HALLENBECK RESERVOIR #2
SPILLWAY REPLACEMENT
TECHNICAL SPECIFICATIONS

MESA COUNTY, COLORADO
DAMID: 420126
WATER DIVISION 4
WATER DISTRICT 42
CONSTRUCTION FILE, C-0402B

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I, Eric L. Krch, a duly registered professional engineer in the State of Colorado (registration #28583) and meeting the experience requirements for dam design, construction, and safety evaluation, have prepared this technical specification and supervised the production of related documents in accordance with the 2020 Rules and Regulations for Dam Safety and Construction. To the best of my knowledge, the information included is accurate and consistent with professional practices in the State of Colorado and the Dam Safety Industry.

COLORADO REGISTERED ERIC L. KRCH 28583 6-1-2023 PROFESSIONAL ENGINEER

June 1, 2023
Eric L. Krch, CO PE 28583

Approved on this 6th day of June, 2023.

Kevin Rein
State Engineer

STATE ENGINEER OF COLORADO

By: _____
John Hunyadi, PE
Chief, Colorado Dam Safety
CO PE 42709

DOCUMENT 00 01 00

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SECTION 01 71 23
FIELD ENGINEERING, MATERIALS TESTING, AND SURVEYING

PART 1 GENERAL

1.1 GENERAL

A. The plans and specifications can only be significantly changed with the prior written approval of the State Engineer Office (SEO). If changed conditions are encountered after the State Engineer's CONSTRUCTION approval is issued, the ENGINEER shall document and approve the changes with the SEO concurrence.

B. The ENGINEER will monitor the quality of construction. The ENGINEER monitoring the construction for the Owner is responsible for compliance with the approved design and specifications, and approval of all design change orders, and preparation of the project completion documents.

C. The CONTRACTOR shall assist and cooperate with the OWNER and ENGINEER to access the work to perform the OWNER's quality assurance work.

D. Where reference is made in these Specifications to other Standard Specifications, it is the intent that the reference Standard Specifications current at the date of bidding be used.

E. Construction shall only be considered complete once the State Engineer has accepted the construction in writing.

1.2 SURVEY

A. The OWNER will provide horizontal and vertical survey control for the project.

B. The CONTRACTOR will be required to perform surveys that are necessary to lay out structures, walls, alignments, grades, and elevations from the OWNER's provided control.

C. The OWNER may elect to review and or verify CONTRACTOR established lines, grades, and elevations by surveys. The CONTRACTOR shall provide access to project work for these surveys.

D. OWNER-performed reviews or surveys shall not relieve the CONTRACTOR's responsibility for correct lines, grades, elevations, and structure layout.

E. CONTRACTOR to provide an as-built survey of new spillways and cutoff wall.

1.3 CONSTRUCTION STAKEOUT

A. The CONTRACTOR shall perform construction stakeout using qualified, competent personnel.

B. The CONTRACTOR shall stake the line and grade of all project elements at intervals sufficient to accurately construct the project per design.

C. All survey data developed by the CONTRACTOR in performing surveys shall be available to the ENGINEER for review throughout the construction period.

D. The CONTRACTOR's construction survey personnel shall enter all survey notes and construction stakeout cut notes into a hard-cover field book.

1. The CONTRACTOR shall submit a copy of cut sheets to the ENGINEER a minimum of 36 hours before construction activities so that the lines and grades may be reviewed before construction.

2. The CONTRACTOR shall submit all field books, notes, cut sheets and other data developed by the CONTRACTOR in performing surveys to the ENGINEER along with other documentation that may be required for Final Acceptance.

1.4 FIELD ENGINEERING

A. Project representative from the OWNER and/or ENGINEER will be assigned to the project to review work in progress.

B. Any construction performed at times other than the normal weekday working hours of 7:00 A.M. to 5:00 P.M. that requires construction observation may, at the option of the OWNER, be charged to the CONTRACTOR.

C. The ENGINEER and the SATE ENGINEER will determine Whether or not construction observation will be performed or deemed necessary.

D. Should the CONTRACTOR fail to complete the project within the Contract time, construction observation and consulting time required during the completion of the project will be charged to the CONTRACTOR and subtracted from any amounts due from progress payments. Whether or not construction observation will be performed or deemed necessary will be determined by the ENGINEER.

1.5 MATERIALS TESTING

A. The CONTRACTOR is required to retain a consultant to perform quality control geotechnical materials testing to determine the conformance of the work with the Specifications.

B. The frequency of the CONTRACTOR's earth fill compaction tests shall be provided for every 10 cubic yards of onsite and imported material. Compaction shall conform to ASTM D 698. One Proctor mold shall be developed for each type of soil used for fill materials.

C. A geotechnical firm retained by the ENGINEER or OWNER will perform on-site quality assurance soils and import materials consulting and testing services for the OWNER to determine the acceptability of the work.

D. Areas for which the OWNER's or CONTRACTOR's tests show noncompliance shall be removed and recompacted to conform to the Specifications upon receipt of the test results. All costs for reworking and retesting backfill material to meet the Specification requirements shall be at the CONTRACTOR's expense.

END OF SECTION

SECTION 02 41 19
SELECTIVE STRUCTURE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected site elements, including removal of existing concrete wall and apron, and riprap from the downstream spillway channel.

B. See Division 31 Section "Clearing and Grubbing" for site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed, and salvaged, or removed and reinstalled.

1.3 SUBMITTALS

A. None

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having authority.

2. Comply with United States Forest Service Special Use Permit criteria.

B. Standards: Comply with ANSI A10.6 and NFPA 241.

C. Pre-Construction Conference: Conduct conference before start of demolition at **Project site.**

1.5 PROJECT CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Notify Engineer of discrepancies between existing conditions and Plans before proceeding with selective demolition.

C. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do

not disturb; immediately notify Engineer and Owner. Owner will remove hazardous materials under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

A. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

B. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate, and measure the nature and extent of conflict. Promptly submit a written report to Engineer.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain systems indicated to remain and protect them against damage during selective demolition operations.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent dam facilities to remain.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated on the project Plans. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Dispose of demolished items and materials promptly and legally

B. Existing Items to Remain: Protect construction indicated to remain against damage and

soiling during selective demolition. When permitted by Owner, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 03 33 00

CAST – IN – PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes. Work to be completed under this section shall include all labor, equipment, plant, and materials necessary to furnish and install all poured-in-place concrete, together with all miscellaneous and appurtenant items, as shown on the Construction Drawings and as specified herein.

