

APPENDIX I
Technical Specifications

2010 Report of Waste Discharge, Bishop Mill Project

0877887 BC Ltd. / CMC Metals Ltd.

TECHNICAL SPECIFICATIONS

REPORT OF WASTE DISCHARGE BISHOP MILL GROUP A MINE WASTE MANAGEMENT UNIT *Inyo County, California*

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BISHOP MILL WASTE MANAGEMENT UNIT TECHNICAL SPECIFICATIONS

1.0 DEFINITIONS

1. "Owner" is defined as an authorized representative of 0877887 BC Ltd. (Owner).
2. "Engineer" is defined as a representative appointed and authorized by the Owner. The Engineer shall be a registered Professional Engineer in the State of California, or a designated site representative under his/her supervision during construction.
3. "Quality Assurance Team" is defined as the individuals working under the direction of the Engineer to perform on-site Quality Assurance (QA) tasks for the Owner.
4. "Contractor" is defined as the party that has executed a contract agreement for the specified work with the Owner.
5. "Specifications" is defined as this document of Technical Specifications prepared by SRK Consulting (SRK), for Owner.
6. "Drawings" is defined as the design Drawings entitled *Report of Waste Discharge, Bishop Mill Waste Management Unit*.
7. "Modifications" are defined as changes made to the Specifications or the Drawings that are approved by the Owner and Engineer in writing after the Specifications and the Drawings have been finalized.
8. "On-site Material" is defined as borrow soils obtained from within required facility excavations.
9. "Off-site Material" is defined as material obtained from sources other than on-site.
10. All slopes are described in terms of horizontal distance to vertical distance (i.e., 2H:1V shall be read as 2 horizontal to 1 vertical).
11. "Work" is defined as the entire completed construction, or the various separately identifiable parts thereof, required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor, and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.
12. "Contract Documents" are defined as the Agreement, Addenda (which pertain to the Contract Documents), Contractor's Bid (including documentation accompanying the Bid and any post-bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Bonds, the General Conditions, the Supplementary Conditions, the Technical Specifications, the Drawings, together with all Modifications issued after the execution of the Agreement.

2.0 CONTRACTOR'S RESPONSIBILITIES

2.1 General

The Contractor shall comply with the following:

- Maintain applicable Workman's Compensation Insurance and provide evidence of such to the Owner.
- Be responsible for the safety of his employees and subcontractors. Provide any document(s) as requested to fulfill safety or Owner Policies.
- Become familiar with the relevant regional and site-specific conditions and existing facilities that may have an impact upon the Work.

- Be responsible for making his own measurements and installing his work to fit the conditions encountered.
- Before proceeding with the Work, examine all Drawings and report to the Engineer any apparent discrepancies or interferences. The Engineer shall have the privilege of making minor alterations to the Drawings. All alterations shall be issued under a covering work order signed by the Owner prior to the start of alteration, if the alteration will affect the terms of Contract.
- All materials and workmanship furnished by the Contractor under this Specification shall be guaranteed by the Contractor against failure due to defective materials and improper installation for a period of one (1) year from the date of final acceptance, or as noted otherwise in these Specifications. Upon receipt of written notice of failure of guaranteed workmanship or materials during the guarantee period, the Contractor shall promptly furnish and install new materials and/or furnish the labor necessary to correct the failure at the expense of the Contractor.
- Comply with all federal, state, and local laws and regulations.

2.2 Construction Water

The Contractor shall comply with the following:

- Water for dust control on haul roads, moisture conditioning of borrow material to be placed as fill, and for maintaining in-place fill soils shall be obtained by the Contractor. The Contractor must supply all pumps and tanks necessary to provide an adequate supply of water to fulfill the conditions of the Work. Water may also be available from the Owner following proper notification and arrangements.

2.3 Fugitive Dust Control

The Contractor shall comply with the following:

- During the performance of the Work defined by these Specifications or any operations appurtenant thereto, whether on right-of-way provided by the Owner or elsewhere, the Contractor shall furnish all labor, equipment, materials, and means required to perform proper and efficient measures to eliminate fugitive dust. If the Contractor fails to prevent fugitive dust generation from the Work that results in damages to land, vegetation, or dwellings or which causes a nuisance to persons, the Contractor is solely responsible for damages.

