Canyon Channel is constructed of roller compacted concrete, soil cement, or riprap, which will all serve as the channel’s erosion protection. A concrete apron and 12-inch thick wire wrapped riprap will provide erosion protection where the dam’s outlet works conduit and 24-inch storm drain pipe empty into the Colorado Drain.

1.9 Storm Drain Line

A ponding area will form between; the new dam embankment (approximately between stations 20+00A and 25+00A), existing Chonte Road, and an existing ridge located south of Chonte Road and west of referenced dam embankment. A storm drain line (approximately 1,684 feet long), consisting of 24-inch diameter pipe and manholes, is provided to eliminate standing water at this location. Manholes are located within the storm drain line at all alignment bends, and at a 500 foot maximum spacing. The three upstream-most manholes (located within the runoff ponding area) are drop inlet manholes. The storm drain line outfall discharges into the Colorado Drain, adjacent to the outlet works conduit outfall. A new headwall is located at the downstream end of the storm drain line. The dam’s sub-surface drainage blanket and toe drain system (from station 17+00A to 32+75A) discharges into the storm drain line at each manhole location.

1.10 Utilities

Refer to Sections 1.2 and 1.4 of this write-up for information related to the removal and relocation of existing utilities required to accommodate the new dam construction. The existence of additional utilities within the dam embankment footprint or within the dam’s reservoir area is
unknown. A current planimetric/topographic/utility survey will be obtained and used for design and development of drawings during the plans and specifications design stage of this project.

1.11 Fencing

A new chain-link fence will surround the perimeter of the new dam and reservoir. The fence is placed on the non-reservoir side of the dam (enclosing the dam’s access road) and extends to high ground (located near the southeast side of the dam reservoir). The fence also encloses the portion of Spring Canyon Channel located exterior to the dam. Gates are provided as needed for vehicular access to the new dam. Temporary fencing will also be provided at the contractor’s staging area.

1.12 Turf and Landscaping

All disturbed areas (i.e., the borrow area within the dam’s reservoir area, the staging area, and etc…) will be seeded with grass to prevent erosion.

1.13 Quantities

Three dam design alternatives (Dam A, Dam B, and Dam C), with differing design capacities, were considered for this project. Associated quantities were developed for each of these alternatives. Refer to the Hydrology and Hydraulics Appendix for information related to each dam’s design capacity. The outlet works and storm drain line design/quantities essentially remained the same for all three alternatives. Dam C was designated the selected alternative and various associated quantities are illustrated in Section 2 of this write-up. The illustrated Dam C quantities reflect the embankment changes that have occurred since the ATR. The quantities associated with Dam C are reflected in the associated MCACES cost estimate located in the Cost Engineering Appendix. For Dam A and for Dam B, all the earth fill material needed for the construction of the new dams comes from borrow located within these dam’s reservoir areas. Both Dam A and Dam B will have excess reservoir excavation/spoil material that will have to be disposed. It will be possible to balance excavation and fill quantities for Dam C if the dam’s reservoir is over excavated between the design capacity (283 acre-feet) and the maximum extent feasible (305 acre-feet). See Section 1.5.4 above for additional related information.

Quantities for each dam design alternative were generated in the manner specified below. Bentley InRoads design software was utilized to model all components for the following: the dam (except the outlet works); Spring Canyon Channel; and the fill material between the dam embankment and Rodey Lateral. Models for the dam embankment, dam spillway, and for the new channel utilized templates representing all applicable section components (i.e., random fill, soil cement, roller compacted concrete, semi-impervious fill, riprap, and gravel surfacing). Once the project feature (i.e., dam embankment, channel section, and etc…) was accurately modeled, associated component volumes were generated from InRoads design software via two different methods (triangle volume and end-area-volume methods). Cross-sections for modeled project features were generated, checked for accuracy, and compared with associated end-area-volume
data. Quantities for other project features (i.e., outlet works, storm drain line, and etc…) were generated from data contained within the Dam C drawings (included in the Civil Engineering Appendix as Exhibit A). Quantity calculations/tables for all three dam alternatives are included in the Civil Engineering Appendix as Exhibit B.