1.2 REFERENCES

A. Except as modified or supplemented herein, all Work shall conform to the following standards, latest edition. Refer to standards for detailed requirements.

1. ACI 318 - Building Code Requirement for Reinforced Concrete.

2. ACI 301 - Specifications for Structural Concrete for Buildings.

3. ACI 347 - Recommended Practice for Concrete Formwork.

4. ACI 306 - Recommended Practice for Cold Weather Concreting.

5. ASTM A 615 - Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

1.3 SUBMITTALS

The following shall be submitted to and approved by the Engineer prior to beginning any concrete work.

A. Lab Design Mix. Prior to the start of Work, Contractor to submit a statement of the proportions for the concrete mixture. Statement to include:

1. Location & identification of the aggregate source.

2. Batch quantities for one (1) cubic yard of concrete, including:
   a. Weight of fine aggregate in a saturated surface dry condition.
   b. Weight of coarse aggregate in a saturated surface dry condition.
   c. Weight or the number of 94-pound bags of cement
   d. Weight or gallons of water.
   e. Amount and description (including manufacturer, specific product name, and number) of all admixtures.

3. Test results on trial batch concrete made from the proposed mix design, including:
   a. Cement factor in bags per cubic yard based on yield tests.
   b. Water-cement ratio.
   c. Percent of entrained air.
   d. Consistency in inches of the slump.
   e. At least three 28-day compressive strength tests.

4. Brand, type, and place of manufacture of cement.

5. Aggregate test results for grading, deleterious substances, and physical properties using test procedures developed by ACI. Aggregate shall be free of substances that are deleteriously reactive with the alkali in the cement in an amount sufficient to cause excessive expansion of the concrete. Acceptable aggregate shall be based on satisfactory evidence furnished by the Contractor that the aggregate is free from such materials. This evidence shall include service records of concrete of comparable properties under similar conditions of exposure and certified records of tests by a testing laboratory that meets the requirements of ASTM C 1077. Tests shall be made in accordance with ASTM C 1260. Prior to approval of mixture design, the Contractor shall submit a written certification that the aggregate does not have a history of D-Cracking and that the aggregate is approved by a state Department of Transportation specifically addressing susceptibility to D-Cracking. If the aggregate is not approved by a state agency, the aggregates may be approved provided the aggregate is tested in accordance with ASTM C 666 and receives a durability factor of 95 percent or greater.

B. Reinforcing Steel. Product data sheet and statement of manufacturer's compliance with applicable standards.

1.4 RECORD OF THE WORK

A. Contractor to keep a record of each concrete pour's time, date, and location and submit these records to the Engineer.

1.5 NOTICE OF INTENTION TO POUR

A. Contractor shall notify the Engineer at least 48 hours before an intended cast-in-place concrete pour. No structural cast-in-place concrete shall be poured until all reinforcing forms and the ENGINEER has inspected foundation soils.

1.6 PROTECTION OF THE WORK

A. Contractor to be responsible for protecting all Work prior to acceptance. In place, concrete shall not be subjected to loadings or stress prematurely.

1.7 STORAGE OF MATERIALS

A. Cement and aggregate shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Any material that has deteriorated or damaged shall not be used for concrete.

B. All reinforcing steel shall be stored in a dry location and protected from excessive accumulation of rust or scale.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement. All cement shall be Portland Cement Type II conforming to "Standard Specifications for Portland Cement" (ASTM C 150). The same brand of cement for all exposed cast-in-place concrete shall be used.

B. Stone Aggregate. Fine and coarse aggregate shall conform to "Specifications for Concrete Aggregates" (ASTM C33-61T). Fine aggregates shall be clean, hard, natural, and free from all foreign matter. Coarse aggregate shall be sound, crushed rock or gravel, free from the adherent coating, organic water, or injurious amounts of flat or friable pieces.

C. All structural concrete shall conform to ACI 301 (latest edition) unless otherwise noted.

D. Water. Water used in mixing shall be potable, cleaned, and free from deleterious amounts of oil, acids, alkalis, and organic material.

E. Admixtures. "Protex," as manufactured by Protex Industries, Inc. and conforming to Specifications of Air-Entraining Admixtures for Concrete (ASTM C260) is an approved air-entraining admixture. Other admixtures for retarding or accelerating concrete may be used in strict accordance with the manufacturer's recommendations and ASTM Specifications upon approval of the Engineer.

F. Add mixtures containing chorine salts shall not be used.

G. Form Material. For unexposed concrete surfaces, forms may be undressed lumber free from excessive knots. For exposed surfaces, use wood or metal forms as required to give a finish as specified.

H. Reinforcing Steel. Reinforcing steel shall be high-grade deformed bars conforming to "Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement" (ASTM A615) and shall be Grade 60.

I. Waterstop. Provide Sika Greenstreak or equal PVC flexible waterstop, model No.

732.

J. If site conditions and temperatures require that “Cold Weather Concreting” is required, the contractor shall provide a “means and methods” submittal for this work.

PART 3 EXECUTION

3.01 CONCRETE MIX

A. Proportions. Concrete is to be proportioned according to laboratory-designed mixes using the type of aggregate, maximum water/cement (W/C) ratio, maximum aggregate size, a minimum of twenty-eight (28) day ultimate compressive strength, and entrained air as follows:

Mix No.	Location	W/C Ratio	Strength (psi)	Entrained Air (%)
1	**Walls, Footings, Structural Slabs**	**0.45**	**4500**	**5 – 7%**

B. Air Entrainment. An air-entraining agent shall be added to all stone concrete so as to entrain 5%-7% by volume. Air-entraining agents shall strictly follow the recommendations of the manufacturer and the testing laboratory for the design mix to ensure that strength requirements are fully met or exceeded.

C. Mixing of Materials. The concrete shall be mixed until there is a uniform distribution of the materials. Job-mixed concrete shall not be allowed.

