

## DIVISION 13 - SPECIAL CONSTRUCTION

The following sections describe the special construction to be performed under this contract.

### 13050 - POLYURETHANE FOAM CLOSURES

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The following section describes the polyurethane foam (PUF) closures to be installed in the specified mine features. The work consists of installing a bottom form, installing PUF to specifications, backfilling over the PUF to the specified level, and, where required, installing corrugated steel riser pipes with steel grates and ventilation/drainage pipes.

### 13051 - MATERIALS AND EQUIPMENT

Unless otherwise specified, polyurethane foam (PUF) shall have a minimum installed density of 1.85 pounds per cubic foot (p.c.f.). Machine-applied or poured-in-place PUF shall be equivalent to SWD Urethane Co. "SWD 320," North Carolina Foam Inc. "NCFI-811," or Urethane Contractors Supply and Consulting "SES III 2.0 Pour". Bagged PUF shall be equivalent to Foam Concepts Inc. (800.556.9641, [www.foamconceptsinc.com](http://www.foamconceptsinc.com)) "EFS Equipmentless Foam Sealant." or Mine Seal, LLC (888.732.5783, [www.mine-seal.com](http://www.mine-seal.com)) "PUF-Seal."

PUF characteristics shall conform to the following standards:

<u>PUF CHARACTERISTIC</u>	<u>STANDARD</u>	<u>SPECIFICATION</u>
Density	As specified	ASTM D1622
Closed Cell Content	90%	ASTM D2856
Compressive Strength	25 psi	ASTM D1621
Water Absorption	0.1 to 0.2 lbs./sq. ft.	ASTM D2842
Exothermic Reaction Rate	Low	-
Fire Resistance	High	-

PUF used in mine closures shall not contain chlorinated fluorocarbons (CFC's) or hydrochlorofluorocarbons (HCFC's).

For machine-applied foam, the proportioning unit shall be capable of attaining a minimum temperature of 125°F and shall be a Gusmer Model H-11 or equivalent. For remote project locations, or with the approval of the Project Manager, smaller capacity proportioners will be acceptable. In this event the proportioner shall be the Gusmer FF or equivalent.

Minimum heated hose length from proportioner to gun shall be 80 feet. The hose shall maintain or increase component temperature from the proportioner. Longer heated hose lengths

may be required depending upon the distance from the proportioning unit to the reclamation site. Approval of the Project Manager is required for the use of any length of unheated hose on a PUF closure.

The application gun shall be capable of mixing plural components in the proper ratio at the minimum acceptable output of four pounds per minute. The gun shall be a Gusmer AR mechanically self-cleaning design or equivalent. Application guns constructed by individuals or manufacturers not typically used in the PUF industry may be used if warranted by the PUF supplier or manufacturer.

For poured foam, separate component measuring and mixing containers shall be used. Each component shall be assigned a specific measuring container, each marked with a predetermined volume level corresponding to the required mix ratio. The components shall always be measured in the same quantities, the components added in a separate container, and thoroughly mixed using an appropriate mixing device. In all cases, measuring and mixing of poured PUF shall be done in strict accordance with manufacturer's recommendations, including maintenance of recommended temperatures of the components for mixing and placement. The Contractor shall supply a proper thermometer and use it to check each mixed batch.

The manufacturer shall package bagged foam with pre-measured amounts of each component.

Foam shall be used prior to the end of the manufacturer's designated shelf life.

Corrugated steel pipe used for access to or venting of the mine shall be as specified in Division 2. Unless otherwise indicated, corrugated steel pipe shall consist of 14 or 16 gauge galvanized steel pipe with helical or annular corrugations. The pipe shall be free of rust, gaps in seams, holes in the wall, and deformations that reduce the inside diameter by more than two inches.

### **13052 - MATERIAL SAFETY, HANDLING AND TRANSPORT**

Materials shall be stored in accordance with the manufacturer's recommendations. All safety precautions outlined by the Polyurethane Division of the Society of Plastics Industries, NFPA, OSHA, EPA, and the manufacturer's Material Safety Data Sheets (MSDS) shall be observed. MSDS and technical data sheet shall be on-site and available at all times.