Dam C quantity calculations/tables reflecting the updated Dam C embankment section are included in the Civil Engineering Appendix as Exhibit C.

1.14 CADD

The following computer-aided design and drafting (CADD) software was used in developing the digital terrain models, new topography, and drawings:

- MicroStation/V8
- Bentley InRoads

The following standards were used in developing drawings:

- A/E/C (Architectural/Engineering/Construction)
- CADD (Computer-Aided Design and Drafting) Standards
2 - SECTION 205 - HATCH NEW MEXICO - SUMMARY OF DAM C PROJECT FEATURES

Illustrated material volumes are not adjusted for compaction and swell.

2.1 Spillway

Maximum capacity at spillway crest................................................................. 283 acre-feet (456,573 cu yd)
Spillway cross section.............................................................................................. Trapezoidal
Construction............................................................................................................ Roller Compacted Concrete
Spillway length (parallel to dam alignment).......................................................... 350 feet
Spillway crest width (perpendicular to dam alignment)......................................... 74 feet
Spillway width (including downstream apron)...................................................... 123 feet
Spillway crest elevation ......................................................................................... 4067.7 feet

2.2 Dam

2.2.1 EMBANKMENTS

Length of dam embankment ................................................................................. 4,191 feet
Embankment crest width...................................................................................... 20 feet
Side slopes – exterior embankment slopes ........................................................... 3H:1V
Maximum height of embankment ......................................................................... 22.6 feet
Maximum footprint of dam.................................................................................. 147 feet
Typical top of dam elevation (top of 6 inch soil cement cap)............................ 4075.60 feet
Typical top of dam fill material (below 6 inch soil cement cap).................... 4075.10 feet
Toe of dam elevation ............................................................................................ Varies
Sediment pool capacity ....................................................................................... 30 acre-feet
Water pool capacity ............................................................................................ 253 acre-feet
Random fill volume for dam embankment ......................................................... 84,399 cu yd
Semi-impervious fill volume for dam embankment.............................................. 39,990 cu yd
Drainage blanket material .................................................................................. 9,331 cu yd
Soil cement fill volume for dam embankment .................................................... 22,553 cu yd
Roller compacted concrete fill volume (at spillway).......................................... 2,731 cu yd
Gravel slope protection fill volume for dam embankment............................... 2,714 cu yd
Excavation volume for dam embankment ........................................................ 24,069 cu yd
2.2.2 OUTLET WORKS

Outlet conduit size (average outside dimensions) ................................................. 5.0 feet x 8.0 feet
Outlet conduit size (inside dimensions) ................................................................. 3.0 feet x 5.0 feet
Intake tower rim elevation ....................................................................................... 4064.0 feet
Intake tower invert elevation ................................................................................... 4053.0 feet
Outlet conduit outfall elevation (invert) .................................................................. 4051.28 feet
Conduit length ......................................................................................................... 306.9 feet
Gatewell structure conduit size (at gate) .................................................................. 3.0 feet x 7.0 feet
Excavation volume for dam outlet works ................................................................. 3,218 cu yd
Random fill volume for dam outlet works ................................................................. 1,086 cu yd

2.3 Channel (at Spring Canyon)

Length of channel (including portion within dam) ................................................... 1,319 feet
Channel bottom width (upstream of dam) ............................................................... 10 feet
Channel bottom width (downstream of dam) ......................................................... 20 feet
Top of channel width ............................................................................................... Varies
Channel side slopes - cut slopes .............................................................................. 3H on 1V
Riprap apron dimension (at downstream of channel within dam) ......................... 100’W x 50’L
Design channel capacity (minimum) .................................................................... 870 cfs
Random fill volume for channel section .................................................................. 2,469 cu yd
Soil cement fill volume for channel section ......................................................... 4,725 cu yd
Roller compacted concrete fill volume for channel section (at upstream end) ........ 605 cu yd
Riprap fill volume for channel section (at downstream end and at apron) .......... 1,303 cu yd
Excavation volume for channel ............................................................................. 11,461 cu yd