2.4 Surface Water Control and Protection of the Work

The Contractor shall comply with the following:

- Install temporary ditches and/or channels and construct facilities to control surface water resulting from precipitation.
- Provide temporary erosion protection for prepared surfaces or other potential erosion areas, or as directed by the Engineer, until all such portions of the Work have been accepted by the Owner.
- If precipitation or runoff damage occurs prior to acceptance of the Owner, repair the damaged Work in accordance with these Specifications at the Contractor's expense.
- All temporary and final design storm water diversion berms, ditches and/or channels shall be installed prior to site grading. Contractor shall be responsible for removal of temporary storm water diversion controls during final site grading.

2.5 Work Limits

The Contractor shall comply with the following:

- Do not construct any staging areas, temporary facilities, haul roads, or access roads without the approval of the Owner. The Owner will provide access to the site.
- Confine apparatus, equipment, the storage of materials, and the operation of workmen to the limits indicated by the law, ordinances, permits or as directed by the Owner.
- Avoid unreasonably encumbering the premises with materials or equipment.
- Avoid interfering with the Owner's operations.
- Do not present a hazard to the Owner's personnel and equipment or to the public.
- Use existing roads whenever possible.
- Minimize construction of new roads.
- Keep the site neat, tidy, and free of waste materials or rubbish.
- Store and dispense fuel, lubricating oils, and chemicals in such a manner as to prevent or contain spills and prevent said materials from reaching local streams or groundwater according to applicable regulatory requirements.
- Dispose of waste in accordance with State and Local regulations.
- Keep Material Safety Data Sheets (MSDS) on file at the site and provide copies of such sheets to the Owner for all hazardous materials used on or stored at the site.
- Avoid damage to monitoring wells, piezometers, or any other instrumentation used at the site.
- Notify Owner if existing facilities, monitoring wells, piezometers or instrumentation is in conflict with the Work prior to construction.

2.6 Traffic Control/Road Use

The Contractor shall comply with the following:

- Any public or private roads that become damaged by the Contractor shall be repaired at the Contractor's expense.

2.7 Safety

The work shall conform to applicable, Federal, State, county, and local laws and regulations and Owner safety policies including, but not limited to, the following:

- Mine Safety and Health Administration – Code of Federal Regulations – Title 30 (Mineral Resources); and
- Occupational Safety and Health Administration (OSHA), General Industry and Health Standards – OSHA 2206, and OSHA Safety and Health Regulations for Construction - 29 CFR 1926.

2.8 Setting Out and Survey

The Owner shall provide appropriate survey control points to set out and control the Work. The Contractor shall be responsible for providing a qualified land surveyor, registered in the State of California, to set out the Work, ensure location accuracy and dimensional correctness, and perform excavation/fill measurements. The Contractor shall provide surveying as necessary to accurately maintain slopes and grades for control of the Work. The Contractor shall notify the

Owner and Engineer of any discrepancies discovered in the control surveying, layout, or design presented on the construction Drawings prior to initiating the Work.

The Contractor shall be responsible for accurately surveying the locations and elevations, and where applicable, the type, thickness, and geometry of any and all berms, channels, ditches, breaks in fill or cut slopes, general grading, change in fill, and any other aspect of the Work for which the design quantity is measured and paid by volume as defined in the Schedule of Quantities.

The Contractor shall provide an accurate and detailed as-built survey following completion of the Work. The as-built survey shall depict the geometry of any and all berms, channels, ditches, breaks in fill or cut slopes, and general site grading at a scale of not more than 1 inch to 100 feet, and a contour interval of not more than 2 feet. The as-built survey shall be submitted within **two (2) weeks** of project acceptance by submitting to the Engineer one (1) reproducible copy and one digital copy in AutoCad or other compatible format.