2. Sufficient time shall be allowed for proper mixing of the concrete to provide uniformity throughout the batch. Long delays in concrete placement shall be avoided, and any concrete that has not been placed within 90 minutes after the water has been added to the mix shall be rejected. The 90-minute time limit may be extended to 120 minutes if no water is added after 90 minutes and the concrete temperature prior to placement is less than 90 F. Over-wet mixes shall be rejected and shall not be corrected by adding either aggregate or cement to the mixer. Mix not less than ten minutes in transit mix trucks after adding the mixing water.

D. Consistency. Slumps shall be minimum, consistent with placing requirements. Slump test shall be made in accordance with the "Slump Test for Consistency of Portland Cement Concrete" (ASTM C143-58). Unless written approval is obtained from the Engineer, the maximum slump shall be four (4”) inches.

3.02 CONCRETE FORMS

A. Forms shall conform to the concrete's shape, lines, grades, and dimensions as

detailed on the Construction Drawings. All forms for exposed finished surfaces shall be built with the material needed to produce the form, texture, and design specified in Concrete Finishes of this section.

B. Design of Forms. Forms shall be sufficiently tight to prevent mortar leakage and shall be properly braced or tied together to maintain the desired position. The forms shall be oiled for ease of removal of forms after the setting of concrete.

C. Form Ties and Incidentals. All form ties shall be bolts and rods (adjustable for tightening) arranged so that no metal is within 3/4" of the surface after removing forms. No ties through exposed concrete will be allowed. Ties for water/wastewater structures (tanks, basins, channels, etc.) shall be furnished with water-resistant washers and cones, as manufactured by SYMONS or approved equal. Ordinary wire ties will be allowed on building foundations with the specific approval of the ENGINEER. Set forms for all required anchors, bolt inserts, slots, sleeves, supports, etc., furnished under portions of this Specification and installed under this section.

D. Removal of Forms. Forms shall not be disturbed until the concrete has hardened sufficiently to permit their removal with safety. The removal of the forms shall be carried out in such a manner as to ensure the safety of the structure. Forms shall not be removed until 24 hours after pouring.

3.03 CONSTRUCTION, CONTROL, AND EXPANSION JOINTS

Construction Joints not shown on the drawings shall be submitted to ENGINEER for approval prior to placing concrete.

3.04 WATERSTOP JOINTS

A. Waterstops are to be installed prior to concrete placement and securely anchored to prevent floating, using factory grommets or field-applied Hog Rings placed at 12” on center.
B. Use split forms for footer-to-wall placement.
C. Splicing shall be done using with a thermostatically controlled waterstop welding iron equipped with a replaceable peel-and-stick Teflon cover. The ends of the waterstop must be cut square at the factory to form matching edges. Uniformly and simultaneously melt the waterstop ends at roughly 380°F using the waterstop welding iron. It is important to use an indirect source of heat for this procedure. Direct exposure to a flame will change the chemical composition of the PVC and result in a weak weld. When a 1/8” diameter melted bead of PVC material develops at each waterstop end, quickly remove the ends of the waterstop from the welding iron and immediately press the two waterstop ends together, keeping the waterstop properly aligned at the weld. Hold until the material has fused and cooled. Allow the splice to cool completely before installing. The surface temperature of the splicing iron must be maintained to avoid burning or charring the material. Welding irons have resistance-type heating elements and experience diminished performance if a reduced voltage is

supplied. Avoid operating with long runs of small gauge extension cords.

D. Unacceptable splices shall be rejected if any of the following are encountered.
   i. Tensile strength less than 80 percent of the parent section.
   ii. Misalignment of centerbulb greater than 1/16 inch.
   iii. Bond failure at joint deep that 1/16 inch or 15 percent of material thickness, whichever is less.
   iv. Misalignment, which reduces waterstop cross-section by more than 15 percent.
   v. Visible porosity in the weld.
   vi. Bubbles or inadequate bonding.
   vii. Visible splice separation when a cooled splice is bent by hand at a sharp angle.
   viii. Charred or brunt material.

3.05 CONCRETE PLACEMENT

A. The ENGINEER shall inspect the subgrade for anywhere concrete is to be placed 24 hours before the placement of concrete. The subgrade must be firm and unyielding.

B. Preparation for Placing. Before placing concrete, all equipment for mixing and transporting concrete shall be cleaned, and all debris and ice shall be removed from places to be occupied by concrete. Forms shall be properly treated, and all reinforcement cleaned of ice and other coatings. Water shall be removed from place of deposit before concrete is placed.

C. Conveying. Concrete shall be conveyed from the mixer to the place of final deposit by methods, which will prevent the separation or loss of the materials. Equipment for chuting, pumping, or pneumatically conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete at the delivery and without separation of the materials.

D. Depositing. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to re-handling or flowing. The concreting shall be carried on at such a rate that the concrete is always plastic and flows readily into the space between the bars. No concrete that has been partially hardened or been contaminated by foreign matter shall be deposited on the Work, nor shall re-tempered concrete be used. When concreting is once started, it shall be carried on as a continuous operation until the placing of the panel or section is completed. Place concrete in approximately horizontal layers avoiding displacement of reinforcement above fresh concrete and formation of seams and planes of weakness in sections. When construction joints are necessary, they shall be located as specified in this section under Construction Joints. For bonding fresh concrete, roughen and clean exposed surface and brush with neat cement grout. Place new concrete before grout takes initial set.

E. Compaction. Place concrete in layers not over 24" deep; compact each layer by

mechanical internal vibrating equipment supplemented by hand spading, rodding, tamping, as directed. Vibrators shall not be used to transport concrete inside forms. Limit vibration duration to the time necessary to produce satisfactory consolidation without causing objectionable segregation. Do not insert vibrator into lower courses that have begun to set.

F. Weather Conditions. Unless adequate protection is provided and the Engineer's approval is obtained, concrete shall not be placed during rain, sleet, or snow. When the mean temperature falls below 40ºF for 3 successive days, concreting shall conform to "Recommended Practice for Cold Weather Conditions: (ACI 306 R-78). Concrete placed in hot weather shall meet the standards of "Recommended Practice for Hot Weather Concreting (ACI 305R-77). Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.

G. Protection and Curing. Concrete protection and curing shall be in conformance with ACI 308. Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected from loss of surface moisture. All concrete shall be kept in a moist condition for at least five (5) days after placement. Curing compounds may be used upon approval of the ENGINEER.