2.4 Miscellaneous

2.4.1 FILL AREA BETWEEN RODEY LATERAL AND DAM

Fill area volume ..................................................................................................... 8,379 cu yd

2.4.2 RESERVOIR GRADING

Excavation volume for dam reservoir (at 283 AF storage) ................................... 113,753 cu yd
Maximum excavation volume for dam reservoir (at 305 AF storage) .................. 149,408 cu yd
Random fill volume for dam reservoir ................................................................. 1,698 cu yd
2.4.3 **STORM DRAIN LINE**

Length of storm drain line................................................................. 1,684 feet
Storm drain line pipe diameter...................................................... 24 inch
Number of manholes/inlets.............................................................. 6
Excavation volume for storm drain line................................. 4,440 cu yd
Random fill volume for storm drain line................................. 4,240 cu yd
Small Flood Risk Management Project Hatch, NM

EXHIBIT A - DAM C FEASIBILITY DRAWINGS

December 2016
DOÑA ANA COUNTY, NEW MEXICO

VILLAGE OF HATCH

PLANS FOR

SECTION 205 – HATCH NEW MEXICO

DAM C – FEASIBILITY DRAWINGS

(EXHIBIT A OF APPENDIX J)

SOLICITATION NO. : W912PP-XX-X-XXXX

DATED : DECEMBER 2016

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

Albuquerque District

Zero Accidents

Zero Tolerance

THE DESIGN, ASSOCIATED DETAILS, AND PRESENTATION CONCEPTS IN THIS SET OF DRAWINGS WERE ASSEMBLED AND REVIEWED BY THE FOLLOWING ALBUQUERQUE DISTRICT DESIGN TEAM. THIS DOCUMENT MEETS OUR HIGH STANDARDS OF QUALITY AND PROFESSIONALISM. DRAWINGS WERE ASSEMBLED AND REVIEWED BY THE FOLLOWING ALBUQUERQUE DISTRICT DESIGN TEAM. THIS DOCUMENT MEETS OUR HIGH STANDARDS OF QUALITY AND PROFESSIONALISM.

TEAM MEMBER

SIGNATURE

FUNCTION

CIVIL

TED SOLANO

CIVIL ENGINEER

GARY EDMAN

HYDRAULIC ENGINEER

WILLIAM CASAUS

ENVIRONMENTAL ENGINEER

ADAM MAESTAS

ENGINEERING TECHNICIAN

GEOTECHNICAL

MRS. MILLS, P.E.

CIVIL ENGINEER

CHARLES LITTLE

ENGINEERING TECHNICIAN

STRUCTURAL

RICHARD ZARAGOZA, P.E.

STRUCTURAL ENGINEER

LANCE FAERBER

STRUCTURAL TECHNICIAN

HYDROLOGY & HYDRAULICS

STEVE BOBERG

HYDRAULIC ENGINEER

ENVIRONMENTAL ENGINEERING

DAVID HENRY

ENVIRONMENTAL ENGINEER

ENVIRONMENTAL RESOURCES

DANIELLE GALLOWAY

ARCHAEOLOGIST

JEREMY DECKER

BIOLOGIST

COST ENGINEERING

TIM TETRICK

COST ESTIMATOR

PROJECT MANAGEMENT

LYNETTE GIESEN

PROJECT MANAGER

SIGNATURES AFFIXED BELOW INDICATE OFFICIAL RECOMMENDATION AND APPROVAL OF ALL DRAWINGS IN THIS SET AS NOTED.