3.0 MEASUREMENT AND PAYMENT

Estimated construction quantities and units of measurement are provided in the SCHEDULE OF QUANTITIES. The Contractor is to provide unit rates and totals for each line item. The specified quantities denote the final, in-place number of units to be paid for under the terms of the contract. They are based upon the original design data available prior to advertising the project. Original design data include the available survey information, design assumptions, calculations, Drawings, and the presentation of the Contract. Changes in the number of units SHOWN in the SCHEDULE OF QUANTITIES may be authorized under any of the following conditions:

1. As a result of changes in the work authorized by the Owner.
2. As a result of the Owner determining that errors exist in the original design data used to determine designed quantities that cause a pay item to change by 15 percent or more.
3. As a result of the Contractor submitting to the Owner a written request showing evidence of errors in the original design data used to determine design quantities that cause a pay item total to change by 15 percent or more. The evidence must be verifiable and consist of calculations, Drawings, or other data that show how the design quantity is believed to be in error.

Facility locations, grades, and elevations are limited to the accuracy of the available topography. Where discrepancies are found to exist that might affect construction as depicted herein, the Owner or the Engineer shall be consulted to modify construction as necessary.

3.1 Mobilization, Running Costs and Demobilization

Mobilization, demobilization and running costs (including but not limited to construction support, construction surveying, final as-built surveying, maintenance and testing required for performance of the workscope, and clean-up) will be paid on a Lump Sum Basis for the mobilization/running costs/demobilization items with up to 50 percent of the items paid under the first monthly pay estimate, and up to 90 percent payable at Notice of Substantial Completion.

3.2 General Soil Fill

The unit of measurement for general soil fill placement is the cubic yard (yd³) of in-place fill material based on survey prior to and after placement. The rate for embankment fill must include excavation, loading, placement, removal of oversize or deleterious material, and compaction as specified.

3.3 Regrading and Sub-Grade Preparation

The unit of measurement for cut-to-fill regrading and sub-grade preparation is either the net cubic yard (yd³) of in-place fill material based on survey prior to and after placement, or the surface area in square feet (ft²) of the surface requiring preparation. The rate for cut-to-fill must include loading and placement as specified.

3.4 Excavation

The unit of measurement for excavation is the cubic yard (yd³), based on the dimensions, elevations and grades provided on the Drawings, and survey prior to and after excavation. The rate for excavation must include excavation and spoil management as specified.

3.5 Geotextile and Geomembrane

The unit of measurement for geotextile and geomembrane is surface area in square feet (ft²). The rate for both must include purchase, shipping, handling, placement/installation according to manufacturer's specifications, and the contractor's responsibilities with respect to testing per the specifications and construction quality assurance plan.

4.0 EXISTING FACILITIES

Existing facilities within the Work area include, but are not limited to, the following:

- Overhead and buried power lines, power poles, and guy wires;
- Chain-link, barbed-wire, and ranch fencing;
- Concrete Ore Patio;
- Mill building and several ancillary facilities;
- Access roads to and around the site.

5.0 TECHNICAL SPECIFICATIONS

5.1 Temporary Excavations

Excavations in surficial soils for drainage channels can likely be made with conventional earth-moving equipment, such as backhoes. Should any excavation exceed 4 feet below ground surface (bgs), OSHA regulations may require shoring or other stabilization. Appropriate regulations should be reviewed and considered during planning.

5.2 Allowable Slopes

Any permanent open slopes required for the project shall not exceed 2.5H:1V (horizontal to vertical) unless otherwise specified by the design drawings. Temporary cut slopes in native granular materials may be as steep as 1.5H:1V, but such steeper slopes should be inspected by a qualified engineer to verify adequate stability.

5.3 Erosion Control

The faces of cut and fill slopes shall be prepared and maintained to control against erosion. In most cases, the granular nature of the soil materials should provide adequate resistance to erosion.

5.4 Site Drainage and Moisture Protection

Positive site drainage shall be provided during construction and maintained thereafter. Free drainage shall be afforded for storm run-off in the vicinity of all construction components. In no case shall long-term ponding of water be allowed near footings or slabs as this condition could cause unanticipated foundation settlement.