3.06 CONCRETE FINISHES

A. Exposed concrete shall be screened to levels indicated and float finished monolithically completed free from humps or pits. Before the finish has set, the surface cement film shall be removed with a fine brush to have a smooth but sanded texture.

B. All surfaces exposed to air or are to be waterproofed shall have fins and other projections carefully removed. Metal form or rebar ties projecting from the surface shall be cut a minimum of 1” back from face of wall.

C. Patching material shall be stiff mixture of sand and cement with the color matching the concrete being patched. Saturate and prepare all areas to be patched as specified by the manufacturer. Patched surfaces to be true and even to surrounding concrete surface. Patch surface voids larger than ¼” in diameter. Patch all holes left by removal of form or rebar ties or bolts.

D. Any area of faulty or honeycombed concrete shall be completely removed to sound concrete and repaired by a method approved by the ENGINEER.

3.07 REINFORCING

A. Placing Reinforcement. Reinforcing steel, at the time concrete is placed, shall be free from scale, rust or other coatings that will destroy or reduce bond. Reinforcement shall be accurately placed as shown on the Construction Drawings and shall be adequately secured in position by concrete or metal chairs and spacers.

B. Reinforcing shall be furnished in the full lengths indicated on the Construction Drawings unless otherwise authorized by the Engineer. Lap splicing of reinforcement shall be Class B lap splices unless otherwise noted. A minimum of 50 bar diameters for #6 bar and smaller and 62 bar diameters for #7 and larger bar for class B lap splices unless otherwise noted. Contact ENGINEER for splicing recommendations prior to construction were not specifically detailed or noted. Do not weld or use mechanical splicing.

C. The placing, fastening, splicing, and supporting of reinforcing steel and welded wire fabric shall be in accordance with the Construction Drawings and the latest edition of the CRSI "Recommended Practice for Placing Reinforcing Bars" and in accordance with ACI 318. Bars shall be placed around all corners to splice steel in adjacent walls, footers, and slabs (such detailing may not be shown on Construction Drawings).

D. Concrete Protection & Reinforcement. See drawings for minimum clear spacing to weather or earth.

E. Bearing Plates, anchor bolts, etc. Place all bearing plates, anchor bolts, reinforcing rods and other structural items furnished by other trades. Contractor to provide 7-day notice to all such trades prior to affected pour. Installation to be within tolerances required by other trades.

3.08 FIELD QUALITY CONTROL (Performed by City retained consultant)

A. Concrete Tests. 6" x 12" (or 4” x 8”) cylinders shall be taken at the point of placing in the forms, shall be job cured and tested in accordance with ASTM Standards by the Engineer. For each strength of concrete used, one set of four (4) cylinders for each day's pour, but not less than one (1) set of cylinders for each 50 cubic yards poured shall be taken. Two (2) cylinders at twenty-eight (28) days shall be tested to determine strength. One cylinder at seven (7) days, and one cylinder at fifty-six (56) days may be tested as indicators at the direction of the Engineer. In addition, when in the opinion of the Engineer there is a possibility of the surrounding air temperature falling below 40º F; additional specimens to be cured under job conditions may be required.

B. If concrete fails to meet the strength requirements of this specification, the ENGINEER may order the CONTRACTOR to have a testing laboratory, acceptable to the Engineer, take and test core samples of questionable concrete. The Engineer may order all low-strength concrete removed and replaced if core strengths are below specified strengths. All costs connected with concrete coring and removal and replacement of low-strength concrete shall be borne by the

Contractor.

C. Slump Tests. Engineer to conduct slump tests on each day's pour and on individual trucks whenever concrete consistency varies. Test failure shall be grounds for rejection of individual or batch loads.

D. Air Content. Engineer to conduct air tests on each day's pour and on individual trucks as determined by the Engineer. Test failure shall be grounds for rejection of entire batch until satisfactory tests are obtained.

END OF SECTION

SECTION 31 02 22
EMBEDMENT AND BASE COURSE AGGREGATE

PART 1 GENERAL

1.1 SUMMARY

A. This work shall consist of furnishing and placing one course of aggregate on the embankment crest prepared surface in accordance with these Specifications in reasonably close conformity with the lines, grades and typical cross sections shown on the drawings or established by the Engineer in the field.

1.2 REFERENCES

A. Colorado Department of Transportation "Standard Specifications for Road and Bridge Construction," latest edition.

B. ASTM D 1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)

C. ASTM D 2922 - Test Methods of Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

A. Aggregates. Certified statement from an independent testing laboratory, acceptable to the Engineer, of material compliance.

PART 2 PRODUCTS

A. Aggregate used for, base course and specified by Class in other sections of this Specification shall conform to the gradation schedule shown below.

B. CLASSIFICATION TABLE FOR AGGREGATE BASE COURSE*

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves						
	LL not greater than 35			LL not greater than 30			
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
4 inch	----	100	----	----	----	-----	-----
3 inch	----	95-100	----	----	----	----	----
2½ inch	100	----	----	----	----	----	----
2 inch	95-100	----	----	100	----	----	----
1½ inch	----	----	----	90-100	100	----	----
1 inch	---	----	----	95-100	----	100	----
¾ inch	----	----	----	50-90	----	100	----
No. 4	30-65	----	----	35-50	30-70	30-65	----
No. 8	----	----	----	----	----	25-65	20-85
No. 200	3-15	3-15	20 max.	3-12	3-15	3-12	5-15

Reproduced from Colorado Department of Transportation Standard Specifications for Road and Bridge Construction.

PART 3 EXECUTION

3.1 PLACING

A. The base course material shall be placed on the previously prepared subgrade at the locations and in the proper quantities to conform to the typical cross sections as shown on the Drawings and as directed by the Engineer. Placing and spreading shall be done by means of a spreader machine, moving vehicle, motor grader or other approved equipment methods. The material shall be placed without segregation. Any segregated areas shall be removed and replaced with uniformly graded material at the Contractor's expense.

B. The base material may be placed in lifts of up to 6 loose inches, providing that after compaction, uniform density is obtained throughout the entire depth of the lift. If the required depth exceeds 6 inches, it shall be placed in two or more lifts of approximately equal thickness. If uniform density cannot be obtained by 6-inch lifts, the maximum lift shall not exceed 4 inches in final thickness.

