



Central Arizona Water Conservation District  
Supplement to MAG Standard Specifications  
for Public Works Construction  
2026

Effective Date: February 1, 2026

## 2026 Supplements to the MAG Standard Specifications

### **Specification Sections Supplemented:**

**Section 101 ABBREVIATIONS AND DEFINITIONS** – Modified abbreviations and definitions for CAWCD.

**Section 201 CLEARING AND GRUBBING** – Modified to reflect work in CAWCD right-of-way and easements.

**Section 205 ROADWAY EXCAVATION** – Modified to require measurement method to be approved by CAWCD.

**Section 210 BORROW EXCAVATION** – Modified to specify maximum diameter of material.

**Section 211 FILL CONSTRUCTION** – Modified for maximum rock size, compaction requirements, and measurement method to be approved by CAWCD.

**Section 215 EARTHWORK FOR OPEN CHANNELS** – Modified to not allow concrete or bituminous pavement in the fill and require CAWCD approval of measurement method.

**Section 337 ASPHALT PAVEMENT CRACK SEALING AND CRACK FILLING** – Modified product submittals requirements.

**Section 350 REMOVAL OF EXISTING IMPROVEMENTS** – Modified to reflect work in CAWCD right-of-way and easements. Modified method of payment to be as specified in the Bid Form.

**Section 401 TRAFFIC CONTROL** – Modified to reflect CAWCD traffic control requirements.

**Section 420 CHAIN LINK FENCES** – Modified for CAWCD chain link fence requirements.

**Section 424 PARKWAY GRADING** – Modified to include site grading.

**Section 430 LANDSCAPING** – Modified measurement and payment.

**Section 440 LANDSCAPE IRRIGATION** – Modified for shop drawing submittals and measurement and payment.

**Section 505 CONCRETE STRUCTURES** – Modified for CAWCD submittal and safety requirements, cold weather concreting.

**Section 515 STEEL STRUCTURES** – Modified for CAWCD as-built requirements.

**Section 520 STEEL AND ALUMINUM HANDRAILS** – Modified to not allow aluminum handrail and to require submittal of mill reports for steel.

**Section 530 PAINTING** – Modified to allow this section to be used for civil improvements only.

**Section 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION** – Modified to require CAWCD submittal procedures and safety requirements.

**Section 608 HORIZONTAL DIRECTIONAL DRILLING** – Added drilling requirements specific to CAP Canal environment.

**Section 610 WATER LINE CONSTRUCTION** – Modified payment for polywrap and requirements for meter service connections. Added Schedule 80 PVC water pipe for pipes less than 4-inches in diameter. Restricted pipe material at CAWCD turn-ins and turn-outs to ductile iron and steel.

**Section 611 WATER, SEWER AND STORM DRAIN TESTING** – Modified to require video inspection record for sanitary sewer pipe.

**Section 620 CAST-IN-PLACE PIPE** – Modified to limit the diameter of pipe under this specification.

**Section 772 CHAIN LINK FENCE** – Modified for CAWCD requirements for chain link fence. Added requirement to use CAWCD detail STD-C-C06755 for chain link fence construction.

### **Specification Sections Deleted:**

**Section 102 BIDDING REQUIREMENTS AND CONDITIONS** – Deleted this section in its entirety.

**Section 103 AWARD AND EXECUTION OF CONTRACT** – Deleted this section in its entirety.

**Section 104 SCOPE OF WORK** – Deleted this section in its entirety.

**Section 105 CONTROL OF WORK** – Deleted this section in its entirety.

**Section 106 CONTROL OF MATERIALS** – Deleted this section in its entirety.

**Section 107 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC** – Deleted this section in its entirety.

**Section 108 COMMENCEMENT, PROSECUTION AND PROGRESS** – Deleted this section in its entirety.

**Section 109 MEASUREMENTS AND PAYMENTS** – Deleted this section in its entirety.

**Section 110 – NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION** – Deleted this section in its entirety.

**Section 602 TRENCHLESS OR OPEN CUT INSTALLATION OF STEEL CASING** – Delete this section in its entirety.

**Section 607 TRENCHLESS INSTALLATION OF SMOOTH WALL JACKING PIPE** – Delete this section in its entirety.

### **Specification Sections Added:**

**CAP Supplement Section 203 STORMWATER POLLUTION PREVENTION PLAN** – Added this section in its entirety.

**CAP Supplement Section 313 GRAVEL SURFACING** – Added this section in its entirety.

**CAP Supplement Section 361 WILDLIFE FENCING** – Added this section in its entirety.

**CAP Supplement Section 411 BOLLARDS** – Added this section in its entirety.

**CAP Supplement Section 421 PAVEMENT MARKING** – Added this section in its entirety.

**CAP Supplement Section 507 CANAL LINING REPLACEMENT** – Added this section in its entirety.

**CAP Supplement Section 508 MISCELLANEOUS CAST-IN-PLACE CONCRETE** – Added this section in its entirety.

**CAP Supplement Section 509 PLACEMENT OF NON-SHRINK CEMENTITIOUS GROUT** – Added this section in its entirety.

**CAP Supplement Section 510 UNDERWATER CONCRETE REMOVAL** – Added this section in its entirety.

**CAP Supplement Section 512 PRECAST CONCRETE VAULTS** – Added this section in its entirety.

**CAP Supplement Section 513 PRECAST CONCRETE BUILDINGS** – Added this section in its entirety.

**CAP Supplement Section 602 TRENCHLESS INSTALLATION OF STEEL CASING** – Added this section in its entirety.

**CAP Supplement Section 604 GROUTING OF STEEL CASING** – Added this section in its entirety.

**2026**  
**CENTRAL ARIZONA WATER CONSERVATION DISTRICT**  
**SUPPLEMENT TO**  
**MAG UNIFORM STANDARD SPECIFICATIONS**  
**FOR PUBLIC WORKS CONSTRUCTION**

**TABLE OF CONTENTS**

**PART 100 – GENERAL CONDITIONS**

<b>SECTION</b>	<b>TITLE</b>	<b>PAGE</b>
101	Abbreviations and Definitions	8

**PART 200 - EARTHWORK**

<b>SECTION</b>	<b>TITLE</b>	<b>PAGE</b>
201	Clearing and Grubbing	9
CAP 203	Stormwater Pollution Prevention Plan	10
205	Roadway Excavation	13
210	Borrow Excavation	14
211	Fill Construction	15
215	Earthwork for Open Channels	16

**PART 300 – STREETS AND RELATED WORK**

<b>SECTION</b>	<b>TITLE</b>	<b>PAGE</b>
CAP 313	Gravel Surfacing	17
337	Asphalt Pavement Crack Sealing and Crack Filling	19
350	Removal of Existing Improvements	20
CAP 361	Pavement Marking	22

## **PART 400 – RIGHT OF WAY AND TRAFFIC CONTROL**

<b>SECTION</b>	<b>TITLE</b>	<b>PAGE</b>
401	Traffic Control	32
CAP 411	Bollards	33
420	Chain Link Fences	35
CAP 421	Wildlife Fence	36
424	Parkway Grading	40
430	Landscaping	41
440	Landscape Irrigation	42

## **PART 500 – STRUCTURES**

<b>SECTION</b>	<b>TITLE</b>	<b>PAGE</b>
505	Concrete Structures	43
CAP 504	Canal Lining Replacement/Repair	46
CAP 508	Miscellaneous Cast-in-Place Concrete	58
CAP 509	Placement of Non-Shrink Cementitious Grout	64
CAP 510	Underwater Concrete Removal	69
CAP 512	Precast Concrete Vaults	72
CAP 513	Precast Concrete Buildings	76
515	Steel Structures	81
520	Steel and Aluminum Handrail	82
530	Painting	83

## **PART 600 – WATER, SEWER, STORM DRAIN AND IRRIGATION**

<b>SECTION</b>	<b>TITLE</b>	<b>PAGE</b>
601	Trench Excavation, Backfilling and Compacting	84
CAP 602	Trenchless Installation of Steel Casing	85

CAP 604	Grouting of Steel Casing	92
607	Trenchless Installation of Smooth Wall Jacking Pipe	97
608	Horizontal Directional Drilling	98
610	Water Line Construction	99
611	Water, Sewer and Storm Drain Testing	100
620	Cast-in-Place Concrete Pipe	101

**PART 700 – MATERIALS**

<b>SECTION</b>	<b>TITLE</b>	<b>PAGE</b>
772	Chain Link Fence	102

## PART 100 – GENERAL CONDITIONS

### SECTION 101

#### ABBREVIATIONS AND DEFINITIONS

##### 101.1 ABBREVIATIONS:

Add the following:

CAP	Central Arizona Project
CAWCD	Central Arizona Water Conservation District

##### 101.2 DEFINITIONS AND TERMS:

Page 101-4, first paragraph, add the following: Replace the terms Agency, Contracting Agency, Engineer, Engineer’s representative, Owner, and Inspector with CAWCD.

Page 101-4, add the following definition: **CAWCD Board:** the governing body of the CAWCD acting under the authority of the laws of the State of Arizona.

Page 101-4, add the following definition: **Contracting Officer:** The CAWCD representative responsible for administering the construction contract.

Page 101-7 **Notice of Award:** Modify as follows: A letter from the CAWCD advising the Contractor that they are the successful bidder and the CAWCD or CAWCD Board has accepted their proposal.

##### 101.3 Add the following paragraph:

Whenever MAG Uniform Standard Specifications (or Details) for Public Works Construction are referenced using such phrases as MAG Detail No. \_\_\_\_, MAG Standard Detail No. \_\_\_\_, MAG Standard Specification Section \_\_\_\_, MAG Section \_\_\_\_, MAG Subsection \_\_\_\_, it shall be understood as if the phrase were followed by the words, “as amended by the CAP Supplement, latest version.” Similarly, it is provided that whenever a CAP Supplement to MAG Uniform Standard Specifications (or Details) for Public Works Construction are referenced using such phrases as CAP Detail No. \_\_\_\_, CAP Supplemental Detail No. \_\_\_\_, CAP Supplemental Specification Section \_\_\_\_, CAP Section \_\_\_\_, CAP Subsection \_\_\_\_, CAP Supplement \_\_\_\_, it shall be understood as if the phrase were followed by the words, “as it amends the MAG Uniform Standard Specifications (or Details) for Public Works Construction , latest version.”

**Sections 102 through 110:** Delete these sections in their entirety. Use CAP DIV 00 – INVITATION TO BID, BID SUBMITTAL AND CONTRACT DOCUMENTS and CAP DIV 01 GENERAL REQUIREMENTS.

## **PART 200 - EARTHWORK**

### **SECTION 201 CLEARING AND GRUBBING**

**201.1 DESCRIPTION:** shall be modified to read:

This work consists of removing objectionable material from the CAWCD right-of-way, easements and such other areas specified in the project plans. Any areas to be cleared as part of the project must be specified on the plans or in the special provisions. No clearing and grubbing shall take place outside the specified limits unless such work is authorized by CAWCD.

Perform clearing and grubbing in advance of grading operations.

**201.2 PRESERVATION OF PROPERTY:** add the following:

Protect benchmarks and survey control points from damage or displacement.

**201.3 CONSTRUCTION METHODS:** add the following:

Call Arizona Blue Stake at 811 not less than three working days before performing the work. Request underground utilities to be located and marked within and surrounding the construction areas.

Obtain a no-cost CAWCD Dig Permit through the CAWCD Inspection or Engineering staff assigned to the construction operations. Anticipate no more than 10 days to obtain the permit.

Contractor shall comply with all applicable Federal, State and County or local laws or requirements regarding prevention, control, and abatement of dust pollution. The Contractor shall be responsible for all damages resulting from dust generated by the Contractor at the site or any related operations.

Pre-wetting work areas may be required in which case the Contractor shall be responsible for all related costs of obtaining, hauling, and distributing the water. Water shall be applied as often as necessary to maintain a dust-free environment.

All materials removed in clearing and grubbing shall be hauled off and disposed of at locations outside of CAWCD right-of-way or as directed in the special provisions. CAWCD right-of-way and easements shall be left with a neat and finished appearance. No accumulation of material shall remain on or adjacent to the right-of-way or easement.

**CAP SUPPLEMENT SECTION 203**  
**STORM WATER POLLUTION PREVENTION PLAN**

Add this specification in its entirety:

**203.1 DESCRIPTION:**

The work under this section shall consist of Storm Water Pollution Prevention Plan (SWPPP) preparation and associated erosion control measures within the project limits and/or within CAWCD right-of-way or easements.

The Contractor shall be responsible to implement the requirements of the Arizona Pollutant Discharge Elimination System (AZPDES) for erosion and sediment control as specified in the General Permit for Discharge from Construction Activities to the Waters of the United States, as issued by the Arizona Department of Environmental Quality (ADEQ). The document is referred herein as the AZPDES General Permit.

The Permit is for stormwater discharges that enter Arizona surface waters, or a Municipal Separate Storm Sewer System leading to Arizona surface waters and are associated with (1) construction activities that disturb 1 or more acres of land or (2) activities that will disturb less than 1 acre of land but are part of a larger common plan of development that will ultimately disturb 1 acre or more.

The work shall include providing, installing, maintaining, removing, and disposing of erosion and sediment control measures as shown on the Erosion Control/SWPPP Plan that can include such items as gravel filter berms, dikes, catch basin inlet protection, end-of-pipe filtering devices, silt fences, dams, sediment basins, earthen berms, netting, geotextile fabrics, slope drains, seeding, stream stabilization, and other erosion and sediment control devices or methods for the duration of the project.

The contractor shall be responsible for the preparation and processing of all documents required in the AZPDES General Permit.

**203.2 SUBMITTALS:**

Contractor shall provide the following documents:

- (A) Erosion control plan sealed by an Arizona registered professional engineer.
- (B) Storm Water Pollution Prevention Plan, utilizing AZDEQ SWPPP template
- (C) Erosion control details, using ADOT Erosion Control Details
- (D) AZPDES General Permit

Maintain one copy of each required document on site.

### **203.3 MATERIALS:**

Sediment logs, sediment wattles, and fiber rolls shall be manufactured or constructed rolls of fiber matrix, secured with netting, and used for the purpose of controlling erosion by slowing high flow. water velocity and trapping silt sediments. Netting at each end of sediment logs and wattles shall be secured with metal clips or knotted ends to assure fiber containment.

Stabilized construction entrance/exit gravel pads shall be gravel material of crushed angular rock in compliance with ADOT Gradation C sized between 1-3 inches material and filter fabric. Filter fabric shall be non-woven, high survivability separation geotextile fabric.

Any other materials planned for use shall be submitted for review by CAWCD.

### **203.4 CONSTRUCTION METHODS:**

Contractor shall verify existing conditions before starting work and incorporate erosion control devices indicated on the plans into the project at the earliest practical time.

Construct, stabilize and activate erosion controls before site disturbance within the tributary areas of these controls. Stabilize disturbed areas on which activity has ceased and which will remain exposed for more than 20 days. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2:1 or flatter.

Protect benchmarks, survey control points and existing structures from damage or displacement.

### **203.5 MAINTENANCE AND CLEAN UP:**

Perform weekly inspection of erosion control measures and after each runoff event. When sediment accumulation in sedimentation structures has reached a point of one-third depth of sediment structure or device, remove, and dispose of sediment. Do not damage structure or device during operations. If an installed erosion control measure is disturbed during construction, repair or replace prior to proceeding. Do not permit sediment to erode into construction or site areas or natural waterways.

All materials used for erosion control shall be hauled off and disposed of at locations outside of CAWCD right-of-way. CAWCD right-of-way shall be left in a neat appearance. No accumulation of material shall remain on or adjacent to the right-of-way, easement, or project limits.

### **203.6 MEASUREMENT:**

SWPPP and erosion control will be measured on a lump sum basis. The lump sum shall include the placement, maintenance, and removal of all items in this specification and as directed by CAWCD.

### **203.7 PAYMENT:**

Payment for this item shall be paid at the contract lump sum price for all work, complete in place. No additional payment shall be made for haul-off and disposal of waste material. No payment will be made for erosion control outside the specified limits unless such work is authorized by CAWCD.

When the Bid Proposal does not include a pay item for SWPPP and erosion control, the cost thereof shall be considered as being included in the price bid for the construction or installation of the items to which such SWPPP and erosion control is incidental or appurtenant.

**SECTION 205**  
**ROADWAY EXCAVATION**

**205.7 MEASUREMENT:** Revise the third paragraph to read: The computed quantities of material shall be measured by a method which is best suited to obtain an accurate determination and is approved by CAWCD.

## SECTION 210

### BORROW EXCAVATION

**210.2 IMPORTED BORROW:** Revise the second paragraph to read: Borrow material for fill within CAWCD right of way or easement shall meet the following requirements:

Revise the sixth paragraph to read: The material shall be free from wood, vegetation, or other deleterious matter. The maximum size of this material shall not be greater than 3-inches in diameter.

## SECTION 211

### FILL CONSTRUCTION

**211.2 PLACING:** Modify the first paragraph as follows: Rocks or other solid material greater than 3 inches in greatest dimension shall not be placed in fill areas.

Delete the fourth paragraph.

**211.3 COMPACTING:** Modify the fifth paragraph as follows: The loose thickness of each layer of fill material before compacting shall not exceed 8 inches. Each layer shall be compacted in accordance with the following requirements to a uniform density of not less than 90 percent, except that where a new or widened roadway and appurtenances are required, density of the upper 2 feet and when the fill is within 2 feet of the above shall be not less than 95 percent or as otherwise indicated on the plans or in the special provisions. Testing shall be in accordance with 211.4 TESTS.

Delete the sixth and seventh paragraph. Add the following: Unless otherwise indicated on the Plans or in the Special Provisions, broken Portland cement concrete and bituminous type pavement will not be permitted in the fill.

**211.5 MEASUREMENT:** Revise the second paragraph to read: The computed quantities of material shall be measured by a method which is best suited to obtain an accurate determination and is approved by CAWCD.

**SECTION 215**  
**EARTHWORK FOR OPEN CHANNELS**

**215.4 FILL AND BACKFILL:** First paragraph, delete the second sentence and add the following: Broken Portland cement concrete and bituminous type pavement will not be permitted in the backfill or fill.

**215.7 MEASUREMENT:** Revise the second paragraph to read: The computed quantities of excavation shall be measured by a method which is best suited to obtain an accurate determination and is approved by CAWCD.

## **PART 300 - STREETS AND RELATED WORK**

### **CAP SUPPLEMENT SECTION 313**

#### **GRAVEL SURFACING**

Add this specification in its entirety:

##### **313.1 GENERAL:**

The work under this section consists of the gravel surfacing of CAP O&M roads. The Contractor shall furnish all necessary labor, material, tools, and equipment to complete the proper installation of gravel surfacing at the locations shown in the Plans. Items not included in this specification include subgrade preparation, road grading, fill construction, placement of base material, that are in other specification sections.

**313.1.1 Submittals:** Submittals shall be prepared in accordance with the requirements of CAWCD Section 013300 SUBMITTAL PROCEDURES. The following submittals are required under this specification:

- (A) Surfacing material source and product information
- (B) Laboratory sieve test data on a sample of the source product
- (C) Proposed binding material (if needed)

**313.1.2 Quality Assurance:** When working outside of CAWCD right-of-way or easements, perform the work in accordance with the requirements of the local jurisdiction.

CAWCD surveyors may spot verify the final product prior to acceptance of the project.

##### **313.2 PRODUCTS:**

The material used in the work shall meet the requirements of MAG Section 702, Table 702-1 – Aggregate Base Course.

##### **313.3 EXECUTION:**

**313.3.1 Preparation:** Call Arizona Blue Stake at 811 not less than three working days before performing the work. Request underground utilities to be located and marked within and surrounding the construction areas.

Obtain a no-cost CAWCD Dig Permit through the CAWCD Inspector or Engineering Staff assigned to the construction operations. Anticipate no more than 10 days to obtain the permit.

Before surfacing material is placed, the subgrade shall conform to the prescribed grades and cross sections. The subgrade shall be approved by CAWCD and may be spot checked by CAWCD surveyors prior to the placement of surfacing materials. Any grade discrepancies of  $\pm 0.5"$  or 0.1% grade shall be corrected at no additional cost.

**313.3.2 Protection:** Protect utilities and storm drains indicated to remain from damage. Protect trees, plant growth, and features designated to remain, as final landscaping. Protect bench marks, survey control points, and existing structures from damage or displacement.