5.5 Construction Considerations and Quality Assurance

All excavations shall be inspected by a qualified geotechnical engineer to verify the competency of bearing soils and adequacy of foundation preparation. Fill material's base shall be tested to determine their suitability for use. Quality assurance observations and testing shall be provided by the Owner and shall be performed during all phases of construction. It is the Contractor's responsibility to ensure that the Engineer is aware of the construction schedule and that all elements of the design are inspected prior to covering.

5.6 Subgrade Preparation

Upon completion of regrading cut-to-fill activities, the upper 12 inches of exposed native soil within all areas to receive flexible membrane liner shall be scarified, moisture conditioned and compacted to at least 90 percent of maximum dry density at ± 2 percent of optimum moisture content as determined by ASTM D1557.

The compacted density of all existing embankments and pond slopes must be verified to be within specifications prior to their acceptance. Verification is required to a minimum depth of 12 inches for all existing cut slopes and from existing ground surface down to native soil for all existing pond embankments. To be accepted, compaction must be shown by testing to be at least 90 percent of maximum dry density (as determined by ASTM D1557).

5.7 General Soil Fill

General soil fill shall be used in embankment construction for new waste management unit (WMU) construction. Material used as general soil fill shall be entirely derived from on-site or other approved borrow sources. The suitability of all fill materials intended for use shall be subject to approval by the Engineer. General soil fill shall be free of brush, roots, sod, or other deleterious or unsuitable materials. The Contractor shall provide all necessary labor and equipment to remove such materials from borrow and fill areas.

Prior to placement in new WMU construction, the subgrade preparation specifications of **Section 5.6** must be satisfied. General soil fill shall be placed in loose lifts not exceeding 8 inches in thickness. Following placement of the geomembrane-geotextile liner component of the final cover, general fill material shall be moisture-conditioned, placed in loose lifts not exceeding 12 inches in thickness, and compacted to at least 90 percent of maximum dry density at ± 2 percent of optimum moisture content as determined by ASTM D1557.

General fill forming the final surface to be lined shall be smooth-rolled prior to liner placement. The maximum nominal particle size within 6 inches of the liner shall be ½ inch. Particles or other deleterious material protruding above the finished surface more than ½ inch shall be removed and the hole filled with sand. The final surface to be lined shall be subject to approval of the CQA technician and the Engineer.

5.8 Flexible Membrane Liner

The flexible membrane liner (FML) shall consist of 60 mil high-density polyethylene (HDPE) Agru Super GripNet® (or equivalent) overlain by a single layer of 80 mil smooth HDPE. The FML shall be manufactured, installed and inspected in accordance with the manufacturer's recommendations and these specifications.

5.8.1 General

5.8.1.1 Performance Requirements

- A. The Contractor shall furnish and install the FML and all miscellaneous materials incidental to the liner system installation in accordance with these Specifications and with the Drawings.
- B. The alignment, lengths, and areas for FML placement are shown on the Drawings. Exact locations and lengths may be varied to suit conditions encountered in the field only as approved by the Engineer.
- C. The Contractor will furnish sufficient material to provide the finished FML's shown on the Drawings; including material for all seams, laps, anchors, and pipe boots. The Contractor shall balance the actual project FML requirements, as determined from the Contractor's quantity take-offs, against those shown on the Drawings.

5.8.1.2 Submittals

- A. This section describes the material required to be submitted by the resin supplier, FML manufacturer, and the Contractor. Some items are required to be submitted with the bid documents, other items are required to be submitted after contract award prior to FML installation. The after contract award submittals must be received by the Engineer a minimum of fourteen (14) days prior to commencing with FML installation.
- B. The submittals detailed below shall be in accordance with Section 01300.
- C. Resin Supplier for HDPE:
 - 1. Shall submit the following with bid documents:
 - a. The resin trade name.
 - b. The resin identification number.
 - c. The range in specific gravity as per ASTM D 792, Method A.
 - d. The range in melt index as per ASTM D 1238.

