



**CUDO Stormwater Products, Inc.**  
**Guide Specifications**  
**Section 33 49 23**

**SECTION 33 49 23**

**STORM WATER STORAGE STRUCTURES**

CUDO™ is a modular plastic system used to construct underground water storage structures. Lightweight CUDO Cubes form strong, economical structures and can be configured to meet project requirements. With 95 percent storage capacity and large interior openings, CUDO reduces footprint and excavation required for stormwater management. CUDO is easily integrated into stormwater detention, retention, and storage systems or used for rainwater harvesting and bio-retention designs.

**ENGINEERING:** A soil engineering report should be obtained prior to construction. If contractor is responsible for obtaining soil report, add pertinent requirements. Designer must also size each component of system to perform intended function.

**DRAWING COORDINATION:** Show location and configuration of underground water-holding structures, water inlets and outlets, access openings, and pretreatment and filtration devices. Show coordination with adjacent materials and related construction, and provide details necessary to explain project requirements.

**SPECIFICATION COORDINATION:** Edit guide specification to meet project requirements. Remove language that is not applicable and add additional language as required. Coordinate work of this section with work of other specification sections.

This document is available in word processing format at [www.CUDOCube.com](http://www.CUDOCube.com); **TURN ON HIDDEN TEXT** to view or print notes to specifier.

**DESIGN ASSISTANCE:** Contact CUDO for design assistance and name of local CUDO representative:

Phone: 877-876-3345 *Toll-Free*  
Fax: 707-876-3346  
Email: [info@CUDOCube.com](mailto:info@CUDOCube.com)  
Website: [www.CUDOCube.com](http://www.CUDOCube.com)

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes underground water storage structures and related work for stormwater **[detention,] [retention,] [and] [harvesting]**.
- B. Related Sections:
  - 1. Division 22 Section "Gray Water Pumps".
  - 2. Division 31 Section "Excavation and Fill".
  - 3. Division 31 Section "Soil Stabilization".
  - 4. Division 32 Section "Bases, Ballasts and Paving".

5. Division 32 Section "Irrigation": Pumps.
6. Division 33 Section "Common Work Results for Utilities".
7. Division 33 Section "Utility Storm Water Treatment": Treatment not specified in this section.
8. <Other Section>.

## 1.2 REFERENCES

- A. Reference Standards:
  1. AASHTO LRFD Bridge Construction Specifications
  2. AASHTO M288 – Geotextile Specification for Highway Applications
  3. ASTM A48 – Gray Iron Castings
  4. ASTM D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort
  5. ASTM D751 – Test Methods for Coated Fabrics
  6. ASTM D3776 – Mass Per Unit Area (Weight) of Fabric
  7. ASTM D3786 – Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
  8. ASTM E96 – Water Vapor Transmission of Materials
- B. Regulatory Requirements:
  1. <If applicable, add stormwater management or low-impact development requirements.>

## 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting:
  1. Discuss scheduling, sequence of activities, coordination of related work, handling of materials, safety, stormwater management during construction, and protection of water storage structures.
  2. Comply with requirements of Division 01 Section ["**Project Management and Coordination**"] <Other Section title>.
  3. Invite parties affected by work of this Section.
  4. Notify water storage structure manufacturer not less than 15 days prior to scheduled meeting.

## 1.4 SUBMITTALS

- A. Action Submittals:
  1. Product Data.
  2. Shop Drawings.
- B. Informational Submittals:
  1. Inspection reports.
  2. Manufacturer's installation instructions.
- C. Sustainable Design and Construction Submittals:
  1. LEED Credit SS 6.1 – Stormwater Design – Quantity Control: Provide stormwater management plan demonstrating compliance with requirements for [**Case 1, Option 1.**][**Case 1, Option 2.**][**Case 2.**]
  2. LEED Credit SS 6.2 – Stormwater Design – Quality Control: Provide stormwater management plan demonstrating compliance with credit requirements.