**313.3.3 Placing:** The surface material shall be spread on the prepared subgrade to such depth that, when thoroughly compacted, it will conform to the prescribed grades and dimension. Segregation of coarse and fine materials shall be avoided and any segregated materials shall be remixed by harrowing and blading.

**313.3.4: Compaction:** Compaction for gravel surfacing shall be in conformance with MAG Section 310.3.

**3.3.3.5: Clean-up:** CAWCD right-of-way shall be left in a neat and finished appearance. No accumulation of material shall remain on or adjacent to the right-of-way. If significant amounts of material have migrated or been dumped into the canal, removal will be required at the discretion of CAWCD.

## SECTION 337

### ASPHALT PAVEMENT CRACK SEALING AND CRACK FILLING

**337.2.4 Product Submittals:** the first paragraph shall be modified to read:

Prior to application of category 1 crack sealant and category 2 crack filler material, the Contractor shall submit to CAWCD for approval the material manufacturer's product specifications and installation recommendations. Installation recommendations shall include surface preparation, product installation, and curing requirements. For sealant material, a Certificate of Compliance per CAWCD DIV 01 Section 013300 Submittal Procedures shall be submitted to CAWCD. Asphalt mix design for category 3 crack filler shall be submitted to the CAWCD for approval.

The second paragraph shall be modified to read: Prior to and during production, when requested by CAWCD, the Contractor shall provide material samples to the CAWCD for testing to verify the quality of the materials and to ensure conformance with the Specifications.

## SECTION 350

### REMOVAL OF EXISTING IMPROVEMENTS

**350.1 DESCRIPTION:** Delete this section in its entirety and add the following:

The work under this section shall consist of the removal, wholly or in part, and satisfactory disposal of all structures and obstructions within the right-of-way or project limits which have not been designated on the project plans or specified in the Special Provisions to remain, except for those structures and obstructions which are to be removed and disposed of under other items of work in the contract. The work shall also include salvaging of designated materials and backfilling the resulting cavities.

This work shall consist of removing and disposing of existing features such as concrete, pavements, structures, fence, gates, pipes, conduits, curbs, and gutters as specified on the project plans or within the Special Provisions.

Existing improvements, adjacent property, utilities and other facilities, and trees and plants not to be removed, shall be protected from injury or damage resulting from the Contractor's operations. Protect benchmarks, survey control points, and existing structures from damage or displacement. CAWCD shall be notified immediately if any existing improvements are damaged because of Contractor's activities.

Removal of existing improvements included in the project that are located outside of CAWCD right-of-way or easements shall be performed in compliance with the requirements of the local jurisdiction.

Removals and demolition to be performed inside CAP Pumping Plants, Structures, or Buildings are not covered by this specification.

**350.2 CONSTRUCTION METHODS:** Insert the following after the first paragraph:

Call Arizona Blue Stake at 811 not less than three working days before performing the work. Request underground utilities to be located and marked within and surrounding the construction areas.

Obtain a no-cost CAWCD Dig Permit through the CAWCD Inspection or Engineering staff assigned to the construction operations. Anticipate no more than 10 days to obtain the permit.

Contractor shall comply with all applicable Federal, State and County or local laws or requirements regarding prevention, control, and abatement of dust pollution. The Contractor shall be responsible for all damages resulting from dust generated by the Contractor at the site or any related operations.

All removals of existing improvements shall be conducted such that no existing utilities to remain in service are damaged or their service unexpectedly affected.

**350.2.2 Others:** Add the following at the end of this section:

Any salvage materials shall be relocated and stored at the direction of CAWCD.

**350.4 PAYMENT:** Delete this section in its entirety and add the following:

Removal of Existing Improvements will be measured on a basis per type of removal as specified in the Bid Form and payment shall be made at the specified unit price, complete in place. No payment will be made for removals outside the specified limits unless such work is authorized by CAWCD.

## **CAP SUPPLEMENT SECTION 361**

### **PAVEMENT MARKING**

#### **361.1 DESCRIPTION:**

The work under this section shall consist of cleaning and preparing the pavement surface, furnishing all materials and applying white or yellow, water- borne, fast- dry or rapid- dry traffic paint, and reflective glass beads at the locations and in accordance with the details shown on the plans, MUTCD, the requirements of these specifications, or as directed by the CAWCD.

#### **361.2 PAVEMENT MARKING PAINT - GENERAL:**

All material used in the formulation of the pavement marking paint shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of CAWCD.

Only waterborne traffic paint that has been reviewed, evaluated, and approved by the Arizona Department of Transportation (ADOT) Product Evaluation Program or equal shall be used.

Copies of the most recent version of the Approved Products List (APL) are available on the internet from the ADOT Research Center through its Product Evaluation Program.

Certificates of Compliance conforming to the requirements of Section 013300 Article 1.3 shall be submitted. Safety data sheets for all products shall be submitted in accordance with Section 019150 Article 1.6.

#### **361.3 WATERBORNE PAVEMENT MARKING PAINT TYPE I (STANDARD)**

Type I (Standard) waterborne pavement marking paint shall be the traffic paint for long line and short line striping, arrows, symbols, and legends. Type I shall be used:

For temporary traffic control.

At the end of the construction work shift if the roadway is open to traffic over an intermediate layer of pavement while the final lift or layer of pavement has not been placed yet.

As a primer on the final lift or layer of pavement 30 days prior to the application of the durable pavement marking materials; and

During Construction on pavement that will not be resurfaced. Two applications of waterborne paint may be used, allowing 30 to 60 days between applications.

Type I paint shall be capable of performing as specified herein when subjected to high traffic volumes and severe wear conditions such as repeated crossing, starting, stopping, and turning movements.

#### **361.4 WATERBORNE PAVEMENT MARKING PAINT: TYPE II (HIGH-BUILD)**

Type II (High- build) waterborne pavement marking paint shall be used for long line and short line striping, arrows, symbols, and legends. Type II shall be used for temporary traffic control that needs to be in place for at least 180 days, and between two construction seasons.

Type II paint shall be capable of performing as specified herein when subjected to two- season projects, high traffic volumes, and severe wear conditions such as repeated crossing, starting, stopping, and turning movements.

**361.4.1 Composition Requirements:** The pavement marking paint shall be a ready-mixed, one component, waterborne traffic line paint of the correct color, to be applied to either asphaltic or Portland cement concrete pavement. The composition of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to produce pigmented waterborne paint containing all the necessary co-solvents, dispersant, wetting agents, preservatives and all other additives, so that the paint shall retain its viscosity, stability and all the properties as specified herein.

Lead concentrations shall not exceed 0.009 percent by weight (90 ppm) using test method ASTM D 3335.

The manufacturer shall certify that the product contains no detectable concentrations of:

- (A) Antimony
- (B) Arsenic
- (C) Cadmium
- (D) Mercury
- (E) Chromium, Inorganic
- (F) Chromium, Hexavalent
- (G) Toluene
- (H) Chlorinated solvents
- (I) Hydrolysable chlorine derivatives
- (J) Ethylene-based glycol ethers and their acetates; and/or A carcinogen as defined in 29 CFR 1910.1200.

**361.5 MANUFACTURING FORMULATIONS:**

The manufacturer shall formulate the pavement marking paint in a consistent manner. The formulation of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to formulate paint which will meet the quantitative and qualitative requirements of this specification

**361.5.1 Quantitative Requirements of Mixed Paints:**

<b>Table 708 – 1 (ADOT)</b>		
	<b>White</b>	<b>Yellow</b>
Pigment: Percent by weight, ASTM D 3723, Allowable variation from the qualifying sample	± 2.0	± 2.0
Non-Volatile Content/ Non-Volatile Vehicle: Percent by weight, ASTM D 2369, Allowable variation from the qualifying sample	± 2.0	± 2.0
Viscosity: Krebs Units at 77 ± 1 ° F, ASTM D 562	70 - 85	70 - 85
Weight per Gallon: Pounds per gallon 77 ± 1 ° F, ASTM D 1475, Allowable variation from the qualifying sample	± 0.3	± 0.3

Vehicle Composition: Vehicle Infrared Spectra, ASTM D 2621, Allowable variation from the qualifying sample	None	None
PH: ASTM E70, Allowable variation from the qualifying sample	± 1.0	± 1.0
Fineness of Dispersion: HEGMAN, minimum, ASTM D 121	3.0	3.0
Volatile Organic Compounds: Pounds per gallon of paint, maximum, ASTM D 3960 according to 7.1.2.	2.1	2.1
Flash Point: Degrees F., minimum, ASTM D 93, Method A	100	100
Dry Time to No Pickup: With no beads: minutes, maximum, ASTM D 711	10	10
Dry Through Time: Minutes, ASTM D 1640 except no thumb pressure is used when thumb is rotated 90 ° on paint film	20	20
Flexibility: ASTM D 522, Method B: Flexibility shall be tested per ASTM D 522, Method B. Draw down the paint to a wet film thickness of 0.005 inches (0.13mm) on a clean bare cold-rolled steel panel. Air-dry for 24 hours at standard conditions then bake for 5 hours at 221 °F ± 3 ° F (105 ° C ± 2 ° C) and finally condition the panel for 30 minutes at standard conditions. When tested as specified the paint film shall not crack, chip, or flake after the test panel is bent over a ½ inch (13 mm) diameter, cylindrical mandrel.	Pass	Pass

### **361.5.2 Qualitative Requirements:**

**Color of Yellow Paint:** The color of the yellow paint shall closely match Federal Standard 595b, Color No. 33538.

**Dry Opacity:** Dry opacity for the paint will be determined using a black- white Leneta Chart, Form 2C Opacity, or equal, and a calibrated reflectance meter capable of determining reflectance to the nearest 1 percent. Using a 10-mil gap doctor blade, a film of paint is drawn down, covering both black and white portions of the chart on a vacuum plate. The film shall be allowed to dry 24 hours. After calibrating the meter according to the manufacturer' s instructions, measure the reflectance over the white and black portions according to the manufacturer' s instructions. Dry Opacity for both white and yellow paint shall be at least 0.90.

**Yellowness Index:** Yellowness Index for white paint will be determined as described for dry opacity, only use a 15 - mil gap doctor blade to draw down the paint. Calculate the Yellowness Index in accordance with ASTM E 313. Yellowness Index for the white paint shall be a maximum of 10.

**Reflectance:** Reflectance for both white and yellow paint will be determined using the same 15 - mil draw-down film as for the Yellowness Index. For white paint the same sample may be utilized for both the Yellowness Index and Reflectance. Measure the reflectance of the paint film using the reflectance meter according to the manufacturer's instructions. Reflectance for the white paint shall be at least 85. Reflectance for the yellow paint may range from 42 to 59, inclusive.

**UV Color Durability:** UV Color Durability shall be determined using a QUV Weatherometer, with Ultraviolet Light and Condensate Exposure according to ASTM G 154, for 300 hours total. The repeating cycle shall be four hours UV exposure at 140 degrees F (60 degrees C) followed by four hours condensate exposure at 104 degrees F (40 degrees C). After 300 hours of exposure, the Yellowness Index for white paint shall not exceed 12, and yellow paint shall closely match Federal Standard 595b, Color No. 33538.

**Static Heat Stability:** To determine static heat stability for the paint, place 1 pint of paint in a sealed can and heat in an air circulation oven at  $120 \pm 1$  degree F (49 degrees C) for a period of one week. Remove the paint from the oven and check the viscosity in Krebs Units at  $77 \pm 1$  degree F (25 degrees C) according to ASTM D 562. The viscosity measured shall be in the range from 68 to 90 Krebs Units, inclusive. Also, check for any signs of instability.

**Heat-Shear Stability:** To determine heat- shear stability for the paint, 1 pint of the paint is sheared in a Waring Blender at high speed to 150 degrees F (66 degrees C). The blender should have a tight-fitting lid taped onto it to minimize volatile loss. When the paint reaches 150 degrees F (66 degrees C), stop the blender, immediately pour the paint into a sample can, and apply a cover to seal the can. Let the paint cool overnight and examine for jelling or other signs of instability. Measure viscosity in Krebs Units at  $77 \pm 1$  degree F (25 degrees C), according to ASTM D 562. The viscosity measured shall be in the range from 68 to 95 Krebs Units, inclusive. If not within the upper limit, run total solids on the sheared paint and adjust solids, if necessary, by adding water to reach the original solids content. If the solids content required adjustment, again check the viscosity of the paint. The viscosity shall be in the range from 68 to 95 Krebs Units, inclusive.

**Scrub Resistance:** Scrub Resistance will be determined according to ASTM D 2486. Use an appropriate doctor blade to provide a dry film thickness of 3 to 4 mils. Allow the paint to cure for

24 hours. Perform the scrub resistance test at  $77 \pm 1$  degree F (25 degrees C) and  $50 \pm 5$  percent humidity. Record the number of cycles to remove the paint film. The number of cycles recorded shall be at least 800.

### **361.6 MANUFACTURING REQUIREMENTS:**

All materials used in formulation shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of CAWCD.

All manufactured paint shall be prepared at the factory ready for application.

At least one paint sample shall be submitted from each lot of paint.

Check samples of finished paint while being applied will be taken at intervals as determined by CAWCD.

### **361.7 PRECERTIFICATION OF PAVEMENT MARKING PAINT:**

All tests will be conducted as specified herein.

**361.7.1 General:** As described in Section 013300 Article 1.3 of the specifications, the Contractor shall provide to the CAWCD a Certificate of Compliance from the manufacturer for samples from each batch of material obtained for precertification at the production line of the manufacturer.

### **361.8 PACKAGING:**

All shipping containers for paint shall comply with the Department of Transportation Code of Federal Regulations, Hazardous Materials and Regulation Board, Reference 49 CFR. The container and lids shall be lined with a suitable coating to prevent attack by the paint or by agents in the air space above the paint. The lining shall not come off the container or lid as skins.

Containers shall be colored white, including lids, and containers shall have an identifying band of the appropriate color around and within the top one third of the container.

All containers shall be properly sealed with suitable gaskets, shall show no evidence of leakage, and shall remain in satisfactory condition for a period of 12 months after delivery to a distributor or paint applicator.

The Contractor shall be responsible for all costs and transportation charges incurred in replacing paint and containers

### **361.9 LABELING:**

All containers of paint shall be labeled showing the manufacturer's name, date of manufacture, paint color, product code, manufacturer's batch number, and quantity or weight of paint on both the side of the container and the lid. Containers shall be clearly labeled Rapid Dry or Fast Dry lead-free Waterborne Type I or Type II Traffic Paints.

All containers of paint shall be labeled to indicate that the contents fully comply with all rules and regulations concerning air pollution control in the State of Arizona, Maricopa County.

The manufacturer of the paint shall be responsible for proper shipping labels with reference to whether the contents are toxic, corrosive, flammable, etc., as outlined in the U.S. Department of Transportation, Hazardous Materials Regulations, Reference 49 CFR.

### **361.10 REFLECTIVE GLASS BEADS (SPHERES):**

General: The term "glass bead" shall be synonymous with the term "glass sphere" as used herein.

The beads shall be manufactured from glass of a composition designated to be highly resistant to traffic wear and to the effects of weathering.

The glass beads shall be moisture-proof; contain less than 0.25 percent moisture by weight; and be free of trash, dirt, or other deleterious materials.

Beads shall be essentially free of sharp angular particles showing milkiness or surface scoring or scratching. Beads shall be water white in color.

Certificates of Compliance conforming to the requirements of Section 013300 Article 1.3 of the specifications shall be submitted.

#### **361.10.1 Physical Requirements:**

Gradation: The gradation for the drop-on beads shall conform to AASHTO M 247 Type 1 and Type 3.

Roundness: Glass beads shall conform to AASHTO M 247, Type 1 and Type 3. Beads retained on any screen specified in the gradation requirements shall contain at least 80 percent true spheres.

Index of Refraction: Glass beads shall conform to AASHTO M 247, Type 1 and Type 3.

Specific Gravity: The specific gravity of the beads shall be in the range 2.40 to 2.60 when tested in accordance with the following procedures:

Place 100 grams in an oven at 230 degrees F (110 degrees C) for one hour.

Remove beads and place in a desiccator until the sample is cool.

Pour the beads slowly into a clean 100 - milliliter graduated cylinder containing 50 milliliters of isopropyl alcohol. Make certain that air is not entrapped among the beads.

The total volume reading on the graduated cylinder, minus 50, will give the volume of the beads. Calculate the specific gravity as follows:

Specific Gravity = Weight of sample / Volume of sample

Chemical Stability: Beads which show any tendency toward decomposition, including surface etching, when exposed to atmospheric conditions, moisture, dilute acids, or alkalis or paint film constituents, may be required to demonstrate satisfactory reflectance behavior, prior to acceptance, under such tests as may be prescribed.

Hazardous Constituents: Each lot shall be tested for heavy metal concentration as specified in the following table, tested by an independent laboratory using EPA Method 3052 and EPA Method 6010B.

<b>Table 708 – 2 (ADOT)</b>	
<b>Heavy Metal</b>	<b>Concentration</b>
Arsenic	< 75 ppm
Antimony	< 75 ppm
Lead	< 0.009% by weight (90 ppm)

The manufacturer shall certify that the product contains no detectable concentrations of other hazardous constituents, including:

- (A) Cadmium
- (B) Barium
- (C) Mercury
- (D) Chromium, Inorganic
- (E) Chromium, Hexavalent; and/or
- (F) A carcinogen as defined in 29 CFR 1910.1200.

**Bead Coating:** All glass beads shall have a moisture- proof adhesion enhancing overlay, consisting of a properly formulated material which prevents bead clumping and clogging and promotes proper embedment and adhesion to the applied paint. Water repellent material applied during the process of bead manufacture. The beads so treated shall not absorb moisture in storage and shall remain free of clusters and lumps and shall flow freely from dispensing and testing equipment.

The beads shall conform to AASHTO T 346.

**361.10.2 Acceptance of Glass Beads:**

**Preapproval Testing of Glass Beads:** Glass beads will be tested in accordance with these specifications for gradation, roundness, refraction, and moisture resistance coating. A test report with the lot number will be issued for each project the glass beads are to be used for.

For glass beads that have not been preapproved, the Contractor shall test field samples submitted by the project. The issuance of a test report and the maintaining of a log of all lots tested will be completed as described for glass beads tested for preapproval.

**361.11 EXECUTION:**

**Spraying Properties:** The paint shall be applied, in the field, at a 15 mils wet film thickness for Type I paint and 25 mils wet film thickness for Type II. Both Type I and Type II paint shall show the following properties at ambient temperatures of 50 to 100 degrees F (10 to 38 degrees C) with paint spray temperature of 150 degrees F (66 degrees C), maximum. For Type I paint, 6 to 10 pounds of Type 1 beads shall be post- applied per gallon of paint. For Type II paint, 10 to 12 pounds of Type 3 beads shall be post- applied per gallon of paint. Beads shall conform to Article 361.10.

For rapid-dry paint applied in a mobile operation and not protected by temporary traffic control, dry to a no-track condition in 60 seconds or less when the line is crossed over in a passing maneuver with a standard-sized automobile.

For fast-dry paint applied within an established work zone behind temporary traffic control, dry to a no-track condition in five minutes or less when the line is crossed over in a passing maneuver with a standard-sized automobile.

Produce a clean-cut, smooth line with no overspray or puddling.

Paint immediately after application shall accept glass beads so that the spheres shall be embedded into the paint film to a depth of 50 percent of their diameter.

Paint when heated to the temperature necessary to obtain the specified dry time, shall show no evidence of instability such as viscosity increase, jelling, or poor spray application.

Freeze-Thaw Properties: The paint viscosity or consistency shall not change significantly when the paint is tested for resistance to five cycles of freeze-thaw according to ASTM D 2243.

Road Service Rating: Test stripes of the paint shall be applied transversely across the pavement, 4 inches in width and approximately 12 feet long at a location approved by CAWCD.

Wet film thickness of the test stripes shall be approximately 15 mils for Type I and 25 mils for Type II paint as determined according to ASTM D 4414 and ASTM D 713 prior to test stripe application. To aid in obtaining the correct film thickness, a length of roofing paper placed by the side of the road can be used. Place a rigid metal test panel on the roofing paper in the path of a test line. Immediately after the test line is applied by the striper, measure the wet film thickness. If not satisfactory, adjust the spray pressure and repeat until the target wet film thickness is attained. It is important that no glass beads be present that would give a false wet film thickness. When the wet film thickness is correct, apply a test line across a tared metal test panel. After this, apply another test line across a different tared metal test panel, this time also adding the beads. These samples are necessary to determine the initial bead retention.