There shall be no welding, smoking, or open flames within 25 feet of PUF application. A minimum 15-pound, class ABC, fire extinguisher shall be on site during foam application. Only workers wearing organic respirator masks and safety glasses or goggles shall apply PUF. State or Federal regulations requiring additional safety equipment shall supersede these requirements.

The Contractor shall follow all applicable State and local regulations for the transport and use of PUF and chemicals required for cleanup. The Contractor shall obtain any required permits

for transportation. In the event of a component leak or spill, the Contractor shall notify the appropriate agencies and jurisdictions.

An oxygen meter shall be used to test air before and during installation of the bottom forms or any other work inside a mine opening. The oxygen meter shall be a National Mine Service (NMS) OX231 oxygen meter or equivalent. The oxygen meter shall continuously monitor oxygen levels and have an audible warning. If the oxygen level falls below 19 percent, all personnel shall withdraw from the working area in the mine until the oxygen content increases to safe levels.

Any remedy for increasing oxygen content of the working area or providing ventilation from the surface shall be determined in consultation with the Project Manager.

### **13055 - EXECUTION**

Debris, dirt, and loose rock in the mine opening shall be cleared wherever PUF will be installed. Historic debris shall be placed neatly to the side of the completed opening. Trash shall be taken to permitted landfill or transfer station. No mine equipment such as skips or carts shall be embedded in PUF.

#### **I. Formwork**

The bottom form and cross members may consist of any commonly available building materials capable of sustaining an initial lift of two to four feet of PUF. Acceptable cross member materials include, but are not limited to, reinforcing steel, 2x4's, dowels, cardboard tubes, and fabric air-inflated plugs. Acceptable bottom form materials include, but are not limited to, plywood, cardboard, paneling, and carpeting. Any combination of the above materials will be acceptable. Alternate bottom forms shall be reviewed with the Project Manager prior to use.

The formwork shall be installed at that level specified in the closure drawings or as directed by the Project Engineer following uncovering by the Contractor of the existing conditions within the mine opening. Unless otherwise indicated, cross members may be placed at an angle no greater than 20 degrees from the horizontal as long as both ends are seated in competent rock. The bottom form shall be set over the cross members.

All bottom forms shall be completed prior to the application of any polyurethane foam. The Contractor shall provide the Project Manager with a list of installed depth to bottom forms for polyurethane foam closures. Any breach in the bottom form caused by rock fall or other reason shall be repaired prior to the arrival of PUF applicators at that site. The Contractor shall be responsible for the integrity of the bottom form and the loss of any polyurethane should it fail.

## II. Ventilation/Drainage Pipe and Corrugated Steel Pipe

Except as otherwise indicated, the ventilation/drainage pipe shall consist of a six-inch diameter Schedule 40 PVC or similar gauge HDPE pipe. The ventilation/drainage pipe shall be cut with a hacksaw across the circumference to create slits no longer than three inches and no less than ¼-inch wide at six-inch increments. Only the portions of the pipe exposed to common fill, granular fill, and lightweight aggregate fill shall be slit.

Four to twelve inches of the ventilation/drainage pipe shall extend above the finish grade, except where otherwise indicated. The six-inch PVC or HDPE pipe shall be encased in an eight-inch steel sleeve in the portion exposed above grade and for two feet below grade, except where otherwise indicated. The annular area shall be filled with concrete or grout.

The ventilation/drainage pipe and corrugated steel pipe for access shall be placed over a portion of the bottom form unobstructed by cross members. In shafts with more than one compartment, the access pipe shall be placed in one of the outside compartments, or as directed by the Project Manager. Both pipes shall be open to the underlying mine void after installation of the foam and shall be supported by a tripod or other load-bearing device such that the load is not placed on the bottom form. Any welding that takes place above the PUF closure shall take place prior to placement of PUF in the mine opening or after installation of the backfill. Under no circumstances shall welding take place over exposed PUF.

The slits made for drainage in the ventilation/drainage pipe shall be covered with visqueen or polyethylene tape during foam application. After application of PUF the visqueen or tape shall be removed exposing the slits. Any foam covering the slits shall be removed to allow an unobstructed flow of water into the pipe.