SUBMITTED:

APPROVED:

CHIEF, DESIGN BRANCH

CHIEF, ENGINEERING AND CONSTRUCTION DIVISION

PLAN - DROP INLET MANHOLE

8" DIA. CONCRETE MANHOLE BASE

6" RCP MANHOLE C-76 CLASS 1

8" DIA. DRAINAGE BLANKET 12" DRAIN

ALUMINUM GRATING SEE NOTE 3/145 PLATE

CONCRETE APRON

OUTLET WORKS CONDUIT

24" PIPE

CONCRETE HEADWALL AND APRON

CONDITION OF WORKS CONDUIT

CONCRETE OUTLET BASE

12" DRAINAGE BLANKET 10" OF DRAIN

RANDOM FILL

12" DRAINAGE BLANKET 10" OF DRAIN

4057.28

1" = 5'

PLAN - MANHOLE

NOT TO SCALE

8" DIA. CONCRETE MANHOLE BASE

6" RCP MANHOLE C-76 CLASS 1

8" DIA. DRAINAGE BLANKET 12" DRAIN

MANHOLE COVER

REINFORCE WITH 4" REBAR AT 12" ON CENTER BOTH WAYS MINIMUM 3" COVER

RANDOM FILL

FLOW

24" DIA. PIPE

RANDOM FILL

FLOW

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REINFORCE WITH 4" REBAR AT 12" ON CENTER BOTH WAYS MINIMUM 3" COVER

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EXCAVATION

REINFORCE WITH 4" REBAR AT 12" ON CENTER BOTH WAYS MINIMUM 3" COVER

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8" DIA. CONCRETE MANHOLE BASE

6" RCP MANHOLE C-76 CLASS 1

8" DIA. DRAINAGE BLANKET 12" DRAIN

ALUMINUM GRATING SEE NOTE 3/145 PLATE

CONCRETE APRON

OUTLET WORKS CONDUIT

24" PIPE

CONCRETE HEADWALL AND APRON

CONDITION OF WORKS CONDUIT

CONCRETE OUTLET BASE

12" DRAINAGE BLANKET 10" OF DRAIN

RANDOM FILL

12" DRAINAGE BLANKET 10" OF DRAIN

4057.28

1" = 5'
Small Flood Risk Management Project Hatch, NM

EXHIBIT B – QUANTITY CALCULATIONS FOR DAMS A, B AND C

December 2016
## Hatch Quantities Summary (2014)

<table>
<thead>
<tr>
<th>Item</th>
<th>Dam A</th>
<th>Dam B</th>
<th>Dam C</th>
<th>Spring Canyon Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random Fill (General)</td>
<td>65,919.8</td>
<td>71,699.4</td>
<td>99,435.1</td>
<td><strong>2,468.6</strong></td>
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<tr>
<td>Random Fill (Key Trench)</td>
<td>11,122.5</td>
<td>11,275.3</td>
<td>11,816.7</td>
<td></td>
</tr>
<tr>
<td>Random Fill (SC Key)</td>
<td>6,347.0</td>
<td>6,485.0</td>
<td>6,756.2</td>
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<tr>
<td>Semi-Imp Fill</td>
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<td>Gravel Material (6&quot; thick)</td>
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<td>2,228.4</td>
<td>2,713.2</td>
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<tr>
<td>Soil Cement (SC)</td>
<td>18,939.5</td>
<td>19,377.1</td>
<td>22,552.9</td>
<td><strong>4,725.0</strong></td>
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<tr>
<td>RCC</td>
<td>1,972.0</td>
<td>2,144.9</td>
<td>2,730.4</td>
<td>605.0</td>
</tr>
<tr>
<td>Rip Rap (2' thick)</td>
<td>1,302.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedding Material (6&quot; thick)</td>
<td></td>
<td></td>
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<td>351.0</td>
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<tr>
<td>Concrete Box Culvert (CBC)</td>
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<td>126.7</td>
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<tr>
<td>Filter Fabric (sq. yards)</td>
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<td>2,355.9</td>
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<tr>
<td>Dam-Channel Exc (general)</td>
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<td>10,808.4</td>
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<tr>
<td>Dam Excav. (Key Trench)</td>
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<td>11,275.3</td>
<td>11,816.7</td>
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<tr>
<td>Reservoir Exc. (RE) (Model)</td>
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<td>156,178.1</td>
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<td>Clear &amp; Grubb (part of RE)</td>
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<td>9,000.0</td>
<td>9,000.0</td>
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<tr>
<td>Extra Reservoir Storage Above Design Cap (acre-ft)</td>
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<td>Extra Reservoir Stor. Above Design Cap (cubic yards)</td>
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<td>8,378.8</td>
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<td><strong>OTHER</strong></td>
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<tr>
<td>OutletWorks</td>
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<td>3,218.0</td>
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<td>Storm Drain System</td>
<td>4,240.0</td>
<td>4,440.0</td>
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<tr>
<td><strong>Total Excv (less clr &amp; grub)</strong></td>
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<td>188,380.0</td>
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<td><strong>182,602.9</strong></td>
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<td><strong>Total Excavation (less extra res storage)</strong></td>
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<td><strong>Total Fill</strong></td>
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<td><strong>177,876.7</strong></td>
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<td><strong>Net Soil Import</strong></td>
<td>45,389.4</td>
<td>3,316.9</td>
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<td></td>
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</table>