Glass beads conforming to the requirements of these specifications (moisture proof type) shall be applied after the paint has been applied, but during the same striping operation at a rate such that the initial bead retention on the test line is at least 6 pounds of beads per gallon of wet paint for Type I paint and at least 10 pounds of beads per gallon of wet paint Type II. The paint shall accept the glass beads so that the spheres are embedded into the paint film to a depth of 50 percent of their diameter. Test stripes will be observed for a period of 180 days from date of application. Paints will be evaluated for wear according to ASTM D 913.

After 180 days of service, on a visual rating scale of 0 to 100 percent, paints shall have a rating of 90 percent or better to be acceptable. All ratings will be taken in the wheel track area. Glass beads shall show no more than a 30 percent loss after 180 days of test. This will be determined by taking close-up, before and after photographs of the paint film and by count determining the average bead loss.

The road service test may be waived at the option of CAWCD or evaluated for a period of time less than 180 days.

Workmanship: Paint shall be free from foreign materials, such as dirt, sand, fibers from bags, or other material capable of clogging screens, valves, pumps, and other equipment used in a paint striping apparatus.

The paint pigment shall be well ground and properly dispersed in the vehicle. The pigment shall not cake or thicken in the container and shall not become granular or curdled. Any settlement of pigment in the paint shall result in a thoroughly wetted, soft mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sidewise manual motion of a paddle across the bottom of the container, to form a smooth uniform product of the proper consistency. If the paint cannot be easily redispersed, due to excessive pigment settlement as described above or due to any other cause, the paint shall be considered unfit for use.

The paint shall retain all specified properties under normal storage conditions for 12 months after acceptance and delivery. The Contractor shall be responsible for all costs and transportation charges incurred in replacing paint that is unfit for use. The properties of any replacement paint, as specified herein, shall remain satisfactory for eight months from the date of acceptance and delivery.

### **361.12 CONSTRUCTION REQUIREMENTS:**

Equipment: The traffic paint and beads shall be placed on the pavement by a spray- type, self-propelled pavement marking machine except that temporary striping during construction may be placed with other equipment designed for application of paint and beads.

The application equipment to be used on roadway installation shall have, as a minimum, the following characteristic and/ or apparatus:

Capable of applying clear- cut lines of the width specified on the project plans.

Equipped with a mechanical device capable of placing a broken reflectorized line with a 10 - foot painted segment and a 30 - foot gap; and

Equipped with an air- operated glass bead drop-in dispenser controlled by the spray gun mechanism.

A glass bead dispenser which is capable of placing the glass beads into the paint line as the paint is applied to the pavement shall be utilized. This dispenser shall provide satisfactory marking and delineation.

### **361.13 APPLICATION:**

Pavement markings shall be applied when the pavement surface is dry and the weather is not foggy, rainy, or otherwise adverse to the application of markings. The surface shall be free from excess asphalt or other deleterious substances before traffic paint, beads or primer are applied. The Contractor shall remove dirt, debris, grease, oil, rocks or chips from the pavement surface before applying markings. The method of cleaning the pavement surface and removal of detrimental material is subject to approval by CAWCD and shall include sweeping and the use of high- pressure air spray. The placing of traffic markings shall be done only by personnel who are experienced in this work.

Painting shall not be performed when the atmospheric temperature is below 50 degrees F (10 degrees C) when using waterborne paint, nor when it can be anticipated that the atmospheric temperature will drop below 50 degrees F (10 degrees C) temperature during the drying period. Waterborne paints shall not be applied if rain is expected within one hour of its application, unless otherwise approved by CAWCD. Waterborne paint shall not be heated to a temperature greater than 150 degrees F (66 degrees C) to accelerate drying.

The volume of paint in place shall be determined by measuring the paint tank with a calibrated rod. At the discretion of CAWCD, if the striping machine is equipped with air-atomized spray units (not airless) and paint gauges, the volume of paint may be determined by utilizing said gauges.

The quantity of glass reflectorizing beads in place shall be determined by measuring the glass reflectorizing bead tank with a calibrated rod.

The Contractor shall provide the necessary personnel and equipment to divert traffic from the installation area where the work is in progress and during drying time when, in the opinion of CAWCD, such diversion of traffic is necessary.

Painted markings placed below the final surface shall be placed immediately after a change in long-term traffic patterns/ configurations, when the need arises, or as directed by CAWCD. On intermediate lifts of overlay projects, painted markings shall consist of at least 4-inch wide by 4-foot-long strips of reflective material, placed at 40-foot intervals. In situations involving severe degree of curvature, CAWCD may direct that the length and spacing be adjusted to 2 feet and 20 feet, respectively. These requirements apply to white lane lines separating traffic moving in the same direction and to yellow center lines for two-lane, two-way roadways in areas where passing is permitted. Painted markings shall be placed on each subsequent pavement course.

Curing compound shall be removed from new concrete surfaces before the placement of painted markings.

**361.13.1 Tolerances for Placing Paint, Beads, and Primer:** The length of painted segment and gap shall not vary more than 6 inches in a 40-foot cycle.

The finished line shall be smooth, aesthetically acceptable and free from undue waviness.

Painted lines shall be 4, 8, or 12 inches wide as shown on the plans with a tolerance of  $\pm 1/8$  inch and shall be placed at a minimum rate of 16 gallons per mile for a solid 4-inch line and 4 gallons per mile for a broken 4-inch line, based on a 10-foot stripe and a 30-foot gap (40-foot cycle aggregate);

Glass reflectorizing beads shall be applied on the wet paint. For Type I paint, 6 to 10 pounds of Type 1 beads shall be post-applied per gallon of paint. And, For Type II paint, 10 to 12 pounds of Type 3 beads shall be post-applied per gallon of paint; and

Wet thickness shall not be less than 15 mils wet film thickness for Type I paint and 25 mils wet film thickness for Type II, unless otherwise shown on the plans.

Unused Paint: Disposal of unused quantities of traffic paint shall be the responsibility of the Contractor and shall meet all applicable Federal regulations for waste disposal. Paint which is saved to be used later shall be packaged as specified and shipped to a storage location. Unused paint shall be identified on the container. Unused paint may be utilized on a future project provided the paint still conforms to all specifications contained herein.

Method of Measurement: Pavement marking paint will be measured by the linear foot along the centerline of the pavement stripe. Skips in dashed lines will not be included in the measurement. Length of pavement markings will be based on a 4-inch-wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or directed by CAWCD will be made by the following method:

Plan Width of Striping (inches) x Linear Feet / 4 (inches)

## **PART 400 - RIGHT-OF-WAY AND TRAFFIC CONTROL**

### **SECTION 401**

#### **TRAFFIC CONTROL**

**401.5 GENERAL TRAFFIC REGULATIONS:** The eighth paragraph shall be revised as follows: Contractor shall arrange for partial or complete street closure permits with the local jurisdiction having authority. An advance notice of 48 hours for major streets and 24 hours for local streets and alleys is required from the Contractor.

Revise the ninth paragraph to read: The Contractor shall provide and maintain all necessary traffic controls to protect and guide traffic for all work in the construction area. Contractor shall comply with all requirements related to access to the work, use of CAWCD roads, and use of public roads as required in Division 1, Section 015000 TEMPORARY FACILITIES AND CONTROLS.

## CAP SUPPLEMENT SECTION 411

### BOLLARDS

Add this specification in its entirety:

#### **411.1 DESCRIPTION:**

This work shall consist of furnishing and installing bollards at the locations shown on the plans or as directed by CAWCD. Bollards shall conform to CAP Standard detail STD-C-06919 or details shown on the plans.

#### **411.2 MATERIALS:**

Bollards shall consist of 4-inch diameter steel pipe cut to the length indicated on CAP Standard drawing STD-C-06919, concrete filled with a crowned concrete cap. Concrete fill shall be Class C.

Anchors, if required shall be concealed (recessed) hooked type as indicated on CAP Standard drawing STD-C-06919, #4 rebar conforming to ASTM A307 Grade C.

Steel components shall conform to the following requirements:

- (A) Steel Plate: ASTM A36
- (B) Steel Pipe: ASTM A53, Grade B, Schedule 40
- (C) Bolts and Washers: SAE Grade 8
- (D) Welding Materials: AWS D1.1; type required for materials being welded

#### **411.3 CONSTRUCTION:**

**411.3.1 Fabrication:** Bollards shall be fabricated with joints tightly fitted and secured. Welds shall be continuous. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush and hairline. Ease exposed edges to small, uniform radius.

Fabrication tolerances for squareness shall be: 1/16-inch maximum difference in diagonal measurements.

**411.3.2 Finishes:** Clean steel surfaces of rust, scale, grease, and foreign matter prior to finishing. Prepare surfaces to be coated in accordance with coating manufacturer's written recommendations. Do not prime surfaces in direct contact with concrete or where field welding is required.

Coating shall be Federal Safety Yellow Atmospheric service applied in accordance with CAP Standard Specification 090101.00 Exterior Atmospheric Coatings. Surface preparation for new steel shall be in accordance with NACE No.3/SSPC SP-6 Commercial Blast Anchor Pattern: 2-4 mils.

The coating system shall be as follows:

- (A) Prime Coat: Devoe 233 (Medium Gray, Buff, or White)

(B) Color Coat: Devoe 379 Color Coat (Federal Safety Yellow or as determined by CAWCD)

(C) Clear Coat: Devoe 379 UVA Clear (average DFT after coating system is complete shall be between 10-15 mils)

Bolts, nuts, and washers shall be galvanized. Touch-up primer shall match shop primer.

**411.3.3 Source Quality Control:** Bolted connections and welded connections shall be visually inspected. Any defective bolted connections or welds shall be corrected.

**411.3.4 Execution:** Verify field conditions are acceptable for work to commence. Obtain approval from CAWCD prior to site cutting or making adjustments not scheduled.

**411.3.5 Tolerances:**

(A) Maximum variation from plumb: 1/8 inch

(B) For bollards in an array, the maximum variation from level: 1/8 inch

(C) Maximum offset from alignment: 1/8 inch

(D) Maximum out of position: 1/8 inch

**411.3.6 Field Quality Control:** Inspect welds according to AWS D1.1. Visually inspect bolted connections and correct defective bolted connections and welds. Replace damaged or improperly functioning hardware. After installation, touch up welds, abrasions, and damaged finished with prime paint or repair paint to match shop finishes.

## SECTION 420

### CHAIN LINK FENCES

**420.3.1 Fence Construction:** Fourth paragraph, second sentence, revise to read: Footings for line posts for 72-inch fabric or less shall not be less than 30 inches deep and 12 inches in diameter, and footings for line posts for fabric more than 72 inches shall be as shown on plans.

Add Paragraph 10 as follows: Chain link fence and gates shall be grounded per CAP STD – C – 06756.

**420.3.2 Construction of Gates:** Fifth paragraph, revise to read: Semi-cantilever gates shall be provided with a 6” by 6” framed block out for chain and padlock utilizing 1-1/2-inch pipe as indicated in CAP STD-C-C06755. Stops to hold gates open shall be provided as indicated on CAP STD-C-C06755 on all double drive gates and on all other gates where required.

**CAP SUPPLEMENT SECTION 421  
WILDLIFE FENCING**

**421.1 DESCRIPTION:**

The work under this section shall consist of performing all operations necessary to erect:

- (A) Barbed Wire Fence
- (B) Security Chain Link Fence
- (C) Wildlife Fence
- (D) Fence Grounding
- (E) Repair Barbed and Smooth Wire

**421.2 SUBMITTALS:**

Product Data: The Contractor shall submit the manufacturer's product data that shows the fence and materials to be furnished under this contract meet all the requirements in these specifications. The Contractor shall identify the names of the manufacturers, catalog numbers, specification references, sizes, weights and gauges of materials, and weights of zinc or aluminum coatings. Certification of product data includes the following items:

- (A) Fence Posts
- (B) Woven Wire Fencing
- (C) Concrete
- (D) Grounding Cables, Connector, and Appurtenances
- (E) Paint
- (F) Wildlife Fence
- (G) Chain Link Fencing
- (H) Chain Link Gates and their Welding Requirements.

**421.3 QUALITY ASSURANCE:**

The fence installer shall submit a statement indicating they have a minimum of 5 years' experience installing similar wire fences.

Welders shall be American Welding Society certified.

**421.3 FENCE MATERIALS:**

Fence posts:

Line post shall be 1 7/8" OD x 8' long (exposed) and bury depth in accordance with CAWCD Drawing M-C04910, galvanized AP40 or TUFF 40.

Pull, Tee, Intersection and Gate Post shall be 2 7/8" OD x 8' long (exposed) and bury depth in accordance with CAWCD Drawing M-C04910, galvanized AP40 or TUFF 40, American Fence P/N 27S401 or approved equal.

Woven Wire Fencing:

Fencing shall be installed per CAWCD Drawing CAP-M-C04910, STD-C-C06755, and STD-C-C06756.

21-Bar. 58" woven wire fencing shall have No. 11 gauge top and bottom wires and No. 13 gauge intermediate and stay.

6-Bar. 35" woven wire fencing shall have No. 10 gauge top and bottom wires and No. 12 gauge intermediate and stay wires.

Barbed wire shall be 2-strand No.12 ½ gage galvanized barbed wire with No. 14 gage 4-point barbs not less than ¾" and not more than 5" apart. The barbed wire shall be placed on the outside of the fence fabric.

Fencing:

Double Gate chain link fence fabric shall be 7 foot in height.

#### **421.4 CONCRETE MIXING MATERIALS FOR NON-STRUCTURAL POST FOOTING:**

Cement: Standard brand of domestic Portland cement, conforming to ASTM C 150, Type II, low alkali. Pre-mixed concrete bags that meet the requirements of this Article will be acceptable.

Fine Aggregate: Hard, clean, screened, and washed natural sand conforming to ASTM C 33, with a minimum sand equivalent value of 70 in accordance with ASTM D 2419.

Coarse Aggregate: Hard crushed or natural gravel conforming to ASTM C 33, Grading Size No. 467, 57, 67 and 7.

Water: Water for mixing concrete shall be clear and from a potable source unless otherwise approved by CAWCD.

Concrete may be placed using two different methods. Concrete may be placed by ready-mix truck or from 60 lbs. pre-mixed concrete bags and water. All concrete placed shall be 3000 psi at the end of 28 days or greater for all locations.

#### **421.5 GROUNDING MATERIALS:**

Grounding Cable: Grounding cable shall be copper-clad steel cable with 11/32-inch nominal diameter (seven No. 9 wires), dead-soft annealed, and 40 percent conductivity, conforming to ANSI/ASTM B 228, where applicable. Ground cable shall be copper weld, annealed stranded, as manufactured by Copperweld Bimetals Division, Glassport, Pennsylvania, or an approved equal product.

Cable Fittings Lugs and Accessories: All cable fittings other than welded type, shall be of the bolted solderless type and shall have a current-carrying capacity equal to that of the cable with which they are used. All cable fittings, lugs, and connectors, together with the bolts, nuts and washers used therewith for copper-clad ground cables, shall be of copper alloy, containing not more than 4 percent zinc. Aluminum connectors shall be used to connect aluminum-to-aluminum and tinned-bronzed connectors shall be used for making aluminum-to-copper connections.

Ground Rod: Each ground rod shall have a layer of copper inseparably bonded to a steel core, ¾-inch in nominal diameter, 10 feet long, and shall meet the requirements of ANSI/UL 467 (C

33.8). If the top of the ground rod cannot be driven vertically 1 foot below the grade, the ground rod may be driven at a 45% angle. If the ground rod cannot be driven vertically or at a 45% angle, a 12 inch by 12 inch by ¼ inch copper clad plate may be buried one foot below natural grade instead of the ground rod, with approval of CAWCD.

Exothermic Welded Connection: The grounding connections of copper to copper and copper to steel shall be CADWELD exothermic welded connections. CADWELD welded electrical connections shall be manufactured by Erico or approved equal.

#### **421.6 PAINT:**

Galvanox or Rust-O-leum Cold Galvanizing paint or approved equal will be used to touch up galvanized metal imperfections and coat copper ground wires.

#### **421.7 CHAIN LINK GATES:**

Gates shall be built per CAWCD Drawing CAP-M-C04910. The frame of the gate shall be constructed using 1 7/8-inch AP40 galvanized pipe. Post caps shall be placed on vertical pipes used for posts and gates per American Fence Part No. BCA17 or approved equal.

All welding of posts, rails and gates shall be completed by an AWS D1.1 certified welder. All welding in the field shall be completed with a 3/16-inch MIG welder or approved equal. Areas to be welded shall have the galvanized coating removed to bare metal by grinding. All welds shall be ¼ inch fillet around the entire circumference. Welds shall be ground smooth of any burrs with no visible cracks or pits. All welds shall be painted with Galvanox or Rust-O-leum Cold Galvanizing paint or approved equal.

All gates shall have a 1-7/8-inch O.D. duck bill hold back gate keeper installed for each swinging section. American Fence Part No. DBM or approved equal.

#### **421.8 ERECTION OF FENCE:**

General Requirements: Trees, brush, ground surface irregularities, and other obstacles which would interfere with the proper erection of the fence shall be cleared and removed in advance of starting fence work as required and specified.

Fence shall be erected in accordance with the details as shown in the Plans.

All posts shall be set plumb to the depth, and spaced at the intervals, as shown in the Plans. In determining the post spacing, measurements shall be made parallel to the ground slope.

Fence shall be thoroughly braced.

The finished fence shall be in accurate alignment, taut, and solid at all points.

Existing fences shall not be connected to the new fence. The new fence shall have an end post placed as close as possible to the existing fence or existing fence post as shown in the Plans.

Fencing wire shall not be pulled from posts set in concrete for a minimum of 72 hours or as approved by CAWCD.

#### **421.9 FENCE GROUNDING:**

The fence shall be grounded as specified in the Plans.

Where cad-weld, thermo-weld or an equivalent process is used, it shall be a heavy-duty type, made of new material from fresh stock, and the installation shall be performed with heavy-duty welding equipment in accordance with manufacturer's instructions.

## SECTION 424

### PARKWAY GRADING

**424.1 DESCRIPTION:** Add a second paragraph as follows:

This grading shall also include cutting, grading, filling, rough contouring, and compacting a site for a structure, building pad, vacant area or area being prepared for landscaping as designated in the plans.

**424.3 FINE GRADING:** First paragraph, modify as follows:

For vacant areas or areas being prepared for landscaping, the finished surface shall be free from stone and all debris and be true to grade and cross-sections after compaction to not less than 80% of maximum density, as determined by test methods specified in Section 301. For areas that will accommodate a structure or building pad, the compaction requirements shall be as required in the plans or Special Provisions for the structure or building.

**SECTION 430**

**LANDSCAPING**

**430.15 MEASUREMENT AND PAYMENT:** Modify the first sentence as follows: Measurement and payments shall be in accordance with the Bid Form and Special Provisions.

## SECTION 440

### LANDSCAPE IRRIGATION

**440.3 MATERIALS:** Modify the first sentence as follows: Prior to the start of construction, submit shop drawings per CAWCD Div 01 Section 013300 on all material for quality approval by CAWCD

**440.12 MEASUREMENT AND PAYMENT:** Revise the first sentence as follows: Measurement and payment shall be in accordance with the Bid Form and Special Provisions.

## SECTION 500 – STRUCTURES

### SECTION 505

#### CONCRETE STRUCTURES

**505.1.1 Minor Structures:** Modify the third sentence as follows: Precast units shall be fabricated in accordance with shop drawings submitted by the Contractor and approved by CAWCD in accordance with the requirements of CAWCD Div 01 Section 013300 SUBMITTAL PROCEDURES.

**505.3 FORMS:** Modify the first sentence as follows: Forming plans for cast-in-place bridge decks and cast-in-place bridge superstructures shall be prepared in accordance with the requirements of CAWCD Div 01 Section 013300 SUBMITTAL PROCEDURES.

**505.4 FALSEWORK:** Third paragraph, first sentence, revise as follows: All falsework, staging, walkways, forms, ladders, cofferdams, and similar accessories shall equal or exceed the minimum applicable safety requirements of CAWCD Div 01 Section 019150 SAFETY.

**505.4.1 Falsework Design:** First sentence, revise to read:

Shop drawings for major temporary support structures such as falsework, shoring, soldier piles, and other major temporary structures that facilitate construction shall be prepared by and bear the seal and signature of a Professional Engineer. Temporary support structures for Minor Structures as defined in Section 505.1.1 are exempt from this requirement.