3.2 COMPACTING

A. Rolling will be continuous until the base material has been compacted to not less than 95% of maximum density as determined by ASTM D 1557 Test Method.

B. Water shall be uniformly applied as necessary during compaction to obtain optimum moisture content and to aid in consolidation. Maintain a moisture content of the material being placed and compacted within 2% of optimum moisture as determined by ASTM D1557 or as directed and approved by the geotechnical consultant, ENGINEER, and STATE ENGINEER.

C. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced, and the aggregates are firmly keyed.

D. The finished base course surface shall be smooth and free of ruts and irregularities and true to grade and crown as shown on the plans or as directed by the Engineer. The final surface shall be finished with a surface smoothness tolerance of ¼ inch, measured as vertical ordinate from the face to a ten-foot straight edge. The base course shall be maintained in this condition by watering, drying, rolling, or blading as necessary, or as the Engineer may direct, until the surface material is placed.

3.3 INSPECTION AND TESTING

A. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance with these Specifications.

B. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D 1557 Test Method.

C. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

D. Frequency of Testing. Conduct a minimum of one test for each layer of specified depth

of fill or backfill as follows:

1. All other areas: For each 500 square feet or less.

3.4 PAYMENT FOR TESTING

A. Owner is responsible for all costs of initial testing of backfill. Contractor to pay for all costs of any retesting required.

END OF SECTION

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This work includes all materials, equipment, and labor required for completed clearing and grubbing operations required for completion of other items of work.

B. Clearing includes the removal of vegetation from defined areas.

C. Grubbing includes the removal of stumps and root obstructions to a minimum of three feet below proposed subgrade and related work. This work includes backfill of holes created by grubbing operations with approved on-site materials.

D. Removed materials, such as stumps and trees, shall not be buried in the backfill.

E. Burning of cleared and grubbed vegetation and trees on site is not permitted.

F. For removal of structures and obstructions including items such as concrete foundations, walls, riprap, etc., see SECTION 02 41 19 – Selective Structure Demolition.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 CLEARING

A. The CONTRACTOR shall remove trees and shrubs and other vegetation called for on the Plans or as observed in the field. Except for staging areas and construction access roads, disturbance will be limited to the excavation area required for the structure.

B. CONTRACTOR shall remove and stockpile all topsoil and surface organics within the limits of disturbance.

C. The CONTRACTOR must make all reasonable efforts to minimize the area of disturbance. Aside from staging areas, the maximum area of disturbance will be 15 feet beyond the excavation slope intercept point. Unless otherwise permitted in writing by the OWNER and ENGINEER no disturbance or construction activity will be allowed outside the above area.

D. Prior to construction the OWNER and ENGINEER will meet with the CONTRACTOR to determine the area(s) required for construction staging. After an agreement is reached regarding the construction staging area size(s) and location(s) the CONTRACTOR shall identify all trees and shrubs to be removed from the staging area(s) by marking the trees with orange paint. The CONTRACTOR may submit a written request for additional construction area when warranted by conditions. The written request must state the reasons for the request and the extent and size of additional area(s) requested.

3.2 GRUBBING

A. Removal of shrubs shall include enough depth of the root system to ensure that vegetation will not continue to grow, a minimum of three feet below existing grade. All holes left after the removal of stumps shall be backfilled with native material and compacted. The resulting unsuitable debris shall be hauled and disposed of by the CONTRACTOR at an off-site location acceptable to and at no additional cost to the ENGINEER and the OWNER. Woody debris such as limbs, small diameter logs, etc. may be chipped/ground into wood chips for mulch and revegetation purposes.

END OF SECTION

SECTION 31 23 00
EXCAVATION AND FILL

PART 1 GENERAL

1.1 WORK INCLUDED

A. Earthwork includes stripping, stockpiling, and placing of designated materials, excavating, scarifying, grading, segregating, and placing on-site and imported fill materials. This includes incidental operations such as hauling, placing, discing, soil moisture control, and compacting to the lines and grades shown on the Plans. Also included is the disposal of excess excavated or unacceptable materials and borrow of materials to make up deficiencies for fills in accordance with this Specification.

B. This section also covers furnishing of all labor, materials, tools, equipment and performing all work and services for excavating, over-excavating, borrowing, and removing undesired or excess materials shown on the Plans, in accordance with the Contract Documents. This work includes but is not limited to, excavation and structural fill for the concrete cutoff wall.

1.2 RELATRED SECTIONS

A. SECTION 01 71 23 – Field Engineering.

B. SECTION 31 11 00 – Clearing and Grubbing

C. SECTION 31 23 19 - Dewatering

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM D 422 - Method for Particle-Size Analysis of Soils
2. ASTM D 698 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)
3. ASTM D 1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)
4. ASTM D 2487 - Classification of Soils for Engineering Purposes
5. ASTM D 2922 - Test Methods of Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
6. ASTM D 4254 - Test Methods for Minimum Index Density of Soils and Calculation of Relative Density
7. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

1.4 SUBMITTALS

A. Particle-Size Analysis and Proctor Test Results for:

1. Native fill materials

1.5 SOIL CONDITIONS

A. The CONTRACTOR shall satisfy himself as to the kind and type of soil to be encountered and any water conditions that might affect the construction of the project.

B. The CONTRACTOR shall perform all excavation regardless of the type, nature, or condition of material encountered, as specified, shown, or required to accomplish the construction.

C. CONTRACTOR shall notify the ENGINEER once the excavation has been completed. The Engineer shall inspect the excavation for uniformity of conditions. The ENGINEER may need to sample and test the encountered soils if conditions differ substantially from those used to prepare the trench filter design.

D. A geotechnical engineer may or may not be retained by the OWNER to review the fill and structural fill placements. The expense of these services will be borne by the OWNER.

1.6 SPECIAL REQUIREMENTS

A. The location of existing utilities is shown in an approximate way only and not all utilities may be shown. The CONTRACTOR shall determine the exact location of all existing utilities prior to commencing work.

B. The CONTRACTOR shall be fully responsible for all damages that might be occasioned by his failure to exactly locate and preserve all utilities. If utilities are to remain in place, the CONTRACTOR shall provide adequate means of support and protection during construction.