Notes:
1. All quantities are neat line and units are cubic yards unless noted otherwise.
2. Dam excavation (general) is primarily excavation for the Soil Cement (SC) key. Random fill (backfill) for the SC key is assumed to be 60% of the Dam Excavation (general) value.
3. Total fill quantities also include semi-impervious fill and the soil cement quantity.
4. Clear and Grub excavation is considered unusable fill material (due to organics present).
5. Net soil waste and import assumes soil shrinkage of 1.23; and soil swell of 1.18.
6. Dam ramps (wider dam section) have not been accounted for at any of the Dams.
7. Quantities associated with the Spring Canyon Channel and Dam Intersection are included above (except for the CBC U/S & D/S headwalls to be done by Cost Engr).
8. The following Outletworks quantities were generated by Cost Engineering: Intake Tower; Gatewell Structure, Conduit Concrete; Pressure Manhole; Filter Drain Material; WWRR (@outfall); Excavation & Fill.
Small Flood Risk Management Project Hatch, NM

EXHIBIT C – QUANTITY ADJUSTMENTS FOR DAM C

December 2016
GENERAL. Due to ongoing design changes, the original 2014 dam section has been modified since the Agency Technical Review (ATR). Quantities have been adjusted for Dam C only (the recommended dam alternative). This write-up and the following tables and the sheets illustrate how the original 2014 quantities for Dam C are modified to account for the material changes associated with the current 2015 dam section. Refer to Exhibit B of this Appendix for Original 2014 Dam C quantities and associated calculations. The table titled “Hatch Modified Dam C Quantities” summarizes the quantities associated with the current/modified Dam C section (including Spring Canyon Channel, which has not changed since the ATR). 2014 Dam C materials affected by the 2015 Dam C section modifications include:

* Random Fill (General) – Quantity decreases due to addition of more semi-impervious material and the drainage blanket within the dam section.

*Random Fill (Key Trench) - This is now all Semi-Impervious Fill. Volume has not changed.

*Semi-Imp Fill (General) – Quantity increases due to addition of a semi-impervious core within the dam section. Associated volume is greater than the semi-impervious fill located within the 2014 Dam C non-reservoir side slope.

*Drain Blanket – This is a new material that was not in the 2014 dam section.

* Dam Excavation – This quantity increases slightly due to excavation associated with the portion of the drainage blanket and toe drain below existing grade.

The other material quantity volumes remain constant.

DAM SECTION COMPARISONS. The current 2015 dam section and the original 2014 dam section are illustrated in the following sheets, at several heights and locations. Only the internal portion of the dam (under the soil cement, roller compacted concrete, and gravel material) has changed. When comparing the 2015 dam section to the 2014 dam section, with a decrease in dam height: percentage of Random Fill decreases; percentage of Semi-Impervious Fill increases; and percentage of Drain Blanket material increases. The dam section material percentages associated with the 11.89 feet high dams section (Sta. 14+00A) were utilized to adjust the applicable 2014 material quantities, as this height is closest to the weighted/average Dam C height. The Sta. 14+00A dam height of 11.89 feet is slightly lower than the weighted/average Dam C height of 12.92 feet, which should be conservative. See the “Station 14+00A (Modified 2015 Dam C Section)” within the “Dam C Section Comparisons” portion of the calculations for associated 2015 dam section material adjustment percentages.