**505.5.4.2 Anchoring Materials:** Revise the first paragraph to read as follows:

Epoxy materials shall be used for anchoring dowels. The Contractor shall, upon request, submit Certificates of Compliance or Analysis, complete with supporting documentation, to CAWCD for all epoxy materials to be used for anchoring dowels on a specific project, in accordance with the requirements of CAWCD DIV 01 Section 013300 Submittal Requirements. The epoxy materials shall be provided by the Contractor in general conformance with the requirements of Section 1015-1 General Requirements of Section 1015 EPOXY MATERIALS of the current Arizona Department of Transportation (ADOT) Standard Specifications for Road and Bridge Construction, amended to date.

**505.6.2 (B) Cold Weather Concreting:** Delete this paragraph in its entirety and add the following:

Concrete shall not be placed on or against ice-coated forms, reinforcing steel, structural steel, conduits, or construction joints, nor on or against snow, ice, or frozen earth materials. Immediately prior to placing concrete, the temperature of forms, reinforcing steel, earthen material, or any other material that will come in contact with the freshly placed concrete shall be a minimum temperature of 40 degrees F. If artificial heat is used to adjust the temperature of the items that will come in contact with the freshly mixed concrete, the temperature of these items shall not exceed 10 degrees F greater than that of the concrete being placed. Concrete operations shall be discontinued when a descending ambient temperature in the shade and away from artificial heat falls below 40 degrees F. Concrete operations shall not be resumed until an ascending ambient temperature in the shade and away from artificial heat exceeds 35

degrees F unless otherwise approved by CAWCD. Mixing and placing concrete shall continue no later than that time of day which allows sufficient time to place and protect the concrete already poured before the ambient temperature drops to 35 degrees F.

Concrete shall be protected in a manner to maintain all concrete surface temperatures at not less than 50 degrees F for a period of 72 hours after placement and at not less than 40 degrees F for an additional 96 hours. The contractor may use equipment to heat the aggregates or water, or both, prior to mixing. If aggregates are heated, the minimum temperature of the heated aggregate shall be 60 degrees F and the aggregates shall have no chunks of ice or frozen aggregate present. Equipment used to heat the aggregates shall be such that consistent temperatures are obtained throughout the aggregate within each batch and from one batch to another. Water shall not be heated in excess of 150 degrees F unless the water is mixed with the aggregate prior to the addition of cement to the batch. During the heating or mixing process, cement shall not be added to water and aggregate combinations which exceed 100 degrees F. When weather forecasts indicate a probability that ambient temperatures are to fall below 35 degrees F during the placement or curing periods, the contractor shall submit a cold weather concreting plan to the CAWCD for approval prior to concrete placement. The cold weather concreting plan shall detail methods and equipment which are to be used to ensure that the required concrete temperatures are maintained. The Contractor shall provide adequate cold weather protection in the form of insulation and/or heated enclosures to protect the concrete after placement. For bridge decks and suspended structures, the cold weather concreting plan shall include protection measures for both the top and bottom surfaces of the concrete. This protection shall maintain concrete surface temperatures as specified above at all locations in the structure. When artificial heating is required, the heating units shall not locally heat or dry the surface of the concrete.

When a cold weather concreting plan is required, CAWCD may require concrete temperatures to be measured and continuously recorded using temperature sensing devices during the entire curing period. The Contractor shall provide the temperature sensing devices, including its manufacturer's certification which shall be in accordance with ASTM C1074, and recording instruments. The Contractor shall install temperature sensing devices near the surface of the concrete at locations and depths designated by CAWCD. When concrete is placed on a bridge deck or suspended structure, both the bottom surface and the top surface shall be monitored with temperature sensing devices. Temperature sensing devices and recording instruments shall be approved by CAWCD. The contractor shall continuously monitor the concrete temperature and provide the recorded data to CAWCD upon request. If the surface concrete temperature at any location in the structure falls below 35 degrees F during the curing period, CAWCD may direct the contractor to core the areas in question at the locations indicated by CAWCD. The Contractor shall submit the cores to a petrographer for examination in accordance with ASTM C856. Concrete damaged by frost, as determined by the petrographer, shall be removed and replaced at no additional cost to CAWCD. All costs associated with coring, transmittal of cores, and petrographic examination shall be at no additional cost to CAWCD regardless of the outcome of the petrographic examination. The placing of concrete will not be permitted until CAWCD is satisfied that all the necessary protection equipment and materials are on hand at the site and in satisfactory working condition. Concrete requiring cold weather protection shall have such protection removed at the end of the required curing period in such a manner that will permit a gradual drop in the concrete temperatures.

**505.6.3.3 Construction Requirements:**

**(1) General:** In the first paragraph, revise the last sentence as follows:

Upon request, Certificates of Compliance conforming to the requirements of CAWCD DIV 01 Section 013300 Submittal Requirements shall also be submitted by the Contractor.

**(2) Shop Drawings:** Revise the first sentence as follows:

Prior to fabrication, the Contractor shall submit shop drawings to CAWCD for approval, in accordance with the requirement of CAWCD DIV 01 Section 013300 Submittal Requirements.

**CAP SUPPLEMENT SECTION 504**  
**CANAL LINING REPLACEMENT/REPAIR**

Add this specification in its entirety:

**504.1 DESCRIPTION:**

Concrete canal lining replacement and repair shall be constructed in conformity with the plans and these specifications. This section includes the requirements for the following items: formwork, subgrade preparation, reinforcement, concrete materials, and admixtures, waterstops, curing, backer rod, joint sealer, concrete mix design, concrete finishing, and concrete repairs.

**504.2 SUBMITTALS:**

The following submittals shall be required under this specification and shall meet the requirements of CAWC Division 01 Section 013300 Submittal Requirements:

- (A) Product data submittals for admixtures, waterstops, joint sealant, reinforcement, curing compound and backer rod.
- (B) Mix design for each concrete mixture indicating amounts of mixing water, if any, to be withheld for later addition at the project site. Mix designs shall include representative concrete cylinder test results for concrete placed using proposed mix within the last six months. Material tests shall conform to the test methods in MAG 725.8 for all materials used under this specification.
- (C) Material certifications for cementitious materials, signed by the manufacturer.
- (D) Material test reports from a qualified testing agency, indicating compliance with the requirements for aggregates.
- (E) All field quality control reports

**504.3 QUALITY ASSURANCE:**

The following quality assurance measures shall be required under this specification:

- (A) Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
- (B) Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
  - (1) Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
  - (2) Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I.

Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

(C) Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

#### **504.4 DELIVERY, STORAGE AND HANDLING:**

Deliver, store, and handle steel reinforcement to prevent bending and damage. Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

#### **504.5 PRODUCTS:**

The following product requirements shall apply:

(A) Form-facing Materials: Materials shall be plywood, lumber, metal, or another material approved by CAWCD for rough-formed finished concrete. Form-release agent shall be commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

(B) Select Subgrade Material: Select material shall be MAG Type B as indicated in Table 702-1 of the MAG Specifications.

(C) Steel Reinforcement and Reinforcement Accessories: Reinforcing bars shall be ASTM A 615, Grade 40 or 60, deformed. Bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing bars and welded wire reinforcement in place shall be manufactured from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

(D) Concrete Materials: Use the following cementitious materials, of the same type, brand, and source, throughout the Project: Portland Cement ASTM C 150 Type II/V. Supplement with fly ash: ASTM C 618 Class F.

Normal -weight aggregates: ASTM C33, coarse aggregate, graded. Provide aggregates from a single source. Maximum coarse aggregate size: 1 inch. Fine aggregate shall be free of materials with deleterious reactivity to alkali in cement.

Water shall conform to ASTM C1602.

(E) Admixtures:

Air entraining admixture shall conform to ASTM C260.

Chemical admixtures shall be certified by the manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

Water-reducing admixture shall conform to ASTM C494/Type A.

(F) Waterstops:

(1) Flexible rubber waterstops: Rubber, 6-inch wide, maximum possible lengths, flat, dumbbell with center bulb; manufactured by Williams Products or as approved by CAWCD. The profile shall be flat, dumbbell with center bulb. Dimensions shall be 6 inches by 3/8 inch thick; non-tapered.

(2) Flexible PVC waterstops: Rubber, 6-inch wide, maximum possible lengths, flat, dumbbell with center bulb; manufactured by Greenstreak or as approved by CAWCD. The profile shall be ribbed with center bulb. The dimensions shall be 6 inches by 3/8 inches; non-tapered.

(3) Self-expanding butyl strip waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/8 by 3/4 inch by Greenstreak; Swellstop or as approved by CAWCD.

(4) Self-expanding rubber strip waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

(a) Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal KBA-1510FP

(b) or as approved by CAWCD

(G) Adhesive:

(1) Single component hydrophilic sealant: Water swelling, single component, elastic sealant for sealing construction joints or uneven surfaces.

Products:

(a) Adeka Ultraseal P-201

(b) Greenstreak Leakmaster

(c) or as approved by CAWCD

(2) Self-expanding butyl strip waterstop adhesive: water-based primer adhesive

(a) Greenstreak WB Primer Adhesive

(b) or as approved by CAWCD

(3) Self-expanding rubber strip waterstop adhesive:

(a) 3M-2141, 3M Spray Adhesive 92, 3M Spray Adhesive 77

(b) Bostik 1142

(c) Scotch Grip 1357

(d) or as approved by CAWCD

(H) Curing materials:

White waterborne, membrane-forming curing compound: ASTM C309, Type 2, Class A dissipating.

Subject to compliance with requirements, provide products by one of the following manufacturers:

(1) Meadows, W.R., Inc.; 1600-WHITE

(2) or as approved by CAWCD

Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

(I) Backer rod:

Closed cell polyethylene rod, of compatible size for joint configuration.

(J) Joint Sealant:

(1) Joint Sealant Primer: Sealant/adhesive primer recommended by the manufacturer of the joint sealant being used.

(a) Provide the following: Sikaflex Primer 429 or as approved by CAWCD.

(2) Joint Sealant: One part polyurethane elastomeric sealant/adhesive.

(a) Provide the following: Sikaflex-1a or as approved by CAWCD.

(3) Joint Sealant: Two-compound, non-sag, polyurethane elastomeric sealant.

(a) Provide the following: Sikaflex -2c NS or as approved by CAWCD.

(K) Concrete Mixtures:

Cementitious Materials: Use fly ash, pozzolan, as needed to reduce the total amount of Portland cement, which would otherwise be used. Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows: Limit fly ash to 25 percent.

Maximum water/cement ratio per Table 1006-5 of the ADOT Standard Specifications for Road and Bridge Construction (2021) and as summarized in the table below:

Maximum water/cement ratio	
Minimum 28-Day Compressive Strength (psi)	Maximum Water/Cementitious Material Ratio
2,500	0.55
3,000	0.55
3,500	0.55
4,000	0.55
4,500	0.50
>4,500	0.45
High performance concrete as specified in Project Special Provisions	

Mix Design for Underwater Placement of Concrete:

CAWCD reserves the right to adjust mix proportions when need for adjustment is indicated by results of materials testing. Adjustments, when required, will be in accordance with USBR Concrete Manual.

Cementitious materials options include the following:

- (1) Specified Portland cement plus specified pozzolan by percent weight specified in Table 03 30 00A – Concrete Mixes.
- (2) Specified Portland cement plus specified slag cement by percent weight specified in Table 03 30 00A – Concrete Mixes.
- (3) Blended Hydraulic: ASTM C595 provided, specified Portland cement with percent of specified pozzolan or specified slag cement specified in Table 03 30 00A – Concrete Mixes.

Design concrete mixes in accordance with Table 03 30 00A – Concrete Mixes. General concrete mix shall be used for concrete unless otherwise specified.

- (1) Net water-cementitious materials ratio (w/c) is maximum, by weight. Cementitious material weight is cement plus SCM.
- (2) Slump at point of placement: In accordance with ASTM C143, except SCC.
- (3) SCC slump flow at point of placement: In accordance with ASTM C1611.
- (4) Air Entrainment: Percent air by volume of concrete as discharged at point of placement, in accordance with ASTM C231.

Table 03 30 00A – Concrete Mixes

Mix No.	Feature	f <sub>c</sub> (psi)	Max w/c*	NMSA**	% SCM*** A: Class F or N Pozzolan B: Slag Cement	Slump or Slump flow	Air Content	Notes
1	Canal Lining	4500 at 28 days	0.45	No. 57 or 67	A: 20 plus or minus 5 B: 30 plus or minus 10	4 max	4.5 to 7.5	1,2

\*Maximum water/cementitious materials ratio.

\*\*Nominal Maximum Size Aggregate

\*\*\*SCM as percent of total cementitious material, by weight. Applies only when ASTM C150 cement is utilized. If ASTM C595 cement is utilized, the requirements listed below regarding ASR mitigation shall be met.

Notes:

1. Ternary blended cementitious materials which meet the specifications may be submitted for approval.
2. Concrete with ASTM C1017, Type I or II plasticizing admixtures, ASTM C494 Type F high-range water-reducing admixtures, or Type G high-range water-reducing and retarding admixtures: Admixture shall be incorporated into trial batch or historical data. Use slump appropriate for placing conditions.

#### Alkali Silica Reaction (ASR) Requirement for Underwater Placement of Concrete:

Test fine and coarse aggregates in accordance with ASTM C1260 for potential deleterious alkali-silica reaction. For ASTM C1260, and other tests when required, continue readings for 14 days after the zero readings. Acceptance criteria specified below are based on 14-day readings after the zero readings. Aggregates are acceptable if expansion is no greater than 0.10 percent.

When expansion is greater than 0.10 percent, test aggregates according to ASTM C1567 using proposed components (e.g. coarse aggregate, fine aggregate, cementitious materials, and Alkali Silica Reaction (ASR) inhibiting admixtures in proportions proposed for mixture design. For mixes using lithium admixtures, use test procedure COE CRD-C 662. If expansion of proposed mixture design test specimens, tested in accordance with ASTM C1567 does not exceed 0.10 percent, aggregates are acceptable. If expansion of proposed mixture design test specimens is greater than 0.10 percent, aggregates are not acceptable unless adjustments to mixture design can reduce expansion to less than 0.10 percent, or testing by ASTM C1293 indicates aggregates will not experience deleterious expansion. ASTM C1293 test results may be substituted for ASTM C1260 test results under the following conditions:

- (1) Less than 3 years old
- (2) Average ASTM C1293 concrete prism expansion less than 0.04 percent at one year: Aggregates acceptable.
- (3) Average ASTM C1293 concrete prism expansion greater than 0.04 percent at one year: Aggregates not acceptable.

Admixtures: Use admixtures according to manufacturer's written instructions.

- (1) Use water-reducing admixture in concrete, as required, for placement and workability.

Specialized Chemical Admixtures for Underwater Placement of Concrete:

When the batch plant has not previously used a specialized chemical admixture, the admixture manufacturer shall provide an on-site representative to assist with mix design and to train batch plant personnel in dispensing and mixing operations. Do not use admixtures which contain more than 0.1 percent chloride, by weight.

- (1) Extended Set Control Admixture: MasterSet Delvo hydration controlling admixture manufactured by BASF Construction Chemicals, Inc. [www.basf-admixtures.com](http://www.basf-admixtures.com); or equal as approved by CAWCD with the following characteristics: Meets ASTM C494, Type B, retards setting, and does not reduce concrete strength. Use within manufacturer's time limits. Dispense admixture in presence of CAWCD and include admixture on batch ticket. Admixture quantity required to stabilize concrete shall be pre-determined using jobsite materials. Initial concrete setting time shall be monitored and adjusted during the project by a qualified concrete technician.
- (2) Anti-washout admixture: Rheomac UW 450 manufactured by BASF Construction Chemicals, Inc., [www.basf-admixtures.com](http://www.basf-admixtures.com); or equal as approved by CAWCD with the following essential characteristics: water soluble polymer, designed to minimize washout of fines and cement, and does not significantly affect slump or time of set. For fresh concrete placed in contact with water only. Incorporate into concrete mix at batch plant in manufacturer's recommended dosage.

Lining replacement: Proportion normal-weight concrete mixture as follows:

- (1) Minimum compressive strength: 3000 psi at 28 days
- (2) Slump limit:  $3 \pm 1$  inch as tested before entering pump. If concrete is to be placed without the use of a pump, slump shall be  $1\text{-}1/2 \pm 1$  inch.

(L) Fabricating Reinforcement:

Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

(M) Concrete Mixing:

Ready-mixed concrete: Measure, batch, mix and deliver concrete according to ASTM C 94, and furnish batch ticket information.

**504.6 EXECUTION:**

(A) Panel removal: Cut panels to be removed along the existing joints, maintaining straight lines and cutting full depth of panel. Remove panels in a manner so that the edges of the adjoining panels are not damaged. Remove rubber seal from existing panel edges to provide a uniform surface against which to place new concrete.

(B) Subgrade preparation: After removal of damaged lining panels, or the reconstruction of canal embankment and bottom and side slopes, including the surfaces of compacted embankment, existing compacted selected bedding materials, and compacted backfill over which concrete lining is to be placed shall be finished accurately to true and even surfaces to

produce a concrete thickness of the dimensions indicated on the Plans. If the subgrade material has been excavated or disturbed beyond the neat lines required to receive the concrete lining, the subgrade shall be reconstructed.

Add select material as required in lifts of 6" to 8". Maintain moisture content in subgrade by pre-wetting existing subgrade and adding moisture to select material during placement and compaction. Compact subgrade to 95% maximum density according to ASTM D698, Standard Proctor.

(C) Formwork: Construct formwork so concrete panels are of size, shape, alignment, and position indicated, within tolerance limits of ACI 117. Construct forms tight enough to prevent loss of concrete mortar. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Set edge forms and bulkheads, to achieve required elevations and slopes in finished concrete surfaces. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instruction, before placing reinforcement.

(D) Steel Reinforcement: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement. Clean reinforcement of loose rust and mill scale, earth, and other foreign materials that would reduce bond to concrete. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

(E) Joints: Construct joints true to line with faces perpendicular to surface plane of concrete at locations indicated on the Plans. Install constructed contraction joints at the perimeter of new panels or between two panels which are placed separately. Tool to the profile as shown on the Plans. The minimum width at the top shall be 5/8" and minimum depth shall be 1-1/4".

Contraction joints shall be a tooled joint at locations to match the original joint layout in the canal lining. Maximum spacing for unreinforced lining is 15' for transverse joints and 12' along the slope for longitudinal joints. Joints shall be tooled to the profile as shown on the Plans. Minimum width at top shall be 5/8" and minimum depth shall be 1-1/4".

Install bonded construction joints in locations where construction joints do not coincide with contraction joints. The existing concrete surface shall be water blasted to remove any curing residue and laitance to promote bonding between the new and existing concrete surfaces. Reinforcing dowels shall extend across the joint if indicated on the Plans.

(F) Waterstops: Install the following products as indicated at the locations shown in the joint details on the Plans.

Install flexible waterstops in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

Install self-expanding strip waterstops in construction joints and at other locations indicated, according to manufacturer's written instructions. Strips shall be adhesive bonded and mechanically fastened. Fasteners shall be spaced no more than 12" apart. Install strips in

longest lengths practicable. Refer to manufacturer's recommendations regarding minimum concrete cover.

Install single component hydrophilic sealant at all locations where existing concrete surface will not allow the use of strip waterstop. Install at all joints in self-expanding strip waterstop. Sealant can be used as an adhesive to install self-expanding strip waterstop. Sealant shall be installed using a maximum ¼" bead size.

(G) Concrete Placement: Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Subgrade shall be moistened thoroughly prior to placement so that moisture is not drawn from the freshly placed concrete. For slope placement, deposit concrete beginning at the bottom of the placement and proceeding upslope.

Before test sampling and placing concrete, water may be added at the Project site, subject to the limitations of ACI 301. Deposit and consolidate concrete for panels in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

Consolidate placed concrete with mechanical vibrating equipment according to ACI 301. Insert vibrator at 12" intervals along embedded waterstop to assure that there are no voids. A minimum of two vibrators shall be onsite during placement of concrete.

Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

Maintain reinforcement in position on chairs during concrete placement. Screed slab surfaces using a rolling screed. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operation.

Hot weather placement of concrete shall comply with ACI 301 as follows: Concrete placements shall be scheduled so that all concrete is placed, finished, and cured prior to the ambient temperature exceeding 90 Deg F. Maintain concrete temperatures below 85 Deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is an option. Fog spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

Cold weather placement of concrete shall comply with Section 505.6.2 (B).

(H) Placing Concrete Underwater: As concrete is placed underwater, do not allow turbid water to discharge into waterways. Placement operations shall not increase pH, turbidity, or temperature of water.