C. Should draw, or incorrectly drawn, piping or other utilities be encountered during excavation the CONTRACTOR shall advise the ENGINEER within 30 minutes of encountering the utility.

D. The CONTRACTOR shall cooperate with the ENGINEER and utility companies in keeping respective services and facilities in operation to the satisfaction of the respective owners.

E. The OWNER reserves the right to perform all work required should the CONTRACTOR fail to cooperate with the respective companies, and back charge the CONTRACTOR for all expenses.

F. The CONTRACTOR is responsible for protecting all monuments, benchmarks, and other reference points to be used to construct foundations. Reference points disturbed that require restaking, will be restaked by the ENGINEER at the CONTRACTOR's expense.

G. The CONTRACTOR shall conduct all site grading operations and other construction activities to minimize erosion of site soil materials.

H. The CONTRACTOR shall be responsible to maintain streets daily removing any spill

age of dirt, rocks or debris from equipment entering or leaving the site.

PART 2 MATERIALS

2.1 FILL CLASSIFICATIONS

A. General

1. Materials used in any classification of fill shall be free from frozen lumps, wood, or other organic, trash, debris or other material that would otherwise adversely affect the performance of the fill.

2. Unless otherwise specified or shown on the Plans, Class 1 materials shall be used for fills. If an insufficient volume of Class 1 material was generated during construction Class 2 material may be substituted for fills.

B. Class 1 – Onsite Soils

1. Class 1 material is suitable onsite soils that came from the original project excavation.

2. All rock particles greater than 3 inches in diameter shall be removed from Class 1 material.

C. Class 2 – Import soils (Offsite Borrow)

1. Class 2 fill material shall be composed of suitable materials that originated from a borrow area previously identified and approved by the ENGINEER.
    a. Suitable borrow material for Class 2 is located at the Carson Lake project, approximately 5 road miles to the southeast of Hallenbeck Reservoir.

2. Unified Soil Classification SC soils are suitable. They shall be classified in accordance with ASTM D 2487, with minimum properties of Atterberg above the “A-Line” and a plastic index greater than 7.

3. All rock particles greater than 3 inches shall be removed from Class 2 material.

4. If the resulting USCS classification differs the ENGINEER should be notified to determine if the material is a suitable fill.

5. A proctor compaction test in accordance with ASTM D698 shall be performed on the excavated, Class 2 material. Test results shall be used during construction of fill.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavation shall include the removal of all materials of whatever nature encountered, including obstructions that interfere with the proper execution of the work. The removal of materials shall conform to the lines and grades shown on the Plans.

B. Unless otherwise shown on the Plans or specified herein, the site shall be stripped of all vegetation, such as bushes and debris. This vegetation shall be removed from the site prior to performing any excavation or placing any fill.

C. Excavations for the concrete cutoff wall shall be made to the elevations and dimensions shown on the Plans. The CONTRACTOR shall provide a safe excavation in accordance with applicable OSHA regulations and shall provide adequate space for construction operations and review of structure construction.

D. The CONTRACTOR shall remove obstructions, including but not limited to rocks, unsuitable subgrade soils, and any other materials which may be concealed beneath the present grade, as required to construct an acceptable grade for the structure.

E. The excavated materials shall be screened of all particles greater than 3” and used for minor embankment fill and site dressing material.

F. After the required excavation has been completed, the exposed surface shall be reasonably smooth for placement of the overlying fills.

3.2 FILL CONSTRUCTION

A. The CONTRACTOR shall construct fills to lines and grades shown or specified. The fill shall be placed in continuous horizontal layers not exceeding eight inches in loose thickness. Where hand-operated compaction equipment is used, the layers shall not exceed six inches in loose thickness.

B. The CONTRACTOR shall cut into the “existing” or temporary excavation slope at least 6-inches with each loose lift placement of backfill to properly disturb the existing-new embankment fill interface. Compaction equipment can be used to cut into this interface to ensure good blending (i.e., stitching) of the embankment material along this interface and to thoroughly mix and blend the new material with the existing embankment.

C. Where the soil moisture content is too high to permit the specified degree of compaction, the material shall be disced and worked until it has dried to the proper moisture content.

D. The CONTRACTOR shall protect the fill against freezing when atmospheric temperature is less than 35° F. (1° C). Foundations and fills that have been allowed to freeze shall be removed to the depth of freezing, replaced, and recompacted.

3.3 FOUNDATION PREPARATION FOR STRUCTURES

A. The CONTRACTOR is responsible for protecting all monuments, benchmarks, and other reference points to be used to construct foundations. Reference points disturbed that require restaking, will be restaked by the ENGINEER at the CONTRACTOR's expense.

B. Where foundations are to rest on subgrade material other than rock, care should be taken to avoid disturbance of the bottom of the excavation. Soils loosened during excavation shall be removed from the excavation, and the excavation restored to a condition at least equal to the undisturbed subgrade.

C. Completed excavations shall be protected from becoming unacceptable including but not limited to becoming wet, frozen, or soft due to weather, and or construction operations. Grading around excavations for structures shall be performed to prevent water from running into the excavation or from damaging completed foundations. Should any free water, ground water, or springs be encountered, the CONTRACTOR shall be required to keep excavations free from water during construction of the foundations using trenches, well points, or other means as reviewed and accepted by the ENGINEER.

D. The CONTRACTOR shall shore, sheet pile, slope, and/or brace excavations as required to maintain a safe site and to conform to all local, State, or Federal agency regulations having jurisdiction over the work. The CONTRACTOR is fully and solely responsible for maintaining safe working conditions during construction.

E. The CONTRACTOR shall use an appropriate method of construction to prevent the excavated surface from changing moisture content. This is especially critical with clay soils.

F. The CONTRACTOR is responsible for notifying the ENGINEER as soon as excavations are completed in order that subgrade may be reviewed.

3.4 COMPACTION

A. Density Requirements

1. Compact soil to not less than the following percentages of maximum density relationship determined in accordance with ASTM D 698 (Standard Proctor) unless otherwise shown on the Plans.
    a. Embankment Fills - 95%
2. Or other methods deemed acceptable to the State Engineer.