WEIGHTED/AVERAGE DAM C HEIGHT. The weighted/average height for Dam see was determined to be 12.92 feet. See associated profile and table calculations.

DAM C RANDOM FILL AND DRAINAGE BLANKET QUANTITY ADJUSTMENTS. The semi-impervious core within the dam section occurs within the entire dam. The drainage blanket and toe drain system are only present from Sta. 17+00A to Sta. 32+75A. The modified Random Fill (General) and Drainage Blanket (above existing grade) volumes assume the blanket occurs within the entire dam. Associated volumes are adjusted to be more realistic. These values are reflected in the table titled “Hatch Modified Dam C Quantities”. See associated assumptions and calculations.
### HATCH MODIFIED DAM C QUANTITIES (2015)

<table>
<thead>
<tr>
<th>Item</th>
<th>Dam C</th>
<th>Spring Canyon</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random Fill (General)</td>
<td>69,303.2</td>
<td>2,468.6</td>
</tr>
<tr>
<td>Adjust Random Fill (General)</td>
<td>77,642.2</td>
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</tr>
<tr>
<td>Semi-Imp Fill (Key Trench)</td>
<td>11,816.7</td>
<td></td>
</tr>
<tr>
<td>Random Fill (SC Key)</td>
<td>6,756.2</td>
<td></td>
</tr>
<tr>
<td>Semi-Imp Fill (General)</td>
<td>28,173.3</td>
<td></td>
</tr>
<tr>
<td>Drain. Blnkt (above exist grade)</td>
<td>16,678.0</td>
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</tr>
<tr>
<td>Drain. Blnkt (below exist grade)</td>
<td>991.7</td>
<td></td>
</tr>
<tr>
<td>Adjust Drain. Blnkt (total)</td>
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<td></td>
</tr>
<tr>
<td>Gravel Material (6&quot; thick)</td>
<td>2,713.2</td>
<td></td>
</tr>
<tr>
<td>Soil Cement (SC)</td>
<td>22,552.9</td>
<td>4,725.0</td>
</tr>
<tr>
<td>RCC</td>
<td>2,730.4</td>
<td>605.0</td>
</tr>
<tr>
<td>Rip Rap (2' thick)</td>
<td>1,302.4</td>
<td></td>
</tr>
<tr>
<td>Bedding Material (6&quot; thick)</td>
<td>351.0</td>
<td></td>
</tr>
<tr>
<td>Concrete Box Culvert (CBC)</td>
<td>126.7</td>
<td></td>
</tr>
<tr>
<td>Filter Fabric (sq. yards)</td>
<td>2,355.9</td>
<td></td>
</tr>
<tr>
<td>Dam-Channel Exc (general)</td>
<td>11,260.3</td>
<td>11,460.2</td>
</tr>
<tr>
<td>Dam Excav. (Key Trench)</td>
<td>11,816.7</td>
<td></td>
</tr>
<tr>
<td>Dam Excav. (D Blnkt below grd)</td>
<td>991.7</td>
<td></td>
</tr>
<tr>
<td>Reservoir Exc. (RE) (Model)</td>
<td>149,407.7</td>
<td></td>
</tr>
<tr>
<td>Reservoir Fill</td>
<td>1,698.0</td>
<td></td>
</tr>
<tr>
<td>Clear &amp; Grubb (part of RE)</td>
<td>9,000.0</td>
<td></td>
</tr>
<tr>
<td>Extra Reservoir Storage Above</td>
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<td></td>
</tr>
<tr>
<td>Design Cap (acre-ft)</td>
<td>22.1</td>
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</tr>
<tr>
<td>Extra Reservoir Stor. Above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Cap (cubic yards)</td>
<td>35,654.7</td>
<td></td>
</tr>
<tr>
<td>Reservoir Exc. (Design Cap)</td>
<td>113,753.0</td>
<td></td>
</tr>
<tr>
<td>Fill between Rodey Lateral and Dam</td>
<td>8,378.8</td>
<td></td>
</tr>
<tr>
<td><strong>OTHER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OutletWorks</td>
<td>1,086.0</td>
<td>3,218.0</td>
</tr>
<tr>
<td>Storm Drain System</td>
<td>4,240.0</td>
<td>4,440.0</td>
</tr>
<tr>
<td><strong>Excavation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Excv (less clr &amp; grub)</td>
<td>183,594.6</td>
<td>183,594.6</td>
</tr>
<tr>
<td>Total Excavation (less extra res</td>
<td>147,939.9</td>
<td></td>
</tr>
<tr>
<td>storage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Fill</td>
<td>169,537.7</td>
<td>169,537.7</td>
</tr>
<tr>
<td>Net Soil Waste</td>
<td>8,110.3</td>
<td></td>
</tr>
<tr>
<td>Net Soil Import</td>
<td>33,962.2</td>
<td></td>
</tr>
</tbody>
</table>