- e. The range in carbon black content, if applicable, as per ASTM D 1603 or D 4218.
 - f. Copy of a typical quality control certificate for the resin to be supplied for this project.
 - g. A listing of individual tests performed, and their frequency, during production of the specified resin.
2. After contract award:
 - a. The submittals included with the bid documents will be subject to approval by the Engineer for inclusion into the Contract.
 3. During supply for manufacture, shall:
 - a. Certify each batch of resin for the following properties:
 1. Specific Gravity - ASTM D 792, Method A
 2. Melt Index - ASTM D 1238
 3. Carbon Black Content - ASTM D 1603 or D 4218
- D. FML Manufacturer:
1. Shall submit the following with bid documents:
 - a. Information on factory size, equipment, personnel, number of shifts per day, and capacity per shift.
 - b. List of material properties (minimum roll) as specified in the Table in Section 2.02 below.
 - c. Quality control program and manual which must include the specific testing proposed to be performed and frequency which the tests will be performed.
 - d. Details of the laboratory that will perform the quality control testing during manufacture, including the name and telephone number of the contact that can discuss the project.
 - e. List documenting a minimum of ten (10) completed facilities totaling a minimum of 5,000,000 square feet of the specified FML. Each entry in the list shall contain as a minimum the name and purpose of the facility, the name of the owner of the facility, the location of the facility, date of installation, name of the Contractor, the type(s), thickness and total(s) square footage of the FML installed at the facility, and the name of the designer.
 2. Shall submit the following after contract award:
 - a. Copies of all quality control certificates issued by the Resin Supplier. There shall be a quality control certificate for each batch, or rail car, of resin used to manufacture FML for this project.
 - b. Statement of production date or dates of the resin.

- c. Statement of the production date of each roll of FML supplied to this project.
 - d. Copy of the quality control certificates in conformance with Section 2.02 of these Specifications.
- E. Contractor:
- 1. Shall submit with bid documents:
 - a. Resumes of the Installation Supervisor and the Master Seamer that will work on this project.
 - b. Installation schedule.
 - c. Contractor's quality control manual and documentation.
 - d. Information on equipment and personnel.
 - e. Samples of field welds of the same type of FML specified for this project from each type of weld proposed to be seamed at this project.
 - f. A list of at least ten (10) completed facilities, totaling a minimum of 5,000,000 square feet for which the Contractor has installed the same type(s) of FML specified for this project. For each installation listed the following information shall be provided as a minimum: name and purpose of the facility, the location of the facility, the date of the installation, the name of the owner, the name of the FML manufacturer, the type, thickness and total surface area of FML installed, type of seaming, patching and CQC (Contractor Quality Control) testing used during the installation.
 - 2. Shall submit after contract award:
 - a. Deployment plan showing the panel layout and the location of field seams. Once approved, this deployment plan will be used for panel placement in the field. Any deviations from the approved deployment plan must be approved in writing by the Engineer prior to implementation.
 - b. Equipment list stating quantity, types and which pieces of equipment are proposed to come in contact with the FML.
 - c. Certification that any extrudate used on this project is in conformance with these Specifications.
 - d. Resumes of installation welders, superintendents, and foremen that will work on this project.
 - 3. Shall submit during installation:
 - a. Quality control documentation prior to deployment of the FML as outlined in Section 2.02 and Part 3 of these Specifications.
 - b. A certificate of acceptance of the soil subgrade, as outlined in Section 3.01, prior to deployment of the FML.

4. Shall submit after completion of installation:
 - a. Certification that the FML was installed in accordance with the Project Specifications with a listing of changes and Engineer's written approval of such, where applicable.
 - b. Manufacturer's materials warranty and the installation Subcontractor's installation warranty.
 - c. Drawing depicting the locations of panels, seams, patches, and destructive sample locations, including numbering associated with said locations.

5.8.1.3 Qualifications

A. Resin Supplier:

1. The resin supplier shall be proven, through the FML manufacturer, to provide the production capacity required for the project size and scheduling requirements while providing first-rate quality material with consistent properties.