B. Moisture Requirements

1. The CONTRACTOR shall maintain a moisture content of the material being placed and compacted within 2% of optimum moisture as determined by ASTM D698 or as directed and approved by the geotechnical consultant, ENGINEER, and STATE ENGINEER.
2. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of cut area subgrade, or loosely placed layer of soil material, to prevent free water appearing on surface during or after compaction operations.
3. The CONTRACTOR shall remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. The CONTRACTOR may assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.5 SETTLEMENT

A. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, the CONTRACTOR shall scarify the ground surface, re-shape, and compact to required density prior to further construction.

B. Any settlement in fill or structural fill which occurs within the one-year guarantee period in the General Conditions will be caused by improper compaction methods and shall be corrected at no cost to the OWNER. Any structure damaged by settlement shall be restored to their original condition by the CONTRACTOR at no cost to the OWNER.

C. The CONTRACTOR may place soil above the final grade to compensate for anticipated settlement if proper drainage can be maintained and when permitted by the

ENGINEER.

3.6 GRADING

A. The CONTRACTOR shall perform all grading to the lines and grades as shown on the Plans and/or established by the ENGINEER, with an allowance for topsoil where required. Stockpiled topsoil shall be placed to a uniform depth of four inches, or the uniform depth the volume of stockpiled topsoil will permit, in areas to be revegetated.

B. The CONTRACTOR shall shape, trim, and finish slopes of channels to conform to the lines, grades, and cross sections as shown or approved. All slopes shall be free of all exposed roots and stones exceeding three inches in diameter that are loose and liable to fall. Tops of banks shall be rounded to circular curves not less than six feet in radius. Rounded surfaces shall be neatly and smoothly trimmed.

3.7 DISPOSAL OF EXCESS EXCAVATION AND WASTE MATERIALS

A. When permitted by the ENGINEER or the OWNER, the CONTRACTOR may dispose of all excess excavated material not required on site.

B. The CONTRACTOR shall remove and legally dispose of excess materials not permitted to be disposed of on site. The ENGINEER may request written confirmation from the OWNER of the property where excess and waste materials are deposited.

END OF SECTION

SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.1 SUMMARY

A. SECTION INCLUDES

1. Design, construction, operation, and eventual complete removal of a dewatering system to protect the excavation.
2. The CONTRACTOR is responsible for obtaining and maintaining a Construction Dewatering and Discharge permit (if required) from the Colorado Department of Public Health and Environmental Quality.
3. Dewatering plan submitted by the CONTRACTOR shall be reviewed and approved by both the State Dam Safety ENGINEER and Project ENGINEER.

1.2 SYSTEM DESCRIPTION

A. Hallenbeck #2 Reservoir must be drained no less than least 3 feet below the bottom of the spillway concrete crest excavation during construction to maintain a dry subgrade condition. The CONTRACTOR shall work with the OWNER to ensure that the reservoir water surface elevation two weeks before mobilization has been drained to the required level.

1. If further dewatering is required, the CONTRACTOR shall be solely responsible for design and installation of a dewatering system capable of allowing construction of all work shown on the State Engineers Office approved construction plans. A “dewatering system” is defined as a combination of temporary capture system and a pump or siphon system to maintain keep the trench and channel excavations sufficiently dry to meet the project specification for their installation.
2. The dewatering plan shall include protection of work in the event of summer monsoonal storm events.

B. Maintenance: After installation, the dewatering system shall be continuously maintained by the CONTRACTOR until completion of the associated work.

1.3 SUBMITTALS

A. Dewatering Plan: CONTRACTOR shall submit a plan indicating proposed means and methods for cofferdam construction and pump and/or siphon configurations.

B. CONTRACTOR shall submit a water diversion plan prepared under the direction of a qualified Professional ENGINEER. Project ENGINEER will review and forward to the State ENGINEER for review in advance of construction of any diversion facilities products.

1.4 MATERIALS

A. Dewatering System: Provide all necessary materials for installation and complete operation of dewatering system. Provide spare pumps, hoses, etc. as required. All pumps shall be new and in good working condition at the time of installation.

PART 2 EXECUTION

2.1 EXAMINATION

A. Existing Conditions: Examine existing conditions to determine dewatering requirements.

2.2 INSTALLATION

A. Design and install systems as required. Furnish stand-by equipment of sufficient size and capacity to ensure continuous operation of the system. Remove all pumps and piping upon completion of demolition and construction work.

2.3 FIELD QUALITY CONTROL

A. Make periodic inspections and verify that the system is maintaining a dry excavation.

END OF SECTION

SECTION 31 25 90
EROSION CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. CONTRACTOR will be responsible for placing and maintaining stormwater and erosion control BMP's as shown on the Plans and as required to protect waters of the United States. The work includes constructing, installing, maintaining, and eventually removing erosion control measures during the contract's life to prevent or minimize erosion, sedimentation, and pollution to Reservoir Creek, adjacent wetlands, and the lake.

1.2 REFERENCE STANDARDS

A. The "Erosion Control and Stormwater Quality Field Guide" as produced and available from the Colorado Department of Transportation (CDOT).

PART 2 PRODUCTS

2.1 BEST MANAGEMENT PRACTICES

A. CONTRACTOR is responsible for placing and maintain erosion control BMP's as shown, as specified below or as needed to protect the Waters of the United States based on CONTRACTORs means and methods to implement the work associated with this project.

2.2 Revegetation Seed Mix

A. Reseeding of disturbed areas shall be done by hydroseeding, drilling, or hand broadcasting. Any area that cannot be reached by hydroseeding or drill seeding shall be hand broadcast.