Provide suitable tremie delivery system or pump. Equipment shall not be fabricated of aluminum.

Tremie system delivery device shall be watertight, fabricated of heavy-gauge steel pipe. Tremie pipe diameter shall be at least 6 times the maximum size of aggregate but not less than 10-

inches in diameter. A funnel or hopper shall facilitate transfer of concrete from delivery device to the tremie. Provide stable, stationary platform to support tremie during placement.

Pump system slickline shall be watertight with a minimum diameter of 5 inches.

Mark tremie pipe or pump slickline to allow quick and accurate determination of distance from surface of water to mouth of discharge pipe. Equip tremie pump or slickline with suitable power hoist to facilitate vertical movement during concrete placement. Air lifts or pumps shall be available to remove unsuitable material which accumulates in low areas during placement. Depending upon method selected for sealing tremie or slickline at beginning of the placement, adequate supply of end closure devices or plugs shall be available.

Ensure that concrete is delivered to point of placement without free-fall. Place concrete in continuous manner from bottom to top. Place by method which minimizes washout. Construction joint surfaces shall be jetted to remove mud, algae, laitance, and other unsuitable material prior to placing adjacent concrete.

Start placements using a dry pipe technique. End closure device shall be filled with concrete before being raised off bottom. Discharge pipe shall then be raised maximum of 3 inches to initiate flow. Do not lift discharge pipe further until a mound is established around the discharge mouth. Initial lifting of discharge pipe shall be done slowly to minimize disturbance of material surrounding pipe mouth.

Placements started using a plug shall be lifted 1 to 3 inches to allow water to escape. Concrete shall be added slowly to force the plug downward. Plugs shall be removed or made of a material approved by CAWCD not to cause a defect in the concrete if not removed.

Furnish uninterrupted concrete supply to discharge pipe at beginning of placement until a mound sufficient to seal tremie pipe or slickline has been established. Once established, maintain embedment of tremie pipe or slickline in fresh concrete. Exact embedment depths shall depend on placement rates and setting time of concrete. Control vertical movement of tremie pipe or slickline to prevent loss of seal. If loss of seal occurs, placement shall be halted immediately. Remove pipe, replace end closure device, and restart flow in presence of CAWCD. To prevent washout of already placed concrete, a plug shall not be allowed to restart after loss of seal. Clear blockages in discharge lines to prevent loss of seal.

(I) Finishing Slabs: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

After applying float finish, the surfaces shall be troweled. The finished surface shall be equivalent in evenness, smoothness, and freedom from rock pockets and surface voids to that obtainable by effective use of a long-handled steel trowel. Light surface pitting and light trowel marks will not be considered objectionable.

Apply a broom finish to the upper four feet of the canal sloped surface. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

(J) Concrete Protecting and Curing: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 301 for hot-weather protection during curing.

Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period. Begin curing unformed surfaces immediately after finishing concrete.

Cure concrete according to ACI 308.1, by the following method: Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

(K) Joint Sealant Application: Install polyurethane elastomeric sealant of the type indicated on the Plans. Concrete shall cure for 72 hours prior to any joint sealant application. Joints to receive joint sealant shall be hydro blasted to remove all concrete curing compound and laitance. Blow joint to remove dust and to promote drying.

Primer shall be applied in accordance with manufacturer's recommendations. Allow primer to dry for 1 hour before applying sealant. Install backer rod of the appropriate size for the formed or tooled joint if indicated on the Plans.

Mix sealant in accordance with manufacturer's recommendations. (Applicable only to two-component sealant.) Place gun nozzle at the bottom of the joint and fill entire joint. Keep the gun tip in the sealant to avoid air entrapment. Avoid overlapping the sealant to eliminate air entrapment. Tool, as required to fill the joint and to ensure full contact with the substrate. Allow sealant 72 hours to cure prior to submersion.

(L) Concrete Crack Sealant Application: Install polyurethane elastomeric sealant of the type indicated on the Plans. Sealant should be gunned into crack to a minimum of 1/4" depth. Keep tip of nozzle in the sealant to avoid air entrapment. Apply sufficient sealant to form a small mushroom cap over crack. Tool sealant to ensure full contact with surface on either side of crack.

(M) Concrete Repairs: All concrete that is damaged or defective from any cause; concrete that is honeycombed, fractured, or otherwise defective; and concrete which, because of excessive surface depressions, must be excavated and built up to bring the surfaces to the prescribed lines shall be removed and replaced as directed by CAWCD. Imperfections and irregularities on concrete surfaces shall be corrected. The repair of damaged or defective concrete and the correction of surface imperfections and irregularities shall be made with concrete, dry pack, cement mortar, epoxy-bonded concrete, epoxy-bonded mortar, or injected epoxy resin, where and as applicable for the type of repair involved, in accordance with "Standard Specifications for Repair of Concrete", US Bureau of Reclamation Publication M-47 (2-1-96 version).

(N) Field Quality Control: Engage a qualified testing agency to perform field tests and prepare test reports.

Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:

(1) Testing Frequency: Obtain one composite sample for each day's placement of each concrete mixture exceeding 5 Cu Yd, but less than 25 Cu Yd, plus one set for each additional 50 Cu Yd or fraction thereof.

(2) Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's placement of each concrete mixture. Perform additional tests where concrete consistency appears to change.

(3) Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

(4) Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 90 Deg F and above, and one test for each composite sample.

(5) Compression Test Specimens: ASTM C31. Cast and laboratory cure a total of four standard cylinder specimens for each composite sample.

(6) Compressive Strength Tests: ASTM C39; test one cylinder at 3 days, one cylinder at 7 days and one set of two cylinders at 28 days.

Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive strength tests equals or exceeds specified compressive strength, and no compressive strength test value falls below specified compressive strength by more than 500 psi.

Test results shall be reported in writing to CAWCD, and concrete manufacturer within 48 hours of testing. Reports of compressive strength tests shall contain CAP milepost location, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day test.

Testing agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by CAWCD. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by CAWCD.

Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

**CAP SUPPLEMENT SECTION 508**  
**MISCELLANEOUS CAST-IN-PLACE CONCRETE**

Add this specification in its entirety:

**508.1 DESCRIPTION:**

The work under this section shall consist of furnishing all labor, equipment, and materials as described herein for the placement of cast-in-place concrete to the forms, shapes, and dimensions shown on the project plans and to the lines and grades established by CAWCD in accordance with the requirements of this specification. This section shall include concrete work inside a CAP pumping plant or other CAWCD building and include structures such as equipment foundations and construction, repair, or modification of other concrete structures such as floor slabs or landings.

**508.2 SUBMITTALS:**

Submittals shall be prepared in accordance with the requirements of DIV 01 Section 013300. The following submittals and Certificates of Compliance are required under this specification:

- (A) Concrete admixtures
- (B) Curing compound
- (C) Form release agent
- (D) Joint materials including expansion joint material, joint sealants, and bonding adhesive materials
- (E) Adhesive materials
- (F) Non-shrink grout
- (G) Metallic hardener
- (H) Non-metallic hardener

**508.2.1 Shop Drawings:**

(A) Formwork: indicate pertinent dimensions, form materials, arrangements of joints and ties, and location of bracing and temporary supports.

(B) Reinforcing steel: Indicate reinforcement sizes, spacing, locations, quantities, bending and cutting schedule and supporting and spacing devices.

**508.2.2 Quality Control Reports:** Submit concrete mix designs including representative concrete cylinder test results for concrete placed using proposed mix within the last six months. Submit material test results conforming to the test methods in MAG 725.8 for all materials used under this specification.

**508.2.3 Submittal Requirements:** Shop drawings and product data shall be submitted to CAWCD for review. Certificates of Compliance for reinforcement steel shall be submitted for each size. Falsework, shoring, soldier piles, and other major temporary structures shall require the signature of a registered structural engineer licensed in Arizona. Review of shop drawings does not relieve the contractor from his errors or omissions nor from his responsibility for complying with the contract documents.

**508.3 CONCRETE MATERIALS:**

Furnish concrete materials and curing materials in conformance with MAG Section 725 and 726.

**508.4 FORMS AND FALSEWORK:**

Furnish formwork and formwork accessories in accordance with MAG Sections 505.3 and 505.4.

**508.5 STEEL REINFORCEMENT:**

Furnish steel reinforcement in accordance with MAG Section 727 and install steel reinforcement and accessories in accordance with MAG Section 505.5.

**508.6 PLACING CONCRETE:**

Subgrade for placing concrete shall be in accordance with MAG Section 505.2. Placement of concrete shall be in accordance with MAG Section 505.6.

**508.7 CURING:**

Concrete curing shall be in accordance with MAG Section 505.8

**508.8 FINISHING CONCRETE:**

**508.8.1 Finishing formed surfaces:** Remove fins, projections, and loose material. Clean surfaces of form oil.

Patch honeycomb, aggregate pockets, voids, and holes as follows: Chip out until sound concrete is exposed to minimum depth of 1-inch. Prepare patching mortar with approximately 2 parts normal Portland cement, one-part white cement, 9 parts fine aggregate; vary proportions of cement as necessary to match color of adjacent concrete. Saturate surfaces with water and fill cavities with patching mortar. All patching using patching mortar shall be completed within 7 days of the original concrete placement. If over 7 days have elapsed, repairs shall be performed using epoxy bonded mortar.

Fill holes left by form ties with patching mortar. Cure patches as specified for concrete. Provide concrete surfaces to be left exposed with sack rubbed finish.

**508.8.2 Separate Floor Toppings:** Place concrete floor toppings to required lines and levels. Protect materials during handling and application to prevent damage or contamination. Prepare concrete base course and place floor topping in accordance with floor topping manufacturer's written recommendations. Place required dividers, edge strips, reinforcing and other items to be cast into the floor topping in accordance with manufacturer's instructions. Apply bonding agent base course or sand and cement slurry coat on base course, immediately prior to placing toppings in accordance with manufacturer's instructions.

**508.8.3 Floor Finishing:** Finish concrete floor surfaces in accordance with ACI 301. Uniformly spread, screed and float concrete.

(A) Float finish: Float surface to true even plane. Float second time to uniform finish with wood or cork float. Use on equipment foundations, tops of structure foundations, and for surfaces receiving quarry tile or ceramic tile with full bed setting system.

(B) Screed trowel finish: Float surface to true even plane. Steel trowel to smooth, uniform finish free of defects. Steel trowel second time to final burnish finish and use edger on exposed edges. Use on floor slabs receiving carpeting, resilient flooring, seamless flooring, thin set quarry tile, thin set ceramic tile or remaining exposed to view in finished construction.

(C) Roughened finish: Roughen surface with rake or stiff broom to minimum depth of 1/4-inch. Use on surfaces to receive additional concrete or grout.

(D) Broomed or belted finish: Float surface to true, even plane. Steel trowel to smooth, uniform surface. Broom with fiber brush or drag burlap belt across surface in direction transverse to traffic flow. Use on sidewalks, paving and exterior slabs at door entrances.

(E) Maintain surface flatness, within the following tolerances as measured with a 10-foot straightedge.

Sidewalks: 5/16-inch

Other slabs: 3/16-inch

(F) In areas with floor drains, maintain floor level at walls and slope surfaces uniformly to drains.

Apply concrete hardener and color on floor surfaces as scheduled.

**508.9 PRODUCTS:**

(A) Water Stops: Rubber, 6-inch wide, maximum possible lengths, flat, dumbbell with center bulb; manufactured by Williams Products or as approved by CAWCD.

(B) Form Release Agent: Provide non-staining mineral oil or commercially produced form-release agent that will not bond, stain or adversely affect concrete surfaces and curing. Form-release agent shall not impair bond or adhesion of subsequent treatment of concrete surfaces. Formulate form-release agent with rust inhibitor for steel form-facing materials.

Provide one of the following products:

Euclid Chemical Company (The): Euco Super Slip or Form Eze Natural

US Mix Products: EZ Kote Green

Or as approved by CAWCD

(C) Formed Construction Joints for Slabs-on-Grade: Provide galvanized steel, tongue and groove type profile with knockout holes to receive doweling.

(D) Expansion Joint Filler: Provide preformed non-extruding and resilient bituminous type, ASTM D1751.

(E) Joint Sealant: Hot applied joint sealant shall conform to the requirements of ASTM D6690 Type II or Type III. Joint sealant shall not contain any coal-tar materials. Certificates of Compliance shall be submitted to CAWCD.

Cold applied joint sealant for traffic rated areas shall be cold-application mastic single component-type and conform to the requirements of ASTM D5893. For non-traffic rated areas, cold applied sealant shall be cold-application mastic single or multiple component type. Certificates of Compliance shall be submitted to CAWCD.

(F) Epoxy Adhesive for Dowels: Provide Hilti HIT-RE 500 epoxy adhesive or as approved by CAWCD.

(G) Vapor Retarder: Provide ASTM E1745 Class A; 10 mil thick clear polyethylene film; type recommended for below grade applications. Furnish joint tape recommended by manufacturer.

(H) Void Forms: Provide moisture resistant treated paper faces, biodegradable and structurally sufficient to support weight of wet concrete mix until initial set; 2 or 4 inches thick.

(I) Non-shrink grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents. Products include:

- (1) Five Star Grout
- (2) Sikagrout 212
- (3) Or as approved by CAWCD

(J) Air Entraining Admixtures: Products include:

- (1) Euclid Chemical Company (The); Air Mix or AEA-92 series
- (2) Grace Construction Products; Darex or Daravair series
- (3) BASF; MB-VR or MB-A
- (4) Or as approved by CAWCD

(K) Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride. Provide all admixtures from same manufacturer to ensure compatibility.

(L) Water-reducing admixture: ASTM C494, Type A. Products include:

- (1) Euclid Chemical Company (The); Eucon series
- (2) BASF; Pozzolith series
- (3) WR Grace; WRDA Hycol
- (4) Or as approved by CAWCD

(M) Retarding Admixtures: ASTM C494, Type B. Products include:

- (1) Euclid Chemical Company (The); Eucon Retarder series

- (2) BASF; Pozzoloth series
- (3) WR Grace; Daratard Series
- (4) Or as approved by CAWCD

(N) Water-reducing and retarding admixture; ASTM C494, Type D. Products include:

- (1) Euclid Chemical Company (The); Eucon Retarder series
- (2) BASF; Pozzoloth Series
- (3) WR Grace; Daratard Series
- (4) Or as approved by CAWCD

(O) High range, water-reducing and retarding admixture; ASTM C494/C494M, Type G. Products include:

- (1) Euclid Chemical Company (The) Eucon 537 or Plastol series
- (2) BASF; Glenium series
- (3) WR Grace; Daracem or Adva series
- (4) Or as approved by CAWCD

(P) Plasticizing and retarding admixture; ASTM C 1017/C 1017M, Type II. Products include:

- (1) Euclid Chemical Company (The); Eucon 537
- (2) BASF; Rheobuild Series
- (3) WR Grace; Darcem Series
- (4) Or as approved by CAWCD

(Q) Curing Materials

- (1) Liquid Membrane Curing Compound: ASTM C309, Type 2, Class A, dissipating.
  - (a) W.R. Meadows 1600 White.
  - (b) Or as approved by CAWCD

VOC Content: Curing and Sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40CFR 59, Subpart D (EPA Method 24).

- (2) Liquid Membrane Curing and Sealing Compound: ASTM C1315 Type I, Class A.
  - (a) W.R. Meadows VOCOMP-30
  - (b) Euclid Super Diamond Clear VOX
  - (c) Or as approved by CAWCD

VOC Content: Curing and Sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40CFR 59, Subpart D (EPA Method 24).

(R) Absorptive Mats: ASTM C171, burlap-polyethylene, minimum 9 oz/sq yd bonded to prevent separation during handling and placing.

(S) Chemical Hardener: Clear

- (1) Dribond Concrete Hardener by Construction Chemicals
- (2) Liqui-Hard Concrete Hardener by W.R. Meadows
- (3) Or as approved by CAWCD

(T) Metallic Hardener: Color as indicated on the plans.

- (1) Euclid Diamond Plate
- (2) Euclid Euco-Plate HD
- (3) Or as approved by CAWCD

(U) Non-Metallic Hardener: Color as indicated on the plans.

- (1) Euclid Surfex
- (2) 785 Glenflor by W.R. Meadows
- (3) Or as approved by CAWCD

**508.10 DEFECTIVE CONCRETE:**

Modify or replace concrete not conforming to required lines, details and elevations as directed by CAWCD. All repairs shall be in accordance with Standard Specifications for Repair of Concrete, U.S. Bureau of Reclamation Publication M-47 (2-1-96 version).

**CAP SUPPLEMENT SECTION 509**  
**PLACEMENT OF NON-SHRINK CEMENTITIOUS GROUT**

Add this specification in its entirety:

**509.1 DESCRIPTION:**

This specification describes the grouting of cavities, voids, keyways and similar applications with Portland cement non-shrink, non-metallic grout as shown on the project plans and as described in this specification. The work consists of furnishing all labor, equipment, appliances, materials and performing all operations in connection with the placement of grout, complete in place.

**509.2 QUALITY ASSURANCE:**

**Manufacturing Qualifications:** The manufacturer of the specified product shall be ISO 9001 certified and have an ongoing quality assurance program independently audited on a regular basis.

**Contractor Qualifications:** Contractor shall be qualified in the field of grouting with a minimum of 5 years of experience. Contractor shall maintain qualified personnel who have received product training by the manufacturer.

Store and apply materials in accordance with all safety and weather conditions required by manufacturer or as modified by applicable rules and regulations of local, state, and federal authorities having jurisdiction. Consult Material Safety Data Sheets for complete handling recommendations.

**509.3 DELIVERY, STORAGE AND HANDLING:**

All materials must be delivered in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers. Damaged material must be removed from the site.

Store all materials off the ground and protect from rain, freezing or excessive heat until ready for use.

Condition the specified product as recommended by the manufacturer.

**509.4 JOB CONDITIONS:**

Do not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature 40 deg F (7deg C) and rising. Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified material.

**509.5 SUBMITTALS:**

Submit manufacturer’s literature to include: Product Data Sheets (PDS), and appropriate Safety Data Sheets (SDS) in conformance with the requirements of Division 01 Section 013300 Submittal Procedures.

Provide a written warranty from the manufacturer against defects of materials for a period on one (1) year.

**509.6 MATERIALS:**

The material shall be a blend of selected Portland cements, specially graded aggregates, admixtures for controlling setting time and water reducers for workability. The material shall be non-combustible both before and after cure. The material shall be supplied in a factory-blended bag.

**509.6.1 Portland cement grout:** The Portland cement grout shall be a non-shrink, non-metallic composition containing a blend of selected Portland cements, plasticizing/water-reducing admixtures and shrinkage compensating agents. The shrinkage agents shall compensate for shrinkage in both the plastic and hardened state.

Materials for forming, as required for the designated work shall be approved by CAWCD.

Curing compound conforming to ASTM C309, as required for the designated work, shall be approved by CAWCD.

**509.6.2 Approved products:**

- (A) Five Star Grout
- (B) Sika Grout 212
- (C) Or as approved by CAWCD

**509.7 PERFORMANCE CRITERIA:**

(A) Compressive Strength (ASTM C109):

Plastic

- 1 day – 3,500 psi
- 7 days – 6,100 psi
- 28 days – 7,500 psi

Flowable

- 1 day – 3,500 psi
- 7 days – 5,500 psi
- 28 days - 5,800

Fluid

- 1 day – 2,700 psi
- 7 days – 5,500 psi
- 28 days – 5,800 psi

## **509.8 EXECUTION:**

### **509.8.1 Surface Preparation:**

Concrete Surfaces: Completely remove all loose, delaminated, and weak concrete, oil, grease, laitance, and other contaminants. Prepare concrete using acceptable mechanical means and concrete cleaners and degreasers as necessary to obtain clean, sound, and rough concrete surfaces exposing coarse aggregate. A Concrete Surface Profile of 6-9 in accordance with ICRI is recommended. Blow surfaces free of dust and debris using oil-free compressed air.

Prior to placement, soak concrete surfaces thoroughly for a minimum of eight hours to an optimum 24 hours with potable water. Concrete shall be saturated and free of standing water at time of placement.

Metal Surfaces: Where bond to metal surfaces is not required, coat with a bond breaker such as paste wax or duct tape. Where bond to metal surfaces is required, the surface shall be clean, free of oil, grease, rust, and other contaminants. Sandblasting will optimize bond development of grout to steel. Provide 1/4-to-1/2-inch air relief holes where baseplate configuration and high spots will entrap air. When grouting skid mounted equipment or frames, provide a four-to-six-inch diameter grout filling hole in the center of each bulkhead section.