The corrugated steel access pipes shall have PUF covering the outside of the pipe at least two inches thick in the common fill section of the PUF plug. Polyurethane foam may be draped or splashed against the culvert during foam installation to achieve this coverage.

Steel strap with a width greater than two inches shall be welded to the steel sleeve across the opening of the ventilation/drainage pipe in such a manner as to prevent rocks with a dimension greater than two inches from being dropped down the pipe. As an alternative, steel grating as specified in Division 5 may be cut to fit the opening across the ventilation/drainage pipe and welded in place.

## III. Polyurethane Foam (PUF)

The depth of polyurethane foam installed to plug a shaft or stope opening shall be as specified or indicated in the contract documents or as directed by the Project Engineer.

Polyurethane foam shall be installed in lifts with a maximum rise of 18 inches. Installed PUF lifts shall pass through the tack free stage before applying the next lift. At no time

shall sprayed or poured PUF cut into the rising foam. The PUF shall be applied in such a manner that the entire void is filled, that shadow zones or voids are not created during PUF application, and that temperatures are not raised to unsafe levels. At the discretion of the Project Manager, thermocouples shall be used to monitor exothermic generation. PUF application shall cease if heating or off-ratio foam is observed. The Contractor shall remedy off-ratio foam and demonstrate proper quality PUF to the Project Manager before application resumes.

Bagged or poured-in-place polyurethane foam shall be placed in strict accordance with the manufacturer's recommendations, including the need for thorough mixing of components. If required by the Project Engineer, the manufacturer of bagged or poured-in-place polyurethane foam shall provide a certified representative experienced in the placement of their product for a minimum of one eight-hour day. This representative will direct field operations and instruct the Contractor in the proper mixing, placement, and safety procedures for bagged or poured-in-place PUF.

The surfaces of the void to be filled shall be as free as possible of grease and standing water. PUF shall not be applied to surfaces with running water. Remedial action for such situations shall be reviewed with the Project Manager. Polyurethane foam shall not be applied directly to a debris plug, but shall be applied to a bottom form of known physical and chemical properties. PUF shall not be applied during rain unless the foam is fully protected from interaction with water by a physical barrier.

If off-ratio PUF is observed, the applicator must stop, correct the imbalance, and continue application with the proper ratio PUF. Correction and determination of the foam ratio shall be done on a plastic sheet away from the work area. Any lift of off-ratio PUF comprising over two percent (2%) of the intended PUF column heights shall be removed. An amount of off-ratio PUF less than two percent of the specified volume may remain if allowed to cool and if the outer perimeter of off-ratio PUF is removed. If off-ratio foam comprises more than ten percent (10%) of the specified PUF volume, five percent (5%) of the price bid for the site will be deducted as a penalty.

The Contractor shall be responsible for lost or damaged equipment. Damages or claims arising from PUF overspray shall be the responsibility of the Contractor. Under no circumstances shall foreign material be placed in the PUF material unless specifically specified or authorized by the Project Manager. Non-PUF materials shall be non-toxic and non-hazardous and shall not compromise the strength or water saturation characteristics of the PUF.

Upon reaching the specified grade level for application of PUF, the Contractor shall undertake cleanup of PUF operations.

IV. Field Quality Control

The Project Manager will make periodic checks of the quality of PUF applied. The principal check on quality will be visual. Acceptable PUF shall be tan-white to buff in color with no vesicles and a smooth to coarse orange peel surface. Any one of the following conditions shall cause PUF application to cease and efforts to correct the off-ratio condition begun.

<u>CONDITION</u>	<u>POSSIBLE CAUSE</u>
Dark PUF color	Excess A Component Smooth and Glassy
Friable or Brittle PUF Improper Density	
Light in Color to White Bad Cell Structure Mottled Appearance Blowholes or Pinholes	Excess B Component
Slow rise Poor Cell Structure Frequent Equipment Clogging Slow Curing Poor Physical Properties	Bad Material

At any time during PUF application the Project Manager may call for a density test. The Contractor shall provide and fill a container for this purpose and the sample will be tested for density. The density of the sample shall be within eight percent (8%) of nominal two pounds per cubic foot (2.00 c.f.) density, with a minimum installed density of 1.85 p.c.f. Density tests indicating that PUF installed is not within the minimum specified range shall cause corrective action resulting in PUF within the acceptable nominal range, less deviation due to barometric pressure changes from Standard Temperature and Pressure.