3. LEED Prerequisite WE 1 – Water Use Reduction [**and Credit WE 1, Water Efficient Landscaping**]: Storage capacity of [**rainwater collection**] [**recycled wastewater collection**] system.
  4. LEED Credit WE 2 – Innovative Wastewater Technologies:
    - a. Storage capacity of [**rainwater collection**] [**recycled wastewater collection**] system.
    - b. Treatment capacity and quality for on-site water treatment system.
  5. LEED Credit WE 3 – Water Use Reduction: Storage capacity of [**rainwater collection**] [**recycled wastewater collection**] system.
  6. LEED Credit MR 4 – Recycled Content: Product data indicating percentage by weight of post-consumer and post-industrial recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
  7. LEED Credit MR 5 – Regional Materials: Product data indicating percentage by weight of material extracted, harvested, or recovered and manufactured within 500 miles of Project site. Include statement indicating costs for each product having regional content.
  8. LEED Credit ID <**Insert Credit Number**> – Innovation in Design: <**Insert requirement for innovative design strategy or exemplary performance.**>
- D. Special Procedure Submittals: <**If required, insert compliance documentation for stormwater protection plan in effect.**>
- E. Qualification Submittals: Submit qualification statements for installer.
- F. Closeout Submittals
1. [**Maintenance Contract.**]
  2. Operation and Maintenance Data.
  3. Warranty Documentation.
  4. Record Documentation: Indicate extent and depth of system. Indicate locations of access and maintenance points.

## 1.5 QUALITY ASSURANCE

- A. Qualifications:
1. Installer: Certified by manufacturer of water storage structures.
  2. [**Maintenance Contractor: Certified by manufacturer of filtration components.**]
- B. Manufacturer Quality Assurance Services:
1. Observation: Conduct first [**day**][**two days**][**10 percent**] of water storage structure installation in presence of manufacturer's field representative.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's written requirements.

## 1.7 WARRANTY

- A. Manufacturer Warranty: One-year materials and workmanship warranty.

## 1.8 MAINTENANCE CONTRACT

- A. Provide contract for maintenance of work of this Section.
1. Duration: <**Insert duration**>.

- a. Qualifications: Maintenance shall be performed by firm normally employed in maintenance of stormwater systems, bonded and licensed for services provided, and with five years experience.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. Surface Loading Capacity: AASHTO [H10][H20-44] <other surface loading capacity>.
- B. <Insert other performance criteria>

### **2.2 WATER STORAGE STRUCTURES**

- A. Manufacturer:
  1. CUDO™ Stormwater Products, Inc.
    - a. Phone: 877-876-3345
    - b. Email: [info@CUDOCube.com](mailto:info@CUDOCube.com)
    - c. Web: [www.CUDOCube.com](http://www.CUDOCube.com)
  2. Substitutions [**will not be considered.**][Substitutions will be considered according to [Instructions to Bidders.][Division 01 Section ["Product Requirements"] ["Substitution Procedures"].]
- B. Water Storage Cubes:
  1. Product: CUDO Cubes.
  2. Size: 24 inch cube, assembled from half cubes that nest for efficient shipping.
  3. Material: Polypropylene with 80 percent minimum recycled-material content.
  4. Open Faces of Cubes: Not less than 18 inches diameter.
  5. Liquid Storage Capacity: 7.7 cubic feet (57 gallons).
  6. Color: Indicator cubes shall be blue. Other cubes shall be gray.
- C. Accessories: Locate as shown in Drawings and as required.
  1. Solid Infill Panels. Use where required to enclose structural cube faces.
  2. Grates. Use where required to allow flow through structural faces.
  3. Couplers: Use to join adjacent structural cubes
  4. Pipe Reducers: Solid infill panels modified for pipe penetrations.

### **2.3 TREATMENT COMPONENTS**

- A. Manufacturers:
  1. KriStar Enterprises, Inc.
    - a. Phone: 800-579-8819
    - b. Email: [info@kristar.com](mailto:info@kristar.com)
    - c. Web: [www.kristar.com](http://www.kristar.com)
  2. Substitutions [**will not be considered.**][Substitutions will be considered according to [Instructions to Bidders.][Division 01 Section ["Product Requirements"] ["Substitution Procedures"].]
- B. Pretreatment Components: Provide where shown on Drawings for connection to water storage structure.