#### QUANTITY CHECK (See Note below)

| 2014 Dam Sect                  |                |               |
| Random Fill (G) =              | 99,435.10      |               |
| Random Fill (KT) =             | 11,816.70      |               |
| Semi-Imp Fill =                | 14,719.40      |               |
| Total Volume =                 | 125,971.20     |               |

| 2015 Dam Sect (See Note 2)     |                |               |
| Random Fill (G) =              | 69,303.2       |               |
| Semi-Imp Fill (KT) =           | 11,816.7       |               |
| Semi-Imp Fill (G) =            | 28,173.3       |               |
| D Blanket (abv ex grd) =       | 16,678.0       |               |
| Total Volume =                 | 125,971.2      |               |

Note: Since only the internal portion of the dam section has changed, the sum of the volumes of the above dam section materials should be equal between the 2014 & 2015 dam sections.

#### ADJUSTMENT QUANTITY CHECK

| Random Fill (G) =              | 77,642.18      |               |
| Semi-Imp Fill (KT) =           | 11,816.70      |               |
| Semi-Imp Fill (G) =            | 28,173.33      |               |
| D Blanket (abv ex grd) =       | 8,338.99       |               |
| Total Volume =                 | 125,971.20     |               |

Notes (See 2015 Dam C Calculations for associated assumption justifications):

1. See Notes 1 through 8 associated with Original (2014) Dam Section Quantities.
2. For 2015 Dam: Random Fill (General) = 60.71% of the above grade internal portion of dam (AGIPD) =114,154.5 yd³ (99,435.1+14,719.4); Semi-Imp Fill (G)=24.68% of AGIPD; and D Blanket=14.61% of AGIPD
3. The above Drainage Blanket volume (above exist grade) assume it is located below the entire dam. Since it is located between Sta 17+00 & 32+75 this value is reduced by 50%. Below grade value is correct.
4. Adjust Random Fill (General) = Random Fill (General) + 50% of D Blnkt (above exist grade).
5. Drain. Blnkt (below exist grade) = avg area x drain blanket length = (17.0 ft² x 1575') /27 = 991.7 yd³
6. Cut and Fill can be balanced by excavating reservoir between Model value of149,407.4 yd³ and the Design Capacity value of 113,753 yd³ (i.e. over excavate reservoir area by 27,544.4 in lieu of 35,654.7 yd³).
Dam C Section Comparisons

Current/Modified 2015 Dam Section

vs.