B. Manufacturer:

The manufacturer shall:

1. Have a minimum of five (5) years continuous experience in the manufacture of the specified FML rolls.
2. Have experience totaling at least 10,000,000 square feet of manufactured FML of the same type as the specified material.
3. Demonstrate experience in producing first-rate quality material with consistent properties for the quantities, and within the schedule, required for this project.
4. Demonstrate adequate quality control facilities and procedures. The quality control facilities and procedures will at all times be subject to approval of the Engineer.

C. Contractor:

The Contractor:

1. Must specialize, or have a specialty branch, in the installation of FML.
2. Must be subject to approval by the FML manufacturer.
3. Shall be a licensed contractor in Nevada, authorized to perform the Work contained in this Specification or demonstrate that the Work contained in this Specification is exempt from Nevada Contractor's regulations.
4. Provide an installation supervisor that has installed or supervised the installation and seaming of at least 5,000,000 square feet of the specified FML. The installation supervisor shall have experience in the installation of FML's with pipe boots.

5. Shall provide a master seamer who has seamed a minimum of 5,000,000 square feet of the specified FML using the same type of seaming equipment and techniques approved for the project.

5.8.1.4 Delivery, Storage, and Handling

A. Transportation:

The FML shall be packaged and shipped in such a manner that the material is not damaged or exposed to damaging substances. Transportation shall be the responsibility of the Contractor unless agreed to by the manufacturer and the Owner, in writing, prior to the initiation of shipment of FML to the project site.

B. Off-Loading:

Off-loading of the FML is the responsibility of the Contractor. No off-loading of FML shall be performed unless the Owner's representative is present. Any damage to the rolls during off-loading shall be documented by the Owner's representative and the Contractor. All damaged rolls must be stored separate from the undamaged rolls. The rolls shall be unrolled to determine the extent of the damage. The use of the roll or portions of the damaged roll shall be only at the approval of the Engineer. The cost of evaluating, replacing or repairing rolls damaged during off-loading shall be the sole responsibility of the Contractor.

C. Storage:

1. The FML shall be stored such that it is protected from UV rays, puncture, dirt, grease, gasoline, diesel fuel, water, moisture, mud, mechanical abrasion, excessive heat, and other causes of damage to the FML material.
2. The rolls shall be stored on a prepared surface. Storage on wooden pallets or other surfaces that may damage the FML material shall not be permitted. The rolls shall not be stacked more than two high and shall be stacked in such a manner that the roll number of each roll is easily visible.
3. Rolls without the proper documentation shall be stored separately until all the required documentation is received and approval given for deployment by the Engineer.

5.8.1.5 Warranty

All workmanship furnished by the Contractor under this Specification shall be guaranteed by the Contractor against failure due to improper installation for a period of not less than five (5) years. All permanent HDPE materials furnished by the Contractor under this Specification shall be guaranteed by the Contractor and the FML manufacturer for a period of not less than twenty (20) years.

Upon written notice that the material fails to meet the original intent of the design, or of failure of guaranteed materials or workmanship during the guarantee period the Contractor shall promptly furnish and install new materials and/or furnish the workmanship necessary to correct the failure at the expense of the Contractor. The

Installation Subcontractor shall bear all costs for labor and materials associated with repair of guaranteed work.

5.8.2 Products

5.8.2.1 Materials

- A. Geomembrane material testing and documentation shall be in accordance with Geotechnical Research Institute document titled *GRI Test Method GM13, Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes*, incorporated herein by reference. Documentation of material compliance with this specification shall be supplied by the Contractor prior to FML installation.

5.8.3 Execution

5.8.3.1 Subgrade Acceptance

- A. The Installation Subcontractor is responsible for accepting the condition of the subgrade for FML placement, which he shall certify in writing to the Owner.
- B. The Installation Subcontractor may, at the Subcontractor's option, accept the subgrade on an incremental basis.
- C. It is the Installation Subcontractor's responsibility to inform the Owner and the Engineer of any change, due to natural or other causes, to an area of subgrade that has been accepted that may require repair work.