The Contractor shall conduct density tests of PUF at no additional expense to EMNRD. At the discretion of the Project Manager, density tests showing PUF in the acceptable range will be taken in the center of the cavity to which PUF is being applied. A sampling box constructed of sheet aluminum and lined with polyethylene shall be lowered into the cavity to take a representative sample of PUF just above the level of installed polyurethane.

At the option of the Project Manager, up to three one-cubic-foot samples of PUF may be taken from the job site for density analysis at the Contractor's expense. In addition, at the option of the Project Manager, up to three samples of up to 100 cubic inches in volume may be taken for on-site tensile strength testing at the Contractor's expense. PUF shall be provided for the samples at no additional cost to EMNRD.

## V. Backfilling

To protect the PUF from vandalism if the site is to be left unattended, two to six inches of fill shall be uniformly shoveled over the foam as soon as possible after the last layer of PUF has solidified. No sooner than 96 hours after PUF application, the remaining void above the PUF plug shall be backfilled. The first two-foot lift of fill shall be placed by hand, bucket, or chute to lower the velocity of impact against the PUF. With approval of the Project Manager, this fill may be placed by streaming from heavy equipment such as a loader bucket. The depths and types of fill over the PUF shall be as indicated or specified in the contract documents or as directed by the Project Manager. Unless otherwise indicated, the minimum cover shall be 24 inches of common fill.

Unless otherwise specified or directed by the Project Manager, common fill above polyurethane foam closures shall be nearby cohesionless mine waste material or other nearby cohesionless material with no pieces larger than six inches in diameter, free of debris or trash, and containing no materials classified as toxic or hazardous.

Fill above the polyurethane foam closures shall be placed in a manner that will prevent damage to the polyurethane foam plug and riser pipes and will allow these structures to assume the load from the fill gradually and uniformly.

The use of riding vibratory compaction equipment shall be prohibited above polyurethane foam closures and vibrations due to other construction equipment operations shall be kept to a minimum in these areas. With care and for the minimum acceptable period of time, small walk-behind compaction equipment, such as rammer tampers, may be used in these areas.

## VI. Survey Caps

As described in Division 2, a steel pipe with grouted survey cap shall be installed near the ventilation/drainage pipe. Where the PUF/interface is less than five feet below finish grade, the pipe shall be set in a concrete footing, which shall be at least one foot in diameter and extend from the PUF/fill interface to a height of two feet. The upper six inches to one foot of pipe shall extend above grade. Where the PUF/fill interface is more than five feet below the finish grade, a six-foot long pipe shall be used. The lower two feet of pipe shall be set in concrete a minimum of one foot in diameter and the upper six inches to one foot of pipe shall extend above grade.

Alternately, the Contractor may drill and grout the cap in undisturbed, competent rock or concrete at or immediately adjacent to the feature.

## VII. Cleanup

The Contractor shall clean the site of all PUF fragments and overspray. PUF overspray greater than 1/8-inch thick on timbers or historic materials shall be scraped or ablated to 1/8 inch minus to permit ultraviolet degradation of oversprayed polyurethane. Tools and

equipment shall be cleaned in such a manner as to avoid injury to vegetation or wildlife. Handling of chemicals used in cleanup shall comply with all applicable local, State and Federal regulations.

### **13130 - PRE-ENGINEERED STRUCTURES**

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The following section describes the high strength steel mesh to be installed over specified mine features.

### **13137 – HIGH-STRENGTH STEEL MESH**

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#### I. General

The work consists of furnishing, transporting and constructing high-strength steel mesh closures over mine openings in accordance with the contract documents and the manufacturer's standards and requirements. The mesh shall be installed at the locations shown on the plans as directed by the Project Manager or Project Engineer.