**509.8.2 Formwork:** Formwork shall be constructed of rigid nonabsorbent materials, securely anchored, watertight and strong enough to resist forces developed during grout placement. Formwork shall be constructed so that the grout is placed across the shortest distance whenever possible. The clearance for remaining sides shall be one to three inches. Height of formwork shall extend a minimum of one inch above the bottom of the baseplate. Formwork shall be coated with a form release agent. Care should be taken not to contaminate grouting surfaces where bonding is required.

**509.8.3 Equipment and Materials:** All necessary tools, equipment and materials shall be as close as possible to the area being grouted, such as mortar mixers, measuring containers, trowels, and grout. Appropriate clothing and safety equipment shall be worn to avoid breathing dust and prevent eye and skin contact with both dry and mixed grout. Wheelbarrows, buckets, shovels, and pumps shall be clean, dampened and readily available for transporting mixed grout. An ample source of potable water shall be available for preconditioning, mixing, cleaning, and curing.

### **509.8.4 Mixing and Application:**

(A) Mixing of Portland cement grout: Mix manually or mechanically. Manually mix in a wheelbarrow or mortar box. Mechanically mix with a low-speed (400-600 rpm) drill and jiffy paddle or in an appropriately sized mortar mixer. Add an appropriate quantity of water to the mixing container to achieve the desired consistency. Do not overwater. While mixing, the bag of powder is added to the mixer. Mix to a uniform consistency for a minimum of 2 minutes. Mix temperature should be maintained at 70-75 deg F, using cold or warm water accordingly.

(B) Placement Procedure:

Spalls: Within 15 minutes of mixing, pour the grout into the prepared form. Work in a manner to avoid air entrapment. Vibrate the form as required to achieve flow and compaction. Flowable

grout must be confined in either the horizontal or vertical direction, leaving a minimum of exposed surface. After the grout has achieved its final set, remove any forms, and trim or shape exposed mortar/concrete to the desired profile, if required.

**Cracks:** Within 15 minutes of mixing pour the grout into prepared crack. Continue pouring until the crack has been filled. Wet cure for a minimum of 3 days or apply a curing compound that conforms to ASTM C-309 as approved by CAWCD. Adhere to all limitations and cautions for the polymer-modified Portland cement coating in the manufacturer's printed Product Data Sheet and literature.

**Baseplate Pour:** A headbox or similar device is required for a continuous pour to avoid air pockets under baseplate. All grouting shall take place from one side to the other, always maintaining contact with the bottom of the plate, maximizing effective bearing area.

When pouring through grout holes, placement shall proceed continuously with a headbox until the grout has risen in the next hole. Maintain head pressure at initial hole so that grout always stays in contact with the bottom of the base plate. Commence grouting at the next hole with an additional headbox. Continue process, alternating headboxes until grouting is complete.

When pouring into the headbox, grout shall be introduced in a manner to avoid air entrapment. Care must be taken during grouting to keep the headbox at least half full of material to ensure even grout flow. If necessary to assist the flow, a plunger may be used. This procedure shall continue until the grout rises above the bottom edge of the baseplate on the opposite side. Throughout the pour, forms shall be constantly checked for leaks. All leaks shall be sealed immediately.

**Pumping:** The type and size of pump and discharge line used are dependent on the parameters of each installation. Contact the pump and grout manufacturers for recommendations. The proposed pumping equipment and procedures shall be submitted for approval.

Pumping raises the grout temperature and shortens the working time while reducing its consistency. Keep mix temperature as cool as necessary except in cold weather. The grout shall be mixed to a consistency that will not segregate while pumping. The grout shall be passed through a #4 screen prior to placement into the pump hopper.

Before pumping, determine the working time under jobsite conditions. Pumpability shall be determined by field testing. The pump shall be positioned to minimize the pumping distance. Keep the discharge line as close to horizontal as possible. All hose connections must be watertight.

Immediately prior to pumping, the pump and lines shall be primed with a priming slurry leaving hopper empty to prevent overwatering. Once the pumping has begun, it is important not to use any of the priming slurry from the discharge lines. Grout shall not be used until a uniform consistency is obtained at the discharge nozzle.

Provide an adequate volume of mixed grout to keep the pump hopper at least half full. The grout shall be placed into pump hopper in a manner to prevent air entrapment. The discharge nozzle shall be withdrawn only while pumping, keeping it always submerged within the grout.

When a pump is needed to transport grout and the nozzle cannot be inserted into the cavity being grouted, a headbox is required. The headbox will allow the pour to be continuous,

avoiding air pockets under the plate. The grout shall be discharged from the nozzle into the headbox in a manner to avoid air entrapment. The headbox shall be always kept at least half full.

All grouting shall take place from one side of the plate to the other. Always maintain contact with the bottom of the plate to maximize the effective bearing area. When pouring through grout holes, placement shall proceed with continuously until the grout has risen in the next hole. Maintain head pressure at initial hole so the grout always stays in contact with the bottom of the baseplate. Commence grouting at the next hole with an additional headbox. Continue process, alternating head boxes until grouting is complete.

**509.8.5 Finishing:** Cut grout back from bottom of baseplate to the foundation at approximately a 45 deg angle or flush with the baseplate as directed by CAWCD. Formwork can be removed for cutback when grout offers stiff resistance, or when cut with a steel trowel, stands up without support. Finish exposed grout surfaces. Grout shall not be allowed to remain above the bottom edge of the baseplate.

**509.8.6 Curing:** Grout shall be wet cured for a minimum of three days or coated with an approved curing compound after a minimum 24-hour wet cure. Grout shall be protected from excessive evaporation with wet rags prior to set. The grout shall be protected from wind, rain, freezing and vibration until a minimum compressive strength of 1000psi is achieved.

**509.8.7 Cleaning:** Grout can be cleaned from tools with water. The cured grout can only be removed mechanically. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent area.

**CAP SUPPLEMENT SECTION 514**  
**UNDERWATER CONCRETE REMOVAL**

Add this specification in its entirety:

**514.1 DESCRIPTION:** Underwater concrete removal shall be at the locations shown, and in conformity with the plans and these specifications. This section includes the requirements for verifying existing conditions, utility locating, removal of concrete and reinforcement, cleaning and surface preparation, and disposal.

**514.2 SUBMITTALS:** Submit the following in accordance with Division 01 Section 013300.

(A) Concrete removal plan indicating methods and equipment used to locate embedded metalwork and reinforcement within the concrete to be removed. Methods, equipment, and sequencing shall include handling and disposing of solid waste and wastewater from concrete removal and other waste resulting from concrete removal used for cutting and removing concrete. Describe cleanup operations, equipment, and equipment locations, and plans to prevent damage to remaining concrete.

(B) Cofferdam plan indicating method used to complete the required work while the canal remains in operation. The plan shall include Cofferdam type and materials used or approved alternative method. Provide installation plan and manufacturer's data sheet if applicable.

**514.3 EXISTING CONDITIONS:** Informational drawings or plans provided by CAWCD provide general locations of embedded reinforcement, pipe, conduit, and metal work. Actual locations may vary. Contractor is required to make their own determination of the actual location of the work in the field.

**514.4 EXECUTION:**

**514.4.1 Coordination:** Cease concrete removal operations and notify CAWCD if electrical conduit containing energized circuits are encountered or if cracked concrete intended to remain in place results in noticeable water suction or movement through the canal embankment. Do not resume operations until directed by CAWCD.

Coordinate performance of noisy, malodorous, or dusty work with CAWCD and control wastewater in accordance with the approved plan.

**514.4.2 Preparation:** Location of concrete removal on plans is approximate. Verify and adjust concrete removal areas with CAWCD in the field. Obtain written permission from CAWCD prior to starting removal work. Locate and mark embedded reinforcement, pipe, conduit, and metalwork within concrete removal areas before beginning concrete removal.

**514.5 ABOVE WATER AND UNDERWATER REMOVAL:** Initially remove damaged, deteriorated, loosened, or unbonded portions of existing concrete by jack hammering or other approved method. Follow with approved mechanical means if necessary. Produce surfaces and edges suitable for required construction. Use methods that will not damage concrete or reinforcement to remain in place.

Do not use jackhammers more than 30 pounds or, dry sandblasting without CAWCD approval. Points on jackhammer bits shall cleanly break the concrete. Replace or sharpen jackhammer bits without points.

Do not line drill parameters of large openings, or pry on concrete to be removed or existing reinforcement. Do not use bush hammer or scabblers. Blasting is not permitted.

**514.5.1 Sawcutting:** Perform sawcutting after removal of concrete damage resulting from reinforcing steel corrosion. Fully encompass the removal area and produce clean, sharp edges. Do not damage reinforcing steel to remain. If embedment or other conditions prevent a minimum 1-inch sawcut depth, use a grinder to create a minimum ¼-inch perpendicular face. Sawcut depth of canal lining shall be the depth of concrete.

Limit the number of corners. Do not produce sharp corners or angles less than 70 degrees. Use diamond blade or diamond wire saws. Make cuts normal to exposed concrete surface except as indicated on the plans. Prevent kerfs from crossing and do not extend kerfs beyond specified limits of removal.

Break concrete into large sections to reduce the amount of concrete debris being washed downstream.

**514.5.2 Reinforcement:** If the full depth of concrete is not being removed and reinforcement is encountered during the concrete removal process, replace reinforcing steel bars or section of bars that have lost more than 25 percent of their cross-sectional area. If adjacent bars are damaged, replace ones with 20 percent or more loss in cross sectional area. Replace bars to match original bar size according to ACE 318, Section 25.5.1 and 25.5.2 or as approved by CAWCD.

If epoxy coating on steel reinforcement is damaged, repair using a coating approved by the rebar manufacturer. Do not coat previously uncoated reinforcing steel. Remove concrete shadows around circumferences of reinforcing bars.

When corroded reinforcement steel bars are exposed, remove additional concrete along corroded bars until a continuous length of 2 inches of bar free from corrosion is exposed. Assess the limit of active corrosion on a visual basis. Edges of additional areas removed shall be cut square. Remove additional concrete along bar to accommodate couplers or lap splices for replacement reinforcement. Obtain approval from CAWCD prior to additional concrete removal.

Where more than 1/3 of the diameter of a reinforcing bar is exposed by removal of concrete to the required depth, remove additional concrete to minimum depth of 1.5 inches below the bar. When removing concrete in and around reinforcing steel to remain in place, use 15-pound or smaller chipping hammers or other approved method. For removal away from saw cut edges, cleanly break concrete with pointed jackhammer bits. Replace or sharpen jackhammer bits that are not pointed. Complete removal near repair boundaries with hammers fitted with spade bits.

**514.5.3 Cleaning and Surface Preparation:** Primary cleaning shall consist of removal of dust and debris resulting from concrete removal. Use contained shortblasting, wet sandblasting, or water blasting to remove weakened or damaged concrete microfractured surfaces. If water

blasting, use pressure sufficiently high to prepare surface. Pressures up to 15,000 psi may be necessary. Remove materials that weaken the bond between remaining concrete and repair material. Include saw cut or ground faces. After primary cleaning, protect surface from contaminants.

Secondary cleaning shall be completed within 48 hours prior to placement of repair material. Use low pressure water jetting to remove materials that may impair bond. Concrete substrate surface roughness shall be equivalent to or larger than CSP 5 in accordance with ICRI 310.2R. Clean and allow surfaces to dry thoroughly unless specific repair technique requires application of materials to a saturated surface. Do not use acids for cleaning or preparing concrete surfaces for repair.

**514.6 DISPOSAL:** Unless otherwise shown on the plans, specified in the Special Provisions, or approved by CAWCD, no waste materials shall be disposed of within the CAWCD right-of-way. Contractor shall arrange for disposal of the materials at off-site locations.

**CAP SUPPLEMENT SECTION 512**  
**PRECAST CONCRETE VAULTS**

Add this specification in its entirety:

**512.1 DESCRIPTION:**

The work under this section shall consist of the manufacture, transport, and installation of all precast vaults within the project limits and/or within CAWCD right-of-way or easements. This work consists of furnishing all labor, equipment, appliances, materials, and performing all operations in connection with precast concrete vaults.

**512.2 SUBMITTALS:**

Submittals shall comply with the requirements of CAP DIV 01 Section 013300 SUBMITTAL PROCEDURES.

Shop drawings shall include the following:

- (A) Vault dimensions, elevations, sections, piping sizes and elevations of penetrations, conduit sizes and elevations.
- (B) Design, construction and installation details, typical reinforcement, and additional reinforcement at openings.
- (C) Grounding and bonding details.
- (C) Structural design calculations and Plans that are prepared, stamped, and signed by a Professional Engineer registered in the State of Arizona.
- (D) The repair method for minor damage to precast concrete sections.
- (E) Concrete test cylinder reports from an independent testing laboratory certifying conformance with this section.
- (F) Joint sealant data sheets

**512.3 QUALITY ASSURANCE:**

Precast vaults shall be designed and manufactured by precast concrete supplier regularly engaged in design and production of precast concrete vaults in accordance with ASTM C857 and C858. The design shall be performed by or under direction of manufacturer's professional engineer.

The quality of materials, manufacturing process, and finished sections are subject to inspection and approval by CAWCD. Inspections may be made at the place of manufacture and/or at the work site following delivery. The materials will be examined for compliance with ASTM specifications, the contract documents, and the approved manufacturer's Plans. Additional inspection criteria may include appearance, dimensions, blisters, cracks, and soundness.

CAWCD will reject materials for failure to meet any specification requirement. Rejection may occur at the place of manufacture, at the work site, or following installation. Mark and identify

rejected materials and immediately remove them from the work site; replace rejected materials at the contractor's sole expense.

Repair minor damage to precast concrete sections by manufacture-approved methods if the repair is authorized by CAWCD.

#### **512.4 MATERIALS:**

**512.4.1 Manufacturers:** Precast vaults shall be manufactured by Oldcastle or as approved by CAWCD. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and the general configuration desired.

Like items of materials or equipment shall be the end products of one manufacturer to provide a standardization of appearance, operation, maintenance, spare parts, and the manufacturer's service.

**512.4.2 Precast Concrete Structures:** Precast reinforced concrete structures include vault structures with integral base and top slabs.

Concrete used in the manufacture shall conform to the following:

- (A) Minimum compressive strength of 4,000 psi
- (B) Maximum water content of 6 gallons per 94-pound sack of cement
- (C) Type I or II Portland cement in accordance with ASTM C150

**512.4.3 Manufactured products:** Products shall be manufactured in accordance with ACI 318 and ACI 350. Design products to support their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO HS-20 and AASHTO HL-93 applied to the top slab. Cast base slab and walls together to form a monolithic base section.

Design structure walls for a pressure assuming groundwater level at ground surface. Originate the pressure diagram at finished ground surface. Include lateral pressure from vehicles in accordance with AASHTO Standard Specifications for Highway Bridges.

Consider discontinuities in the structure produced by openings and joints. Provide additional reinforcing around openings. Frame openings to carry full design loads to support walls. Locate horizontal wall joints through the centerline of any wall openings or at a 12-inch minimum clear distance from the closest outside edge of wall openings.

Design the structure with a minimum number of joints. The maximum number of structure sections including the top slab shall be 4. Provide lifting hooks for the top slab.

Provide drainage sump with dimensions as indicated on the Plans. Drainage sump shall consist of an open knockout in the bottom of the vault. Provide additional reinforcing as required to accommodate knockout. Provide grating as indicated on the Plans. Grating shall be designed for 300 pounds per square foot load with L/200 maximum deflection. Provide removable grating sections to facilitate grating removal.

Provide safety type ladder conforming to OSHA standard 1910.23 as well as state or ANSI standard. Ladders shall be stainless steel (306 SST) with rungs consisting of 1-inch minimum solid square bar with 1/8-inch grooves in top and deeply serrated on all sides, capable of

withstanding 1,000-pound load without failure. Side rails shall be minimum 4-inch by ½-inch flat bars.

Ladders shall be fabricated with welded construction to the size, shape, location, and details indicated on the plans. Ladders shall not have a vertical travel distance of more than 24'. Where travel distance on a single ladder section is more than 24', one or more platforms shall be utilized to ensure that no single section is greater than 24'. If a cage is necessary to prevent an individual from falling past a lower platform, the cage should conform to ANSI A14.3. If design restrictions require a ladder length greater than 24' in a continuous run, a davit arm or other positive fall protection measure must be incorporated in the design. A davit base should be permanently installed near the point of entry at the top of the ladder.

Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or support are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding. A transition ladder shall be installed on the top of the vault to assist individuals with entry. Guardrails shall also be installed to protect employees from the opening, except where access is needed to the ladder (where a self-closing gate shall be provided) and if the vault lid is hinged and protects employees from being exposed to the opening.

Provide access hatch with limit switch indicating hatch has been opened. Provide form C contacts rated for 120 VAC. Additional access hatch requirements shall be as specified on the Plans or in the Special Provisions.

Interior and exterior coatings shall be as specified on the Plans or in the Special Provisions. Apply coatings in accordance with manufacturer's instructions.

## **512.5 EXECUTION:**

**512.5.1 Delivery, storage, and handling:** Lifting, handling, and installation shall be in accordance with ASTM C891 and manufacturer's instructions. The concrete vault shall not be delivered until concrete has cured 5 days or has attained minimum 75% of specified 28-day compressive strength.

Comply with manufacturer's instruction for unloading, storing, and moving vaults. Lift vaults from designated lifting points.

Store vaults to prevent damage to CAWCD property. Repair property damaged from materials storage. Protect materials in clean location remote from construction operations areas. Provide additional protection according to manufacturer's instructions.

**512.5.2 Installation:** Transport and handle precast concrete sections in accordance with the manufacturer's instructions. Use lifting devices where provided in the precast sections. Follow the manufacturer's instructions for lifting procedures when lifting devices are not provided.

Inspect vaults immediately prior to placement in excavations to verify that vaults are internally clean and free from damage. Remove and replace damaged units.

Assemble and place buried precast concrete structures in properly excavated and compacted soil foundations. Provide a minimum of 6-inch thickness of aggregate base course below bottom

of vault. Set precast concrete structures to grade and oriented to provide the required dimensions and clearances from pipes and other structures. Where the possibility exists of a watertight structure becoming buoyant in flooded excavation, anchor the structure to avoid flotation as approved by CAWCD.

Set precast concrete barrel sections and structures plumb within 1/4 inches. Seal the joints of precast barrel sections with preformed flexible joint sealant in a sufficient quantity to fill 75% of the joint cavity. Fill the inside joint with non-shrink grout and finish flush with adjoining surfaces. Caulk the inside of any leaking barrel section joint with non-shrink grout to the satisfaction of CAWCD.

Where required, core holes in precast sections to accommodate pipes prior to setting vault section in place and prevent loosening of the joints. Plug holes in the concrete barrel sections that are required for handling with a non-shrink grout or non-shrink grout in combination with concrete plugs. Finish flush on the inside. Allow joints to set for 12 hours before backfilling unless a shorter period is approved by CAWCD.

**512.5.3 Quality Control:** CAWCD will visually inspect structures for potential leaks before backfilling is allowed. Seal joints to the satisfaction of CAWCD.

**CAP SUPPLEMENT SECTION 513  
PRECAST CONCRETE BUILDINGS**

**513.1 DESCRIPTION:**

This Specification covers the design standards, material specifications, and methods for manufacture, handling, storage, and delivery of precast concrete buildings. The factory built precast concrete building shall be supplied in accordance with the Plans and Specifications. Additional electrical, HVAC, communications, and architectural features shall be as shown on the Plans or as described in the Special Provisions.

The precast building manufacturer shall retain the services of a structural engineer registered in the State of Arizona to design the foundation for the precast building. Sealed plans of the foundation shall be included in the building submittal. The Contractor is responsible for obtaining a building permit for the precast concrete building, including any required fees.

**513.2 SUBMITTALS:**

Shop Drawings shall be submitted showing dimensions, sizes, thickness, materials, finishes and methods of assembly. Submit manufacturer's technical data for all building hardware and equipment. Provide copies of the warranty for the roof coating. All Work shall be fabricated and erected in accordance with the manufacturer's plans.

**513.3 WARRANTY:**

The manufacturer shall warrant the units being supplied against defects in workmanship and material for a period of one year after start-up and under normal use, operation, and service. The warranty shall cover parts and labor and shall be in printed form. Provide a 20-year warranty for roofing materials.