Original 2014 Dam Section
Total Area below gravel and soil cement, but above exist. grade = 862.38 + 232.50 + 153.03 = 1,247.91 ft²
Percent (in feet) = 1247.91
Percent (in percentage) = 1247.91

Percent D.Blanket (above grade) = 153.03/1,247.91 = 12.26
Percent Semi Impervious Fill = 232.50/1,247.91 = 18.63
Percent Random Fill = 862.38/1,247.91 = 69.11
Total Area below gravel and soil cement, but above exist. grade = 862.38 + 232.50 + 153.03 = 1,247.91 ft²

Percent D.Blanket (above grade) = 170.91/1,248.05 = 13.69
Percent Random Fill = 1077.14/1,248.05 = 86.31
Total Area below gravel and soil cement, but above exist. grade = 1077.14 + 170.91 = 1,248.05 ft²

STA. 32+50A (Modiﬁed 2015 Dam C Section)
is now Semi Impervious Fill

was originally Random Fill

area KEY: Trench (below grade) = 102.73 ft²

area D.Blanket (above grade) = 16.13 ft²

area D.Blanket (below grade) = 207.11 ft²

area Semi Impervious Fill (above grade) = 639.26 ft²

area Random Fill (above grade) = 104.73 ft²

area Random Fill (above grade) = 844.35 ft²

Soil Cement (No Change)

Gravel Material (No Change)

Percent D.Blanket (above grade) = 102.73/949.10 = 10.82

Percent Semi Impervious Fill = 207.11/949.10 = 21.82

Percent Random Fill = 639.26/949.10 = 67.36

Total Area below gravel and soil cement, but above exist. grade = 639.26 + 207.11 + 102.73 = 949.10 ft²

Percent Semi Impervious Fill = 104.73/949.08 = 11.03

Percent Random Fill = 844.35/949.08 = 88.97

Total Area below gravel and soil cement, but above exist. grade = 844.35 + 104.73 = 949.08 ft²

STA. 18+50A (Modified 2015 Dam C Section)

STA. 18+50A (Original 2014 Dam C Section)
Percent D.Blanket (above grade) = 79.16/541.62 = 14.61
Percent Semi Impervious Fill = 133.66/541.62 = 24.68
Percent Random Fill = 328.80/541.62 = 60.71
Total Area below gravel and soil cement, but above exist. grade = 328.80 + 133.66 + 79.16 = 541.62 ft²
Percent Semi Impervious Fill = 75.20/541.67 = 13.88
Percent Random Fill = 466.47/541.67 = 86.12
Total Area below gravel and soil cement, but above exist. grade = 466.47 + 75.20 = 541.67 ft²
Percent Semi Impervious Fill = 132.97/806.05 = 16.50
Percent Random Fill = 673.08/806.05 = 83.50
Total Area above exist. grade (w/o Roller Comp Conc. & Soil Cement) = 673.08 + 132.97 = 806.05 ft²
Percent Random Fill = 806.05/806.05 = 100
Total Area above exist. grade (w/o Roller Comp Conc. & Soil Cement) = 806.05 ft²

STA. 35+00A (Modified 2015 Dam C Spillway Section)

STA. 35+00A (Original 2014 Dam C Spillway Section)
Weighted/Average Dam C Height

Current/Modified 2015 Dam Section
## HATCH DAM

**Weighted/Average Dam Height (above existing grade)**

Sta. 5+52.05 To Sta. 47+42.81

<table>
<thead>
<tr>
<th>STATION No.</th>
<th>DISTANCE (ft)</th>
<th>DAM HEIGHT (ft)</th>
<th>AVERAGE DAM HEIGHT Avg Ht*Dist</th>
<th>SUBTOTAL</th>
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**Total Dist = 4190.76**  
**Sum = 54161.55**

**Sta. Dist Chk= 4190.76**  
**Avg Dam Ht = 12.92**

Note: See profile (next page) for dam height values vs. corresponding station.
DAM C Random Fill (General) and Drainage Blanket (above existing grade)

Quantity Adjustments

Current/Modified 2015 Dam Section
PERCENT OF TOTAL DAM TOE SURFACE AREA WHERE DRAINAGE BLANKET IS LOCATED = 4.68 ACRES/9.98 ACRES*100 = 46.89%. SAY 50% TO BE CONSERVATIVE. THE DRAINAGE BLANKET IS ACTUALLY ONLY LOCATED BELOW HALF OF THE DAM (NON-RESERVOIR SIDE). HOWEVER THE PERCENTAGES WILL REMAIN CONSTANT.