Rock anchors shall be installed at the closure location in sufficient numbers to insure that unauthorized visitors cannot circumvent the mesh to gain entrance to the mine. Rock anchor spacing shall not exceed twelve feet between adjacent anchors, unless otherwise directed by the Project Engineer.

#### II. Materials

In order for the Contractor to identify the components easily to minimize installation time, the manufacturer shall properly mark all materials.

##### A. Mesh

The mesh shall be woven construction and shall be diamond shaped. The mesh shall be made with 4-millimeter diameter wire and the ends of each wire formed into a loop and twisted. The loops of the wire mesh shall be fastened together to prevent unraveling of the mesh. The wire shall be alloyed high-strength carbon steel wire with a tensile strength greater than or equal to 1,770 N/mm<sup>2</sup>.

The wire shall be galvanized with a zinc/aluminum coating with a minimum weight of 150g/m<sup>2</sup>. The coating shall be 95% zinc and 5% aluminum.

The size of the mesh opening shall be 103 millimeters by 180 millimeter (+/-2%) and the depth of the mesh shall be 16 millimeters (+/-1 millimeter). The mesh shall have 5.6 meshes per meter across the mesh and 9.7 meshes per meter down the mesh. The mesh opening shall have an inside circular diameter (incircle diameter of mesh) of 80 millimeters.



High tensile strength steel mesh shall be “Tecco” by Geobrugg ([www.geobrugg.com](http://www.geobrugg.com), 505.438.6161) or approved equivalent.

B. Compression Claws

Compression claws shall be 6-millimeter diameter carbon steel bar and hot dipped galvanized to a minimum layer thickness of 85 microns.

C. Spike Plates

The plate shall be made from 10-millimeter thick steel plate and be hot dipped galvanized to a minimum layer thickness of 85 microns. The plate shall be diamond shaped with a width of 190 millimeters and a length of 330 millimeters.

D. Rock and Soil Anchors

The Contractor shall acquire complete installation instructions from the manufacturer for all rock and soil anchors. The Contractor shall be responsible for the proper installation of all rock and soil anchors. If guidance from the manufacturer is different than the specifications given in this manual, the Project Engineer shall be contacted for pre-approval before any actions are taken by the Contractor.

E. Mechanical Rock Anchors

Anchors installed directly into competent rock, as determined by the Project Engineer, shall be 1” diameter R1H Hollow-Core Spin-Lock Rock Bolts by Williams Form Engineering, Inc. or an approved equivalent. The anchor depth into the rock shall be a minimum of 30 inches. The Contractor shall have the option to use this type of anchor at waste pile locations if competent rock is located under a waste pile and/or overburden greater than three feet in depth and the rock anchor is secured at least 14 inches into the rock. Total rock anchor length shall not be less than 36 inches.

F. Grout Bonded Rock and Soil Anchors

Anchors installed in any substratum that is not competent rock shall be grout-bonded anchors with spherical nuts and grade 75 ksi all-threaded bars, by Williams Form Engineering, Inc. or equivalent. Bars shall meet the requirements of ASTM A722 and have a nominal thread diameter of one inch (bar designation #8). Fasteners shall be galvanized in accordance with ASTM A153 to a thickness between 30 and 40 mils. Bars shall be rated for Multiple Corrosion Protection I (MCP I) and shall be epoxy coated with a sleeve over the bar in the free-stressing zone and grout fill inside the sleeve after tensioning to lock in the pre-stress. The embedment depth for grout bonded anchors shall be at least five feet.

The anchor deformation pattern shall comply with ASTM A615. Drill hole and rock anchor installation and grouting procedures shall be as recommended by the manufacturer. All units shall be centered in the drill hole grout with centralizers to assure a grout cover of approximately one inch around the bar.

Epoxy coated bars and fasteners shall be done in accordance with ASTM A775. Prior to installation of each anchor, the Contractor shall repair any scratches and other coating defects on the epoxy-coated bars using an epoxy field patch kit provided by the anchor manufacturer. In addition, the end hardware for epoxy-coated bars, including plates and nuts, shall be field coated with the manufacturer-supplied epoxy. The anchor head shall be galvanized or otherwise treated for corrosion protection according to the recommendations of the anchor manufacturer.