**513.4 MANUFACTURERS**

Oldcastle Precast, Chandler, AZ. or as approved by CAWCD.

**513.5 MATERIALS:**

The Engineer shall have the right to inspect or test any materials during fabrication in the factory. At the option of the Engineer, certified tests of materials may be accepted in lieu of field tests. Calcium chloride shall not be used under any circumstance.

- (A) Cement: Cement shall conform to ASTM C150.
- (B) Aggregate: Fine and coarse aggregate shall conform to ASTM C33.
- (C) Admixtures: Admixtures shall conform to the applicable ASTM Standard:
  - 1. Air-entraining admixture - ASTM A260.
  - 2. Water reducing, high range water reducing, retarding, and accelerating admixtures - ASTM C494.
- (D) Steel Reinforcement:
  - 1. Rebar shall conform to ASTM A615 or ASTM A706 (for welded).
  - 2. Reinforcing mesh shall conform to ASTM A496 and A497.
- (E) Inserts and Embedded Metal.

1. Structural steel plates, angles, etc. shall conform to ASTM A36.
2. Lifting inserts shall be used in accordance with manufacturer's published literature.

**513.5.1 Mix Designs:** Concrete mixes shall be developed in accordance with ACI 211.1 All concrete mixes shall be designed by a Professional Engineer or Certified Testing Lab to meet the specified strength requirements. Maximum allowable water/cement ratio shall be 0.50.

For freeze/thaw conditions air-entraining admixtures shall be used. Total air content percent by volume shall be 4 percent to 6 percent.

### **513.6 ACCESSORIES:**

The following accessories shall be installed by the pre-cast building manufacturer:

Provide a wall mount style mini-split HVAC unit. Indoor unit to be mounted on interior wall with the outdoor condensing unit mounted as close as possible to the indoor unit, on the exterior wall of the structure.

Acceptable Manufacturer: Daikin FTX indoor unit, Daikin RX Outdoor Unit. Sizes to be determined per Design Section 513.7 below.

HVAC Accessories:

1. BRACKET, WALL MOUNT; 440 LB CAPACITY, FOR DAIKIN MINI-SPLIT SUPCO P/N BR440
2. COVER, INSULATOR; A/C LINESET, FOR DAIKIN MINI SPLIT, PLASTIDUCT P/N PD4 (REQ)
3. PROTECTOR, SURGE; FOR DAIKIN MINI SPLIT, HVAC ICM CONTROLS P/N ICM517
4. INTERFACE, NETWORK; BACNET, FOR DAIKIN MINI A/C SPLIT SYSTEMS, INTESIS P/N INBACDAI001I000
5. Daikin DKN Plus Interface Adaptor for S21

No substitute HVAC equipment will be allowed.

Install two 3 feet by 7 feet doors, back-to-back, on the building as shown on the plans. Doors shall be bullet-resistant, heavy-duty, minimum 16 gauge, with polystyrene core. Frame shall be 14 gauge. Provide form C magnetic contacts on each door capable of 120 VAC. Provide all necessary hardware including lock, latch protector, and closer. All hardware mounts shall be reinforced. Locks shall be compatible with the CAP standard keys.

Provide a dead bolt, Best Model 38H7K-SI-626 brushed chrome with 7 -pin housing and inside thumb turns. Doors shall have continuous hinges and shall be provided with chain stops and finger ring pulls.

Install an alarm system including , intrusion, hi/lo temperature, power fail, and HVAC fail with an alarm terminal block for connection to the site alarm system Provide conduit, wire, and connections necessary to bring all alarm signals to a terminal box on the wall of the building. Provide discrete terminal strips in the box for analog and digital signals.

Provide one fire extinguisher appropriate for electrical installations with wall mount.

Install double tube, 4-foot LED light fixtures with wire guards and 18-watt lamps in the configuration indicated on the plans or in the Special Provisions. Install wall mounted outside LED light fixture with motion detector and photocell. Provide two duplex convenience outlets.

**513.7 DESIGN:**

Structural calculations and associated drawings shall conform to the latest revision of the following industry standards:

- (A) 2006 International Building Code.
- (B) Local and State Design Standards.
- (C) ACI-318 Building Code.

Electrical design shall be in accordance with the 2005 National Electrical Code.

The following Design Criteria is the minimum used for precast buildings:

- (A) Roof Load = 65 PSF.
- (B) Wind Load = 110 MPH, EXP. "C."
- (C) Floor Live Load = 250 PSF.
- (D) Seismic Zone 4.
- (E) Minimum Concrete Compressive Strength at 28 days: 5000 psi.

Structural design calculations for the building shall be prepared and sealed by a Registered Professional Engineer in Arizona and shall be submitted for approval prior to fabrication.

The building shall have minimum interior dimensions as shown on the Plans and shall be constructed of steel-reinforced precast concrete. The pre-cast concrete building shall be such that the roof and walls are cast monolithically at manufacture. The floor shall be permanently attached to the walls by eight welded connections and a continuous shear keyway, which is filled with non-shrink grout.

Building shall be supplied with a complete and operational HVAC System that has been designed and sized by the Engineer. Engineer load calculations shall be provided during the design phase for review and approval by CAP. HVAC unit tonnage will vary depending on the size of the structure.

The building exterior shall not be painted. Propane tank to be painted "white" and handrails, doors and motor boxes to be painted "check gray".

### **513.8 MANUFACTURE:**

Forms for precast buildings shall be of steel construction and designed expressly for the fabrication of the specified unit. Tolerances of form construction shall be such that no leakage of slurry occurs, and specified product dimensions are achieved. Forms shall be clean and free of excessive buildup, rust, tape, polystyrene, etc.

Reinforcing steel shall be placed conforming to the design requirements relative to the size, spacing, and location. All reinforcing bars shall be adequately tied at crossover points and lap joints to assure rigidity during handling of the cage and placing of the concrete. Reinforcing shall be supported properly and adequately chaired to provide the proper concrete cover and prevent movement during concrete placement and consolidation.

ASTM A706 reinforcing steel shall be used when welding is required. Welding shall be performed in accordance with the American Welding Society (AWS) "Structural Welding Code - Reinforcing Steel."

Embedded items shall be positioned at locations specified in the Plans. Inserts, weld plates, lifting devices, and other items to be cast in shall be held rigidly in place so that they do not move during pouring operations.

Concrete shall be deposited into the forms as near to its final location as practical. The free fall of the concrete shall be kept to a minimum. The concrete shall be placed uniformly around the form. The concrete pouring operation should be continuous, making sure to avoid letting the previous placed concrete begin hardening. Concrete shall be consolidated in such a manner that segregation of the concrete is minimized. All concrete shall be consolidated by vibration so that the concrete is completely worked around all reinforcement, embedments, and into comers thus eliminating all air and stone pockets.

**513.9 PRODUCT HANDLING:** All products shall only be handled from the designed lifting locations. Care shall be taken when stripping a product from its form to prevent damage.

### **513.10 INSPECTION AND TESTING:**

**513.10.1 Concrete Testing:** As a minimum, concrete testing shall be once per day. Testing shall be performed by an ACI Certified Concrete Field Testing Technician Grade I. As a minimum, concrete testing shall include a Slump Test (per ASTM C143), Temperature (per ASTM C1064) and fabrication of Cylinder Test Samples (per ASTM C31). The test sample shall be obtained in accordance with ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete. If the mix design specifies air entrainment, the air content shall be tested by ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the pressure method.

Concrete Test Cylinders shall be fabricated and cured in accordance with ASTM C31. These cylinders will normally measure 4-inches diameter by 8-inches high. However, if Project Specifications require, the test cylinders may be 6-inches diameter by 12-inches high. The quantity of test cylinders will normally be a set of four with compressive strength tests performed at ages of 1 day, 7 days, and 28 days (2 cylinders), unless specified otherwise. These test sample quantities and ages shall be superseded by any applicable job specifications. After curing per ASTM C31 the cylinders shall be compression tested to failure per ASTM C39.

**513.10.2 Mill Certificates:** The pre-caster shall have on file mill certificates for reinforcing steel, cement, and chemical admixtures to verify compliance with material specifications.

**513.10.3 Aggregate Testing:** A full set of fine and coarse aggregate tests shall be performed at least annually and shall be on file to verify compliance with ASTM C33.

**513.10.4 Product Inspection:** All finished products shall be inspected by a Quality Control Inspector to assure the product has been manufactured in compliance with Plans and Specifications. Approved product shall be marked as such. If repairs are required, they shall be performed and re-inspected before the product is approved and goes to inventory.

**513.10.5 Electrical Testing:** The electrical systems of all precast buildings shall be inspected and tested prior to shipment. Inspection and testing results shall be documented and signed by the inspector. The inspection checklist shall be filed in the Project file.

All electrical components and parts will be inspected for quality workmanship and installation. This inspection will include such items as conduit, conduit couplings, conduit brackets, electrical panels, A/C units, exterior and interior lights, outlets, and smoke detectors. In addition, the following tests will be performed as a minimum:

- (A) Polarity test.
- (B) Continuity test.
- (C) Dielectric test.
- (D) Operational test.

#### **513.11 DELIVERY AND INSTALLATION:**

**513.11.1 Loading:** Product shall be loaded in a manner to prevent damage from occurring during shipment. In general, dunnage shall be placed at the lift points and tie downs at the dunnage. Softeners will be used at tie-down chains. Products shall be loaded only after the concrete has achieved adequate strength.

**513.11.2 Installation:** Product shall be installed in accordance with the precast manufacturer's recommended procedures. Buildings shall be handled in such a manner at the jobsite such that they are not damaged from equipment and excessive stresses. Lift gear, rigging, etc. shall be as specified by the manufacturer.

## **SECTION 515**

### **STEEL STRUCTURES**

**515.1.3 As Built Plans:** Revise this section as follows:

The Contractor shall furnish to CAWCD before formal acceptance of the work, detailed plans of the structure as built. As built plans shall be prepared and submitted in accordance with CAWCD DIV 01 Section 017810 Project Record Documents.

## SECTION 520

### STEEL AND ALUMINUM HANDRAILS

**520.1 DESCRIPTION:** Modify the first paragraph as follows: Metal handrail shall consist of furnishing all materials and constructing handrail of steel, including railing, posts, fittings, and anchorages. Aluminum handrail shall not be allowed. Metal handrail shall be fabricated, installed, and painted, when required, in accordance with the details shown on the plans and these specifications.

**520.2 FABRICATION:** Modify the third paragraph as follows: CAWCD shall be furnished complete copies, in triplicate of all mill reports on steel materials furnished.

Fourth paragraph: Delete the third sentence.

Ninth paragraph: Delete.

## **SECTION 530**

### **PAINTING**

**530.1 DESCRIPTION:** Add the following: MAG 530 Painting shall be used for painting civil-related improvements only. Section 099000 Painting and Coatings shall be used for CAP equipment.

**530.7 SAFETY PRECAUTIONS:** Revise the first sentence as follows:

The following safety precautions shall be observed in addition to those specified in CAWCD DIV 01 Section 019150 Safety.

## **SECTION 600 - WATER, SEWER, STORM DRAIN AND IRRIGATION**

### **SECTION 601**

#### **TRENCH EXCAVATION, BACKFILLING AND COMPACTION**

**601.2.9 Shoring and Sheathing:** Revise the second paragraph as follows:

All shoring and sheathing deemed necessary to protect the excavation and to safeguard employees shall be installed and comply with CAWCD DIV 01 Section 019150 Safety.

**601.3.1 Utilities:** Revise the third paragraph as follows:

The Contractor shall be entirely responsible for safeguarding and maintaining all conflicting utilities that are shown on the plans (CAWCD DIV 01 Sections 013300 Submittal Procedures and 019150 Safety apply). This includes overhead wires and cables and their supporting poles whether they are inside or outside of the open trench. If, in the course of work, a conflicting utility line that was not shown on the plans is discovered, CAWCD will either negotiate with the owner for relocation, relocate the utility, change the alignment and grade of the trench or as a last resort, declare the conflict as “extra work” to be accomplished by the Contractor in accordance with CAWCD DIV 00 Section 00600.4.4 Differing Site Conditions.

## SECTION 602

### TRENCHLESS OR OPEN CUT INSTALLATION OF STEEL CASING

Delete MAG Section 602 in its entirety and replace with the following CAP Standard Specification 602.

### CAP STANDARD SPECIFICATION 602 TRENCHLESS INSTALLATION OF STEEL CASING

#### 602.1 GENERAL:

The work under this section consists of all trenchless installation of steel casing within the project limits and/or within CAWCD Right-of-way or easements. This work includes furnishing all labor, equipment, appliances, and materials required in connection with the trenchless installation of piping. This section includes general information, products, and execution for trenchless installation of steel casing.

When horizontal directional drilling (HDD) or other trenchless methods are used, canal seepage conditions may be aggravated by the collapse of the canal foundation material into the annular void between the bore and pipe. Penetration through the top stratum of fine-grained materials may concentrate seepage at those locations. Pipe installed with trenchless methods shall proceed only after CAWCD has completed a comprehensive evaluation and approved of the following:

- (A) Comprehensive understanding of the subsurface soil and groundwater conditions to a minimum depth of 20 feet below the lowest pipe elevation
- (B) Locations of the HDD pipe penetration entry and exit
- (C) Construction procedure
- (D) Allowable uplift pressures
- (E) Onsite quality control and quality assurance monitoring during construction operation
- (F) Grouting of the pipe annulus
- (G) Backfilling of any excavated areas
- (H) Repair and reinstatement of the construction staging areas

#### 602.2 SUBMITTALS:

**602.2.1 Installation Details:** Submit a lay schedule showing stationing, elevation, casing pipe lengths, and wall thickness. Submit methods for installing carrier pipe inside steel casing, including the Contractor's proposed method for continuously monitoring the line and grade of casing pipe. The proposed method shall provide the capability to control the line and grade of casing pipe during the operation to ensure the installation remains within the tolerances specified.

**602.2.2 Casing Pipe:** Product information, including diameter, thickness, and class for each jacked casing crossing.

**602.2.3 Casing Spacers:** Details of all materials, banding, and insulating material.

### **602.3 QUALITY ASSURANCE:**

**602.3.1 System Description:** The completed installation shall be suitable for transporting water without affecting the stability and integrity of the overlying roadway, or waterway.

Steel casing pipe shall be the product of a single domestic Manufacturer. Welders shall be certified in accordance with AWS. The Manufacturer shall submit a written statement that the inspection and the specified tests have been completed and that results comply with the requirements of this specification.

**602.3.2 Project Requirements:** Discharge from dewatering operations shall be directed into approved receiving basins. Provide maintenance of traffic and maintain safety procedures in road and CAWCD right-of-way during the operation.

Inspect locations where operations are to be conducted and casing pipe is to be installed. Verify conditions under which Work is performed.

Provide necessary details for the orderly installation of Work within CAWCD right-of-way. Verify number, type, and location of existing utilities prior to beginning Work.

The method of installation used shall not result in measurable settlement, movement, or cracking of existing structures, buried facilities, irrigation channels, or adjacent roadways and railways. If movement or settlement occurs that causes or may cause damage to these structures over, along, or adjacent to Work, operations shall stop immediately except for activities that assist in preventing further movement, settlement, or damage.

Existing structures, buried facilities, irrigation channels, and roadways damaged by operations shall be repaired or replaced as necessary to restore them to a proper condition, at the Contractor's expense.

### **602.4 DELIVERY, STORAGE, AND HANDLING:**

Care shall be taken in loading, transporting, and unloading to prevent damage to pipe or coatings. Pipe shall not be dropped. Repair any damage to pipe coatings. Pipe and materials shall be carefully handled to protect against damage to lining and coating and interior and exterior surfaces, impact shocks, and free fall. Pipe handling equipment shall be acceptable to CAWCD.

Pipe shall not be placed directly on rough ground but shall be supported in a manner that protects it from damage. Damaged pipe shall be repaired in a manner acceptable to CAWCD or new undamaged pipe shall be furnished and installed. Inspect each pipe to ensure there are no damaged portions. Remove or smooth out burrs, gouges, weld splatter, or other small defects prior to laying.

### **602.5 APPROVED PRODUCTS/MANUFACTURERS:**

#### **602.5.1 Casing Spacers (Skids) and Insulators:**

Advanced Products & Systems, Inc., Model SI-12

BWM Company, Model SS-12

CCI Pipeline Systems

Pipeline Seal and Insulator, Inc., Model C12G

Or as approved by CAWCD

**602.5.2 Composite Sleeve Casing Spacer:**

Clock Spring Company, L.P.

Or as approved by CAWCD

**602.5.3 Casing Joints:**

Permalok Corporation, Permalok interlocking pipe system.

Or as approved by CAWCD

**602.5.4 End Seals:**

Advance Products and Systems, Inc., Model AC or AW

Pipeline Seal and Insulator Company, Model C or W

Or as approved by CAWCD

**602.6 MATERIALS:**

**602.6.1 Steel Casing Pipe:** Steel casings shall be leak-proof and in accordance with ASTM A 139, Grade B. Steel casing pipe shall have a minimum yield strength of 36,000 psi and shall be designed to withstand Cooper E-80 live loading with diesel impact and any relevant jacking load. The inside diameter of casing pipe shall be large enough to allow carrier pipe to be installed with casing skids and joint restraint without disturbing casing pipe, adjacent subgrade, or adjacent facilities and structures.

Casing pipe shall have the minimum nominal diameter and wall thickness shown on the Plans and listed herein:

Casing Pipe Inside Diameter (Inches)	Casing Pipe Wall Thickness (Inch)
6 to 12	0.250
16 to 20	0.312
22 to 24	0.375
26 to 28	0.437
30 to 34	0.500
36 to 38	0.562
40 to 50	0.625
52 to 58	0.750
60 to 78	0.813
84 to 90	0.875
96 to 102	0.937
108 to 114	1.000
120	1.125

**602.6.2 Joints:** Beveled ends for butt-welding - Permalok.

**602.6.3 Grout ports:** 2-inch standard pipe IP threaded half couplings welded to the casing pipe, and fitted with threaded galvanized iron plugs on 4-foot centers.

**602.6.4 Casing Spacers (skids) and Insulators:** Type: SST, bolt on with a shell made of at least two halves.

**602.6.5 Band:** 14 gauge hot-rolled and pickled mild steel coated with a 10 mil to 16 mil fusion-bonded PVC coating.

**602.6.6 Non-conductive PVC liner:**

Thickness: 0.090 inch minimum.

Hardness: Shore durometer A 85 to A 90.

Dielectric strength: 60 kV minimum.

Surge test, 1/8 inch: 58 kV minimum, step-by-step test.

Water absorption: 1% maximum.

**602.6.7 Risers:** 10-gauge steel MIG welded to band. Ultra-high molecular weight polymer glass-reinforced runners with high abrasion resistance and low coefficient of friction meeting the following properties:

Tensile strength in accordance with ASTM D 638: 17,600 psi, minimum.

Flexural strength in accordance with ASTM D 790: 25,300 psi, minimum.

Compression strength in accordance with ASTM D 648, 10% deformation: 18,000 psi, minimum.

Deflection temperature at 264 psi in accordance with ASTM D 648: 405°F.

#### **602.6.8 Studs, nuts, and washers:**

Studs: 5/16 inch, 18 inches by 2 1/2 inches 18-8 SST.

Hex nuts: 5/16-inch SST.

Washers: 5/16-inch SAE 2330 SST.

**602.6.9 Composite Sleeve Casing Spacers:** A composite sleeve consisting of a three-part system consisting of a unidirectional fiberglass sleeve, high-strength filler, and adhesive.

**602.6.10 Unidirectional fiberglass sleeve:** Fiberglass and polyester/vinyl ester resin. Thickness of each layer is 0.065 inch. The complete eight-layer system is 1/2 inch non-conductive PVC liner. Width is 11/12 inches.

**602.6.11 Filler:** Compressive strength: Greater than 8,000 psi.

**602.6.12 Adhesive:** Lap shear strength: Greater than 1,200 psi.

**602.6.13 End Closure:** Pull-on casing seal or wrap-around casing seal, 1/8 inch minimum thick 60 durometer EPDM or neoprene rubber. Wrap around seals shall overlap the casing pipe by 2 inches and shall be held on with AISI 304L SST worm gear clamps held together with mastic strips to seal the edges. Custom pull-on end seals shall be seamless with vulcanized edges.