1. Hydroseeding shall be applied in a water and hydro-mulch/wood cellulose fiber mulch slurry. Due to high failure rates of hydroseeding, the broadcast rate of seeding shall be increased by 50% in all areas that are hydro-seeded.
    a. Hydroseeded areas shall be mulched with a mixture of wood cellulose fiber, water, and tackifier applied at the following rates
        - Tackifier: Rate per manufacturer
        - Water: 2000 lbs/acre
        - Wood Cellulose: 300 lbs/acre
2. Drilled seeding shall be mulched with a crimped straw mulch placed at a rate of 1-1/2 tons per acre
3. Areas seeded by hand broadcasting shall be lightly raked and mulched with a crimped straw mulch placed at a rate of 1-1/2 tons per acre

B. Recommended Seed mix:

High Elevation Forest / Western North American Cool Temperate Forest

Soil surface textures

Vegetation Community: These montane areas generally include conifer and aspen forests above 7500/8000 feet

Precipitation ranges: less than 30 inches

Acres to be seeded= 0.5

Broadcast Method= Broadcast

Irrigation? No

Seed Recommendations:

Species	Variety	Type	PLS Rates	Broadcast PLS Mult.	Irrigation PLS Mult.	PLS/Ac to use (100%)	% in mix	Rate (PLS lb/ac)	Acres to be seeded	Total PLS
Muttongrass		NB	1.0	2.0	1.0	2.0	25%	1.0	0.5	0.5
Slender Wheatgrass		NCB	5.5	2.0	1.0	5.5	20%	2.2	0.5	1.1
Mountain Brome		NCB	10.0	2.0	1.0	10.0	20%	4.0	0.5	2.0
Thurber's Fescue	Vaughn or Butte	NCB	2.5	2.0	1.0	2.5	10%	0.5	0.5	0.3
Western Wheatgrass	Arriba	NCS	8.0	2.0	1.0	8.0	25%	4.0	0.5	2.0
Totals						28.0	100%	11.7	0.5	5.9

Alternatives:

Wildrye NCB 20.0 / 10.0

Notes:

1. Use adapted improved varieties and cultivars in the following order of preference, when available:
   1. certified name varieties, 2. named varieties, 3. common seed
2. PLS = Pure Live Seed
3. Double the drilled seeding rate to obtain broadcast seeding rate.
4. For irrigated areas double the seeding rate.
5. For critical area seedings use the irrigated rate.

Legend: I = introduced; N = native; C = cool season; W = warm season;
B = bunchgrass; S = sodformer; F = forb; L = legume; Sh= shrub; V = vine

Resources: https://cpw.state.co.us/Documents/CNAP/RevegetationGuide.pdf
https://plants.sc.egov.usda.gov/java/

PART 3 EXECUTION

3.1 EROSION CONTROL MANAGEMENT

A. The CONTRACTOR shall place, properly install and maintain the erosion control BMPs as shown or described. As the project progresses, BMPs shall be maintained and adjusted to maintain effectiveness.

3.2 EROSION CONTROL

A. Construction Implementation

1. The CONTRACTOR shall incorporate into the project all erosion and sediment control features, as well as spill prevention and containment measures, to protect wetlands and waters of the US.

B. Stabilization

1. Permanent stabilization means to cover disturbed areas with final seed as specified and/or indicated on the Plans.

C. Maintenance

1. The CONTRACTOR shall continuously maintain all erosion and sediment control features so that they perform their intended function during construction and work suspensions until project final acceptance.

END OF SECTION

SECTION 32 36 00

RIPRAP & BEDDING

PART 1 GENERAL

1.1 SUMMARY

A. This specification defines the quality of rock and general placement methods to be used in the construction of rock riprap.

B. This specification also defines the riprap bedding material and general placement methods to be used in the rock riprap construction.

1.2 REFERENCES

A. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction – section 506 and section 703. Riprap and bedding gradation and placement are based on this reference.

1.3 SUBMITTALS

A. Bedding (fine and coarse). Certified statement from independent testing laboratory, acceptable to Engineer, of material compliance.

PART 2 PRODUCTS

2.1 MATERIALS

A. RIPRAP: Project riprap shall be angular onsite rock with minimum size and gradation meeting CDOT D_{50} = 9 per Section 506. Minimum gradation requirements for D_{50} = 9 material are shown in Table 1 below.

TABLE 2: RIPRAP GRADATION	
Percent Passing (%)	Particle Size (in)
70 – 100	15
50 – 70	12
35 – 50	9
2 – 10	3

B. Quality – Shall be suitable onsite rock crushed and screened. If an alternative source is proposed, the contractor shall furnish test results to the engineer demonstrating the following material properties are met.

1. SG ≥ 1.65

2. LA Abrasion (ASTM C535) = 50% loss (max) or approved equal testing method

C. Bedding Material:

1. Fine Bedding: Granular material meeting CDOT requirements for fine aggregate (ASTM C-33 sand). CDOT Construction Specifications Section 703.

TABLE 2: FINE BEDDING GRADATION		
Percent Passing (%)	*Particle Size (mm)*	*Sieve Size*
100	9.5	3/8”
95 – 100	4.75	#4
80 – 100	2.36	#8
50 – 85	1.18	#16
25 – 60	600µm	#30
10 – 30	300µm	#50
2 – 10	150µm	#100

2. Coarse Bedding: Granular material meeting CDOT requirements for Class C Filter Material per CDOT Construction Specifications Section 703.09

TABLE 3: COARSE BEDDING GRADATION		
Percent Passing (%)	*Particle Size (mm)*	*Sieve Size*
100	19	3/4”
60 – 100	4.75	#4
10 – 30	300µm	#50
0 – 10	150µm	#100
0 – 3	75µm	#200

PART 3 EXECUTION

3.1 PREPARATION AND PLACEMENT

A. Subgrade Preparation and riprap placement on Embankment – Prepare the subgrade for riprap to the required lines and grades shown on the Construction Drawings and as defined below. Scarify and compact any fill required/native soils in the subgrade to 90% compaction ASTM D-698.

1. On the embankment slope, remove existing rock, soil, and vegetation to a depth of 1.5’ below finish grade.
2. On compacted subgrade place 4 inch (minimum) loose layer of fine bedding material then place 4 inch (minimum) loose layer of coarse bedding Material.
3. After placement of bedding, place 13 inches (minimum) graded D_{50} = 9” riprap to finish grade and up sides of the channel as shown.

B. Riprap less than or equal to 15” (230lbs) may be dumped from a height no greater than 3’ with hand sorting to achieve a stable and well-graded surface finish. Riprap larger than 15” shall be machine placed in an evenly distributed manner throughout the project.

C. Placement of bedding and riprap should follow immediately after sub-grade preparation. Place riprap to form a dense mass of stone with minimum voids.

D. Rock and bedding should be placed in uniform lifts.

END OF SECTION