The Contractor shall pump cementitious grout (conforming to ASTM C845, Williams “Wil-X-Cement” grout, or approved equivalent) to completely fill the annular space between the bar and the drill hole wall.

#### G. Miscellaneous Materials

The vendor of the wire mesh system shall supply all miscellaneous materials associated with the system. All miscellaneous material associated with the wire mesh system such as clips, thimbles, etc., shall be hot dipped galvanized.

### III. System Installation

The Contractor shall dress the slope, removing all brush, debris and loose rock in accordance with the contract documents.

The Contractor shall locate the anchors on the slope as shown on the contract drawings. The anchors shall be installed in accordance with the anchor manufacturer’s instructions.

The Contractor shall install the anchors in depressions and low points in order to pull the mesh into them and against the ground, and as indicated on the contract drawings. Alternately, the mesh may be laid on the slope first, followed by anchor installation, depending on site conditions.

After the anchors are installed, set and load tested, the Contractor shall form hollows of four to twelve inches deep at each anchor if placed on waste piles.

The mesh shall be laid on the slope by unrolling down the slope. The rolls can be shortened or lengthened as necessary by removing or adding sections, respectively. The mesh panels shall be overlapped by minimum of one mesh. The overlapped mesh panels shall be fastened with compression claws with two at each mesh. The compression claws are installed with one claw directly above the loop and one directly below the loop.

At obstructions that cannot be moved and will obstruct proper mesh installation, the mesh shall be cut and the mesh pieces bent back and secured in place with aluminum clamps.

The spike plates shall be placed onto the anchors. Using a hydraulic wrench, the nuts shall be tightened and the spike plates and mesh pushed into the hollows in order to tension the mesh between 1,125 and 4,500 pounds (5kN and 20kN). The nuts shall be torqued to an anchor pre-stress force of 1,675 pounds (7.5kN) and a tightening torque of 125 foot-pounds (0.17 kN\*m).

#### IV. Field Installation Supervision

The manufacturer shall include at no extra cost to EMNRD one day of eight hours installation supervision by a qualified field engineer. Travel and living expenses shall be borne by the manufacturer. All costs for the field supervision shall be included in the unit bid price.

### **13140 – TOROID TIRE PLUGS**

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This section describes the toroid tire plug closures to be installed at specified mine features. At each site, the work consists of wedging large, used tires into the mine opening, covering these with fill, placing a tire mat over this fill then placing a geogrid mesh on top of the tire mat and a geotextile cloth on top of the mesh, finished by three feet of backfill material. For photos of this process, please use the following web address: <http://members.shaw.ca/nta/nltribe/>. At some sites, corrugated steel pipes will be placed at the plugs to allow for bat access to the underground mine workings.

#### I. Materials

##### A. Used Tires

For each feature to be safeguarded using toroid tire plugs, an estimated number and size of used tires needed is found on the construction drawings. The Contractor shall be responsible for obtaining and transporting the necessary tires. For transport, the Contractor shall either hire a registered scrap tire hauler or register as a scrap tire hauler per the Recycling and Illegal Dumping Act (NMSA 1978, 74-13-1, et seq.). EMNRD will provide the required used tire disposal permit and associated fees per the Recycling and Illegal Dumping Act.

The tires used to plug the openings shall be variously sized, used or spent large-scale earth moving and construction equipment tires. A supply of used or spent highway truck tires shall form the toroid mat. Tires may be worn, but shall be complete or nearly complete units that will perform the desired engineering functions.

##### B. Geogrid and Geotextile

The geotextile placed on top of the toroid mat shall be a geogrid mesh equivalent to a Tensar BX1400. On top of the geogrid, a geotextile cloth equivalent to ProPex 4512 shall be placed. (One local supplier for these materials is Apex Erosion Control Supply, Inc., PO Box 1063, Kirtland, NM 87417, phone: 505.330.6896.)