1. Inlet: **[Downspout.] [Modular inlet unit.] <Other inlet source.>**
  2. Inlet Bay: Inlet with integral treatment chamber.
  3. Presettlement Chamber: Structural cubes, segregated from major water storage structure by solid infil panels.
  4. Filtration Units: **[Modular gross pollutant filtration units.][In-line filters.][Radial media filters.][Vortex separators.]**
  5. Inspection and cleanout port for pretreatment components.
  6. Sump area.
- C. Filtration Components: Components shall be compatible with water storage structure, fit within its footprint and align with surface improvements.
1. Media filtration:
    - a. Perk Filter Concrete Catch Basin System
    - b. Up-Flo Filter
  2. Hydrodynamic Separators: FloGard Dual-Vortex Hydrodynamic Separator
  3. Inlet filter devices:
    - a. SwaleGard Pre-Filter.
    - b. FloGard+PLUS catch basin insert filter
    - c. FloGard
    - d. FloGard LoPro Trench Drain Filter
    - e. FloGard Downspout Filter
    - f. FloGard Trash and Debris Guard
  4. Tree and planter biofilter chambers: TreePOD Biofilter System.
  5. Fiberglass boxes with filtration units: Perk POD.
  6. Gross Pollutant Trap: Nettek Gross Pollutant Trap
  7. **<Insert other treatment components.>**

## 2.4 ACCESS

- A. Inspection and maintenance access to interior of water storage structures shall be through open faces of structural cubes.
- B. Access Risers:
1. Connect **[to uppermost structural cube of water storage structure with unobstructed access for maintenance.] [where shown in Drawings.]** Size to align with surface improvements.
  2. Material: **[Corrugated polypropylene,] [corrugated HTPE,] [or] [Ribbed PVC].**
- C. Access Covers: **[ASTM A48 Cast-iron] [fiberglass]**, size as shown in Drawings.
1. **[Fiberglass Cover Color: Green.]**
  2. Closure: Bolted and gasket sealed.

## 2.5 MEMBRANES

- A. For **[Detention] [and] [Harvesting]** System[s]: Use waterproof membrane with chemically welded seams:
1. Type: 36 mil polypropylene waterproof membrane.
  2. Hydrostatic Resistance: 360 psi minimum per ASTM D3776.
  3. Tongue Tear Strength: 110 lb machine direction and 130 lb transverse direction minimum per ASTM D751.
  4. Grab Tensile Strength: 28 percent in machine direction and 21 percent in transverse direction minimum per ASTM D751.
  5. Ball Burst Strength: 800 lb minimum per ASTM D3776.

6. Mullen Burst Strength: 990 psi minimum per ASTM D3786.
  7. Water Vapor Transmission: 0.7 g/square meter/day maximum per ASTM E96.
- B. For Retention System: Use geotextile membrane
1. Type: [AASHTO M288, Class 1,][8 oz,][4 oz,] nonwoven.
  2. Grab Tensile Strength: 200 lb machine direction and 200 lb transverse direction minimum per ASTM D4632.
  3. Puncture Strength: 2500 psi minimum per ASTM D4833.
  4. Mullen Burst Strength: 380 psi minimum per ASTM D3786.
  5. Flow Rate: 90 gallon/min/square foot minimum per ASTM D 4491.
- C. Membrane Accessories:
1. Boots: Fabricate for pipe sizes indicated, with minimum lap distance of 12 inches.
  2. Hose Clamps: Stainless steel.

## 2.6 EARTHWORK

- A. Structural Fill:
1. Gravel or Crushed Rock: <Insert requirements>
  2. Sand: <Insert requirements>
  3. **[Fill shall be washed when used in installations that require percolation.]**
- B. Geogrid: Structural plastic grid with live load distribution characteristics.
1. Product: <Insert requirements>
  2. See Division 32 Section ["Geosynthetics for Exterior Improvements."]
- C. Overburden: [Comply with Division 31 and 32 Sections for earthwork and landscaping requirements.] <Insert requirements>

## 2.7 ACCESSORIES

- A. Pipe: See Division 33 Section "Common Work Results for Utilities".
- B. Outlets: <Insert requirements>
- C. Pumps: See [Division 22 Section "Domestic Water Pumps"] [Division 32 Section "Irrigation Pumps"].
- D. Permanent Surface Markers: <Insert requirements>

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that site conditions are acceptable for installation of work of this section. Do not begin until detrimental conditions have been corrected.