**602.6.14 Liner Plate:** Plates shall be accurately curved to comply with tunnel cross-section and all dimensions of such size and accuracy so that plates of similar curvature will be interchangeable. Bolts shall be on both the longitudinal and circumferential joints. Bolts and nuts shall not be less than 5/8-inch diameter and in accordance with ASTM A 307, Grade A, and hot-dip galvanized in accordance with ASTM A 153. Zinc coating shall be minimum of 2 oz/sf surface area on all sides in accordance with ASTM A 123.

Grout ports shall be two standard pipe IP threaded half couplings welded into a hole in the center corrugation and fitted with threaded plugs. Locate grout ports at a minimum of every 4 feet along pipeline alternating top of pipe and pipe springline.

Loading shall be soil and HS-20 traffic loading or Cooper E-80 as applicable.

#### **602.7 CONSTRUCTION:**

**602.7.1 General:** Furnish labor, materials, equipment, and incidentals required to install casing pipe and carrier pipe at the locations shown on the Plans. Work shall include steel casing pipe, liner plate, casing spacers, carrier pipe, carrier pipe installation. Additional groundwater controls may be ordered on short notice; implement as directed. Observed water levels prior to the Work shall be below the invert level of the jacking pits and pipe subgrade. Groundwater control along and at the face of the tunneling operation shall include chemical grout stabilization as required.

Earthwork operations including, but not limited to, trench excavation, pit excavation, pipe bedding, trench backfill, and compaction required for the installation of casing pipe shall be performed as specified in MAG Section 601. Pipe shall be laid directly on imported bedding material. Blocking is not permitted. The bedding shall form a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate the removal of handling devices after the pipe is laid. Excavation shall be made outside the normal trench section, as needed and at field joints to permit adequate access to the joints for field welding operations.

**602.7.3 Installation:** Excavate the launching pit; furnish excavation supports as required. Excavation support shall extend a sufficient depth below the invert of the steel casing pipe to resist any pressure developed by the soil outside the launching pit. Provide a level concrete slab or level stable gravel surface at the bottom of the launching pit. Steel rails or beams may be embedded in the concrete slab to aid in the placement and alignment of casing pipe or CP during installation operations. Furnish, install, and remove thrust blocks or similar features as may be required in driving casing pipe or CP forward.

Pothole utility crossings in advance of the installation of casing pipe to determine their exact locations; verify there are no conflicts with the boring and jacking operation. Damages and costs that may be realized by the failure to locate and protect utilities are the responsibility of the Contractor. Maintain proper alignment and elevation of the casing pipe consistently throughout the tunneling operation. The proposed method shall provide the capability to control the line and grade of the casing pipe during the operation to ensure installation remains within the tolerances provided herein.

Tolerances for the installation of casing pipe: Vertical alignment:  $\pm 3$  inches; select casing pipe diameter that is sufficiently large to compensate for off grade installation. Horizontal alignment:  $\pm 3$  inches.

Installation of the casing pipe shall be continuous. Take precautions to avoid interruptions that may cause the pipe to freeze in place. Dewatering through the casing pipe during construction is not permitted.

Steel casing pipe sections shall have one end square and one end beveled with a single v-groove and full penetration butt-welded on the entire outside circumference of the casing. Prior to butt-welding, the pipe and the pipe joint shall be properly positioned using line up clamps. In the finished joint, the abutting pipe sections shall not be misaligned by more than 1/16 inch. Welding procedures used to install casing pipe shall be prequalified in accordance with AWS D1.1 or ASME Boiler and Pressure Vessel Code, Section IX. ASME certification is required for butt-welded joints. Joints of steel casing shall be butt-welded prior to being subjected to the jacking operation.

Jacking shall be performed in a manner that prevents voids from developing outside the jacking sleeve. A jacking shield shall be used to minimize the number of voids produced during excavation in the forward end of the jacking sleeve. If the jacking operation causes an excessive loss of soil, pressure grout the jacked section to fill external voids outside of the jacked casing. Install in such a manner as to ensure exterior voids are filled after completion. Provide grout holes and fill voids with pressure grout as specified in CAP Standard Specification 603.

After casing pipe is installed, thoroughly clean its interior; remove excess material leaving a smooth interior throughout. The exit pit shall be excavated to the casing pipe. Provide excavation support as required. Provide sufficient room to continue installation of the carrier pipe.

**602.7.4 Carrier Pipe:** Support the carrier pipe within the casing pipe so that pipe bells do not rest directly on the casing. Distribute the load of the carrier pipe along the casing pipe by using casing spacers. Install within the casing using casing spacers. Install from the jacking pit end of the casing. Each joint within the casing pipe shall be of the restrained push-on type if DI or PVC pipe is utilized, and thoroughly checked prior to being installed into the casing. Steel pipe joints

located within a steel casing shall be double welded lap or buttstrap joints as shown on the Plans.

For carrier pipe 24 inches and larger, fill the annular space between the casing pipe and the carrier pipe with sand throughout the length of pipe. The method to be used to place the sand shall be such to ensure complete filling of the annular space. Install a rubber end closure seal after the carrier pipe is installed.

#### **602.8 RESTORATION:**

Remove excavation support systems for jacking pits. If withdrawal could damage or disturb the improvements leave supports in place and cut them off 36 inches below finished grade.

Following the casing and pipe installation and backfill operations, restore the Work area to its original grade and condition. Replace or construct miscellaneous small structures and fencing, if applicable, to match existing. Remove equipment, supplies, excess excavation materials, and miscellaneous items associated with the casing installation operation. Leave the site in a clean and neat condition. If required by CAWCD, coordinate and schedule a final inspection of the Work.

## **CAP STANDARD SPECIFICATION 604 GROUTING OF STEEL CASING**

Add the following **CAP STANDARD SPECIFICATION 604** in its entirety:

### **604.1 GENERAL:**

Section Includes general information, products, and execution for grouting of steel casing for the controlled injection of fluid grout at the interface between tunnel liner plates or casing pipe and the ground.

### **604.2 SUBMITTALS:**

**604.2.1 Pre-Construction:** Provide a detailed description of the grouting operation including procedures for monitoring grout placement and controlling pressures, grout material and properties, grout mix design including fluidizers, accelerators, and other additives.

Provide grout material properties including density, viscosity, bleeding, shrinkage, expansion, and set time and grout manufacturer's mixing and installation instructions including data on water volume, workability, setting times, and temperatures.

Provide the proposed method of verifying that voids have been successfully grouted.

**604.2.2 Construction:** Provide grout logs within 1 day of grouting. Submit field logs containing as a minimum:

- (A) A description of injection points using stationing along the tunnel and degrees clockwise looking up station from the crown.
- (B) The volume of grout taken at each injection point.
- (C) The maximum sustained pressure at each injection point.
- (D) Grout time for each hole from beginning to end of injection.
- (E) Grout sequence and stages, both longitudinal to and in a cross- section of the tunnel.
- (F) Grout equipment and setup including, as a minimum, mixers, pumps, agitators, circulation or deliver circuit, and gauges.
- (G) Quantity of grout mix pumped.

### **604.2 QUALITY ASSURANCE:**

**604.2.1 Performance Requirements:** Design, plan, and perform grouting by or under the supervision of an experienced reputable firm regularly engaged in the type of work involved for at least 5 years. Determine contact grouting equipment, materials, and methods subject to the

requirements specified herein. Ensure that the tunnel's final lining, utilities, and other facilities are not damaged by contact grouting operations.

### **604.3 APPROVED PRODUCTS/MANUFACTURERS:**

#### **604.3.1 Dry Pack Mortar:**

1. Sika Corporation, Sika Repair 223
2. Williams Form Engineering Corporation, Wil-X Cement Grout, mixed with sand
3. Or as approved by CAWCD

### **604.4 MATERIALS:**

**604.4.1 Grout:** Stable colloidal suspension of cement, bentonite, water, fluidifier, and admixtures. Sand may be added provided the grout is demonstrated to have suitable flow characteristics and may also be used to fill voids at the locations specified. Design the grout mix to achieve the material properties specified, to grout the tunnel and anticipated ground conditions and be compatible with the grouting equipment. Adjust the grout mix as necessary to address varying tunnel and ground conditions.

Unconfined compressive strength shall be minimum 200 psi at 28 days and minimum 20 psi in 1 day. Adjust the w/cm of the grout as necessary to fill voids within the zone of grout influence, however, at all times the grout shall have a w/cm of between 1 to 1 and 3 to 1 by volume and a bentonite content of no more than 2%. No hole shall be completed with a w/cm above 1 to 1 by weight. Grout shall not show shrinkage when tested in accordance with ASTM C 827.

Grout components and the handling and storage of grout components including, but not limited to, cement, fly ash, bentonite, pozzolan's, admixtures, and water shall be as specified and as recommended by the Manufacturer. Store bulk cement and fly ash in suitable moisture-proof enclosures. Cement and fly ash that have become caked or lumpy shall not be used. Store sand in a manner that prevents segregation and the inclusion of foreign materials. The bottom 6 inches of sand piles in contact with the ground shall not be used.

**604.4.2 Cement:** In accordance with ASTM C 150, Type II, with less than 1% retained on the No. 200 sieve.

**604.4.3 Fly Ash:** In accordance with ASTM C 618.

**604.4.4 Admixtures:** Grout admixtures shall be compounds possessing characteristics which will increase the flowability of the grout mixture, assist in dispersal of the cement grains, retard or accelerate the set time, minimize bleed voids in grout, and neutralize the setting shrinkage of the grout. Admixtures shall be in accordance with ASTM C 494, compatible with grout materials including other admixtures, and approved by CAWCD prior to use.

**604.4.5 Fluidifier:** Fluidifier holds the solid constituents of the grout in colloidal suspension and is compatible with the cement, sand, gravel, and water used in the grouting program. Fluidifier contains an expansive shrinkage compensator. Fluidifier shall not contain bentonite and other clay-like substances. Approved fluidifiers are Calcium ligno-sulfonate and sodium ligno-sulfonate. Furnish fluidifier in sealed containers and protect from moisture. Material that has become caked due to moisture adsorption will be rejected.

**604.4.6 Dry Pack Mortar:** A specially proportioned mixture of Type II Portland cement, sand, quick-setting admixture, and water, or an approved, commercially manufactured mortar.

**604.4.7 Water:** Water used in drilling grout holes and preparing grout shall be potable, clean, and free from sewage, oil, acid, alkali, chlorides, salts, organic materials, and other impurities

**604.4.8 Bentonite:** Pulverized or powdered premium grade natural sodium cation bentonite in accordance with API 13A with a minimum yield of 90 barrels per ton.

**604.4.9 Sand:** In accordance with ASTM C 144.

#### **604.5 FABRICATION:**

**604.5.1 Grout Ports:** 2-inch standard pipe threaded half couplings welded to the casing pipe and fitted with threaded galvanized iron plugs. Locate grout ports a minimum of every 4 feet along pipe springline and centerline of the pipe section per Grout Injection Port Detail.

#### **604.6 CONSTRUCTION:**

**604.6.1 General:** The purpose of contact grouting is to fill voids completely behind tunnel liner plates and casing pipe to result in firm contact between the ground and the structural elements of the tunnel.

**604.6.2 Controls and instrumentation:** At the grout injection point, provide suitable valves and accurate pressure gauges so the pressure and grout flow at the grout holes may be monitored and regulated by increasing or decreasing the flow in the grout return line. Provide means for accurately determining the amount of grout injected into each hole. Provide suitable stop, check, or ball valves at the collar of the hole for use in maintaining pressure as required until the grout has set.

**604.6.3 Contact Grouting:** Inject contact grout through grout ports in liner plates or casing pipe to fill the annular space between the tunnel and the excavated ground. Grouting behind liner plates shall follow as soon as practicable after liner plates are erected. At the end of a work shift or when work is interrupted for any reason, no liner plates shall be left ungrouted. Grouting shall follow progressively with each adjacent set of holes. Grouting behind casing pipe shall immediately follow the jacking of casing pipe into its final position. Grouting shall be performed over the entire 360-degree circumference of the tunnel. Vent air and fluids (e.g., water, grout, and slurry) through the upper holes. Continue grouting until grout appears in the next set of grout holes which shall be kept open during grouting to permit the release of air and water.

**604.6.4 Mixing and Injection of Grout:** Grout materials shall be free of lumps when put into the mixer and the grout mix constantly agitated. Screen grout before entering the pump. Grout shall flow unimpeded and shall completely fill voids. Grout that has not been injected after 90 minutes of mixing shall not be used.

Make connections for injecting grout at each grout fitting of the pipe as shown on the approved plans at each grout connection. The injection of grout during any stage of grouting shall be performed continuously, filling the spaces and voids, and avoiding the disturbance of grout that has taken initial set. The grouting process shall be operated and controlled so that grout will be delivered uniformly and steadily.

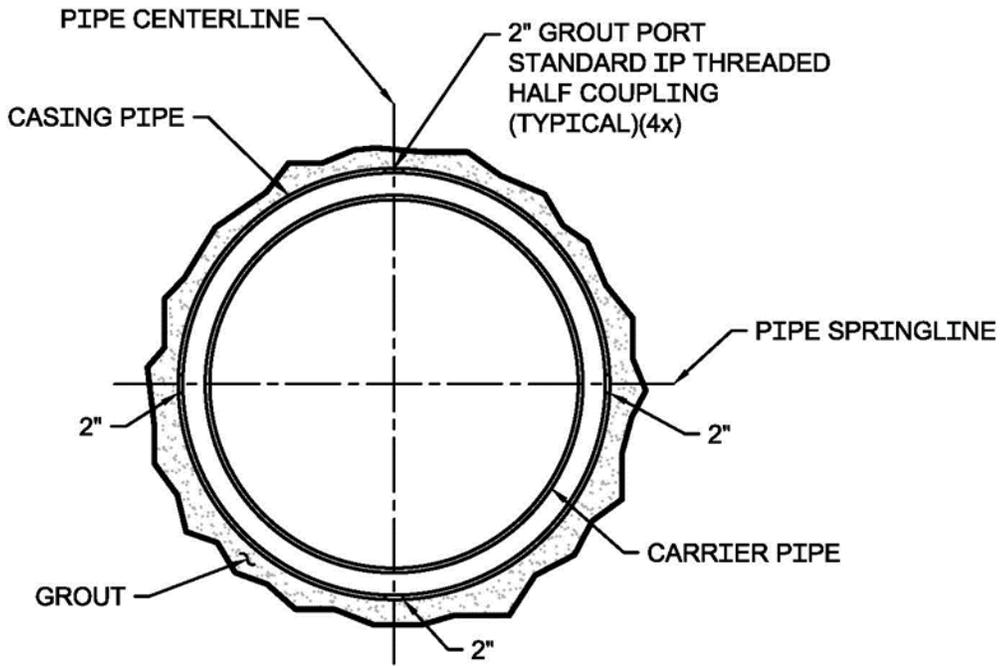
Grouting shall progress from the grout hole in the sequence shown in the approved construction submittal. Maintain grout injection pressure so as not to heave or deform the ground surface or leak grout onto the ground surface. Grout injection pressure shall be determined by the Contractor but in no case shall pressure exceed 1 psi per vertical foot of over burden cover. Maintain grout injection pressure so as not to deform liner plates or casing pipe. After the grouting of any grout pipe is finished, pressure shall be maintained by means of a ball or check valve or other suitable device until the grout has set to the extent that it will be retained in the hole.

After removing the packer or grout pipe, fill any void left with dry pack mortar. Replace grout plugs in the pipe at the completion of grouting. Dry pack mortar shall be used to fill any recesses.

**604.6.5 Protection:** Take necessary precautions to protect and preserve the interior of the tunnel from damage. Any damage to the lining caused by or occurring during the grouting operations shall be repaired by a method approved by and at no additional cost to CAWCD. Minimize grout spills and clean-up immediately after grouting.

**604.6.6 Quality Control:** Perform Work in the presence of CAWCD. Provide notification to the CAWCD, in writing, 14 days in advance of the start of a grouting operation.

REVISION HISTORY							
REV	ENG	CADD	DATE	WORK ORDER	DESCRIPTION	APPR	DATE APP
A	STS	AJW	02-15-23	030668	ISSUED FOR EXECUTION GROUT PORT DESIGN	REJ	03-20-23



**GROUT INJECTION PORT DETAIL**

DIVISION <b>ENGINEERING</b>		 <b>CENTRAL ARIZONA PROJECT</b> 23030 NORTH 7th STREET - PHOENIX, ARIZONA 85024	
APPROVALS		<b>CENTRAL ARIZONA PROJECT</b> <b>CANAL</b> <b>GROUT INJECTION PORT</b> - DETAIL	
DESIGNED BY:	T. SMITH	DATE	02-15-23
DRAWN BY:	A. WEIZEL		02-15-23
CHECKED BY:	C. BRESCIANI		-
CADD BY:	-	DISC.	CIVIL
SUBMITTED BY:	-	ORG. W.O.	030668
MANAGEMENT BY:	-	SCALE:	NTS
		DWG No:	<b>CAP-C-C23373-EXH-01</b>
		Contractor Sheet No.:	N/A

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**SECTION 607**

**TRENCHLESS INSTALLATION OF SMOOTH WALL JACKING PIPE**

Delete this section in its entirety.

**SECTION 608**  
**HORIZONTAL DIRECTIONAL DRILLING**

**608.1 DESCRIPTION:** Add the following as the fifth paragraph:

When horizontal directional drilling (HDD) or other trenchless methods are used, canal seepage conditions may be aggravated by the collapse of the canal foundation material into the annular void between the bore and pipe. Penetration through the top stratum of fine-grained materials may concentrate seepage at those locations. Pipe installed with trenchless methods shall proceed only after CAWCD has completed a comprehensive evaluation and approved of the following provided by the Contractor.:

- (A) Comprehensive understanding of the subsurface soil and groundwater conditions to a minimum depth of 20 feet below the lowest pipe elevation
- (B) Locations of the HDD pipe penetration entry and exit
- (C) Construction procedure
- (D) Allowable uplift pressures
- (E) Onsite quality control and quality assurance monitoring during construction operation
- (F) Grouting of the pipe annulus
- (G) Backfilling of any excavated areas
- (H) Repair and reinstatement of the construction staging areas

## SECTION 610

### WATER LINE CONSTRUCTION

**610.3 (A) MATERIALS:** Add the following: Water lines less than 4-inches in diameter shall be Schedule 80 PVC and be NSF-61 certified in potable water applications. Ductile iron and steel pipe shall be the only materials allowed for CAWCD turn-ins and turn-outs.

**610.6.4 Payment for Polywrap:** Revise this section as follows:

No payment shall be made for polywrap and is considered incidental to the related bid item.

**610.13 METER SERVICE CONNECTIONS:** First paragraph, revise to read: All new meters must be installed by the local water authority after the proper application as required by Code with fees paid at the prevailing rate.

Fourth paragraph, revise the first two sentences to read: Water meter boxes, which are broken during construction shall be replaced by the Contractor at no additional cost to the local water authority. Existing meter boxes, which are already broken prior to start of construction, shall be replaced by the Contractor with boxes furnished by the local water authority.

## SECTION 611

### WATER, SEWER AND STORM DRAIN TESTING

**611.4 SEWER LINE TESTING Article (D) Video Inspection:** Revise to read: The Contractor shall provide the Engineer with an annotated video inspection record in digital format acceptable to CAWCD of the new sanitary sewer line. The video shall clearly show all joints, seals, connecting pipes, and manholes. This video shall be provided to CAWCD and reviewed and approved prior to final acceptance of the Work. The video should be approved by CAWCD prior to any paving over the sewer line where applicable. The cost of the video shall be incidental to the sewer line.

## **SECTION 620**

### **CAST-IN-PLACE PIPE**

**620.1 GENERAL:** Modify the first sentence in the first paragraph to read: This specification covers cast-in-place non-reinforced concrete pipe intended for use as storm drains or irrigation lines up to and including 60-inches in diameter.

## **PART 700 - MATERIALS**

### **SECTION 772**

#### **CHAIN LINK FENCE**

**772.1 GENERAL:** Add the following: Chain link fence shall be constructed in accordance with CAWCD Standard Detail STD-C-C06755.

**772.3 CHAIN LINK FABRIC:** First paragraph, first sentence, revise to read: Chain link fabric shall conform to the requirement of ASTM A392 (Zinc-Coated).

**772.4 TENSION WIRES AND FABRIC TIES:** First paragraph, second sentence, revise to read: Ties used to fasten the fabric to posts, rails, and gate frames shall be not smaller than 11 gage galvanized steel.

**772.7 BARBED WIRE:** First paragraph, first sentence, revise to read: Barbed wire shall be 3-strand, 12-1/2 gage barbed wire with 4- point barbs not more than 5-inches apart.