Material from other manufacturers may be acceptable, following review by the Project Engineer. Any substitution shall have equal quality of construction, similar materials, and the same performance characteristics as that specified. If the Project Engineer accepts the proposed substitution, the Contractor shall accept the unqualified responsibility for the performance of the substituted item. Changes or modifications of construction caused by the substitution shall be the responsibility of the Contractor and shall be at his sole expense.

## II. Execution

### A. Preparation

Timbers, debris, sloughed rock and soil, and other material as required shall be removed from the mine opening to the point where the opening is defined and adequately shaped for installation of the tire plug. Topsoil (as indicated by the growth of vegetation and as directed by the Project Manager) shall be pulled back and stockpiled for later use.

### B. Tire Plugs

The tire plugs shall provide dynamic, expandable, flexible plugs that expand to fill the mine openings. A variety of tire sizes will be needed as mine openings come in various shapes and dimensions. The arrangement of tire placement may be varied from that indicated on the drawings to fit site conditions and tire availability, as long as the functionality of the plug is not compromised. Where bat access is required at a mine opening, the corrugated steel pipe shall be positioned first and the tire plug fitted around it.

The Contractor shall adapt the use of the recycled tires to the shape and size of the mine opening. As indicated on the drawings, many of the openings can be successfully plugged by arranging the tires in a stack of four to six tires, tied together with galvanized 5/16th inch steel cable. Elsewhere individual tires can be used, placed vertically adjacent to each other. The tires shall be compressed by an excavator, wedged into the hole, and the compressed stack allowed to expand to fill the hole.

As directed by the Project Manager and as indicated on the drawings, polyurethane foam may be used to fill gaps between the tire plug and corrugated steel pipe installed for bat access. Authorized use of polyurethane foam at tire plugs will be paid for at the unit price per cubic yard bid therefor in the Bid Form.

A layer of fill material shall be placed above the completed plug to create a platform. With the throat of the mine opening now stabilized, an area around the opening shall be

cleared to allow room for the mat. Except as otherwise indicated, this cleared area shall be larger than the opening by about half again. As this larger area is cleared, additional topsoil shall be removed and added to the topsoil stockpile for later use.

Experience has shown that a Caterpillar 325 tracked excavator (or equivalent) with thumb is required to handle, compress and place the toroid tire plugs. The Contractor shall provide the equipment; supplies, small tools and personnel necessary to complete the toroid tire plug closures.

#### C. Tire Mat, Mesh and Cloth

The next layer placed is referred to as the tire mat. This mat shall be made up of a number of highway truck tires linked together by joining adjacent tires with a clamped or swaged loop of galvanized 5/16th inch steel cable. The mat shall be sufficiently large to cover the area of the mine opening and a minimum of three feet over stable rock on all sides and as indicated on the drawings.

Immediately over the tire mat, the Contractor shall place the specified geogrid mesh so that it completely covers the tire mat. Directly above the geotextile material the Contractor shall place a layer of geotextile cloth that completely covers the mesh.

#### D. Backfilling, Recontouring and Reseeding

The next layer shall be composed of gravel, broken rock, or nearby or imported acceptable material applied to a depth of at least three feet over the entire mat area. The contour of the final reclamation shall be established with drainage leading surface water away from the safeguarded mine opening and diverting any flow of water which may be directed toward the opening or as indicated on the drawings. The final layer shall be the topsoil that was salvaged earlier. The final step is revegetation as described under Section 02900, Landscaping. A survey cap as specified shall be placed at each toroid tire plug.

#### E. Field Installation Guidance

EMNRD has made arrangements for an experienced professional to provide one to two eight-hour days of installation guidance for toroid tire plugs. A minimum of three weeks in advance of the date that these services will be required, the Contractor shall make a written request to EMNRD for these services, detailing the dates that these services are required.

**13990 - SUBMITTALS**

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Complete data covering polyurethane foam, high-strength steel mesh, rock anchors, geogrid mesh, geotextile cloth and accessories shall be submitted in accordance with the procedure set forth in Section 01340.

In addition, the Contractor shall provide the Project Engineer with a copy of the state registration for the scrap tire hauler.

**END OF DIVISION 13**