### 3.2 PREPARATION

- A. Excavation:

1. Over-excavate **[[six ][eight ] <Other depth> inches] [to depth shown in Drawings.]** Remove soft soils, if encountered, to provide subgrade capable of supporting water storage structure and applied loads.
- B. Do not install work in standing water. Dewater to below base of excavation.
- C. Base Fill:
  1. Install structural fill and compact to 95 percent Standard Proctor equivalent, per ASTM D698.
  2. Base shall be smooth and flat. Slope shall be **[as shown on Drawings but]** not greater than 1:5 rise to run.

### 3.3 INSTALLATION

- A. Membrane: Form continuous enclosure **[as shown in Drawings]**. Comply with membrane manufacturer's instructions.
- B. Water Storage Structure:
  1. Install in configuration shown in Drawings and in accordance with manufacturer's instructions. Connect adjacent structural cubes.
  2. Install indicator cubes where shown in Drawings and as required to identify locations of access points, filtration equipment and other critical features.
- C. Pipe Interfaces:
  1. Provide pipe reducers, if required, at faces of water storage structure.
  2. Boots:
    - a. **[Waterproof Membrane: Weld to waterproof membrane around water storage structure and seal to pipe with hose clamps.]**
    - b. **[Geotextile: Lap 12 inches minimum over geotextile around water storage structure and over pipe. Secure in place.]**
- D. Access Interfaces: Install to meet surface improvements level and flush, unless otherwise shown in Drawings.
  1. Access Risers: Adjust length to meet surface improvements.
  2. **[Cast Iron Access Covers: Install in concrete collars constructed as specified in Divison 03 Sections.]**
  3. **[Fiberglass Access Covers: Secure and seal collars to access risers.]**
- E. **[Pretreatment] [and] [Filtration]** Components: Install according to manufacturer's installation instructions.
- F. Interface with other work: **<Insert requirements or references>**

### 3.4 BACKFILL

- A. Comply with requirements in Division 31 Section **["Excavation and Fill"]<other section title>** unless otherwise specified in this Section.
- B. Compaction, General: **[95 percent] <other percentage>** Standard Proctor equivalent per ASTM D698.
  1. Compact overburden with small tracked equipment and walk-behind equipment.
  2. Do not use ride-on equipment or vehicular travel exposed water storage structure.

- C. Structural Fill:
  - 1. Backfill sides with structural fill in 12-inch maximum lifts. Compact each lift.
  - 2. Continue backfilling and compacting until sides are level with top of water storage structure.
  - 3. Install geogrid according to Division 31 Section ["Soil Stabilization"] <Insert other Section title>.
  - 4. Place structural fill over water storage structure to thickness not less than [12] [depth shown on Drawings] <greater number> compacted inches.
- D. Overburden:
  - 1. Place and compact remainder of overburden. Comply with Division 31 and 32 Sections for earthwork and landscaping requirements.
  - 2. Place overburden to thickness not less than [12] [depth shown on Drawings] <greater number> compacted inches.
- E. Surface Improvements: Install as specified in other Sections.

### 3.5 COMMISSIONING

- A. Maintenance contractor will inspect work of this Section for compliance with requirements and will provide written inspection report noting deficiencies.
- B. Correct deficiencies in work of this Section according to manufacturer's instructions and recommendations in inspection report.
- C. Just before Substantial Completion, clean system and replace or clean filters as required.
- D. Turn system over to Owner, ready for use.

### 3.6 PROTECTION

- A. Vehicular Traffic:
  - 1. Mark extent of water storage structure with flags and caution tape or fencing until Substantial Completion.
  - 2. Do not allow stockpiling of materials or vehicular traffic other than low ground pressure vehicles water over storage structure until surface improvements are in place.
  - 3. Do not allow stockpiling or vehicular traffic in excess of design capacity over stormwater system after surface improvements are complete.
- B. Permanent Surface Markers: <Insert requirements>
- C. Contamination: Protect [inlets,] [permeable paving,] [and] <Insert other components> from stormwater runoff, debris, sediment, and construction pollution for remainder of construction period. [Label inlets to storage system to prevent dumping.]
  - 1. See Division 01 Section "Temporary Facilities and Controls" for construction stormwater protection requirements.

### 3.7 MAINTENANCE

- A. Maintenance contract commences at Substantial Completion.

**END OF SECTION**

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