5.8.3.2 Supervision

- A. Installation shall be performed under the constant supervision of the approved installation supervisor. The installation supervisor shall be in responsible charge of the project and shall be on-site full time during any activity of the Installation Contractor including, but not limited to, deployment, seaming, patching, testing, and repair work.
- B. Seaming shall be performed under the constant presence of the approved master seamer. The master seamer shall be on-site during all activity of the Installation Subcontractor requiring seaming including, but not limited to, seaming, patching and repairing.

5.8.3.3 Deployment

- A. Prior to the deployment of a FML roll or panel the following documentation must be reviewed and approved:
 - 1. The visible roll or panel number on the roll or panel prior to unrolling or unfolding.
 - 2. Liner certification sheet with all the tests required in Section 2.02 of these Specifications.

3. Production Log, as specified in Section 2.02 of these Specifications, which includes that particular roll or panel number.
 4. The resin certificate, as specified in Section 2.02 of these Specifications, for the resin that was used to manufacture that particular roll of FML.
- B. No roll of liner will be deployed without the review and acceptance by the Engineer of the required documentation. The Installation Subcontractor shall be solely responsible for expenses incurred for replacing rolls without the required documentation, replacing rolls that are rejected upon review of the required documentation, delays in deployment while waiting for the required documentation, and expenses incurred due to excessive amounts of time spent by the Owner's representative reviewing incomplete documentation.
- C. Handling of FML During Deployment:
1. The Installation Subcontractor shall use equipment that will not damage the FML during moving and deployment.
 2. The Installation Subcontractor shall not use equipment or methods that damage the subgrade during deployment.
 3. The Engineer will be the final authority regarding damage to the FML or to the subgrade. Items that will be considered as damage to the FML will include, but not be limited to, abrasions, tears, punctures, gas, oil or fuel spills, and creases. Items that will be considered as damage to the subgrade will include, but not be limited to, ruts, pumping, segregation, loose rocks or clods on the surface, gas, oil or fuel spills, or any abrupt projection that may damage the FML. Construction methods that crease the liner will not be permitted.
 4. Dragging the FML across the ground will not be permitted.
 5. Methods that are found to consistently damage the liner or the subgrade, as determined by the Owner and Engineer, will be terminated immediately upon written notice to the Installation Subcontractor.
 6. Damage to the FML or to the subgrade, during handling and deployment of the FML shall be repaired at the sole expense of the Installation Subcontractor.
- D. Deployment Pattern:
1. The deployment pattern used shall be according to the deployment plan submitted as required by the Owner. Any deviation from the approved deployment pattern must be approved, in writing, by the Engineer prior to implementation.
 2. The individual panels shall be numbered in a logical sequence and in accordance with the approved deployment plan.
 3. The deployment pattern shall be such that seams are oriented parallel to any slopes. No horizontal seams shall be placed along a slope. Overlap seams shall be placed in a downhill direction.

4. No base or T-seams shall be placed within 5 feet from the toe of the slope.
 5. To the extent possible, the number of field seams shall be minimized.
- E. Tension and Excess Material:
1. The FML shall be installed in a relaxed condition and shall be free of tension or stress on completion of the installation.
 2. Stretching of the liner to fit will not be allowed.
 3. The installation shall contain slack material sufficient to allow for shrink and wrinkles as per the FML manufacturer's recommendations. Individual wrinkles shall take the form of undulations of the FML material and shall not be enough to allow the material to fold back over itself. Corrective measures will depend upon the cause and severity and will be determined by the Owner.
- F. Daily Deployment:
1. No more FML shall be deployed than can be seamed during that day's shift.
 2. FML that is deployed and not welded during that day will be inspected prior to seaming for damage and moisture. If it is determined that the FML has been damaged, it shall be repaired or removed. If it is determined that the FML has become wet or moist it shall be dried prior to seaming to the satisfaction of the Engineer.
- G. Weather Conditions:
1. No FML shall be deployed during periods of precipitation, high winds, in the presence of excessive moisture, or in areas of excessive moisture in the subgrade.
 2. No FML shall be deployed while the ambient air temperature is below 40°F or over frozen ground until the test weld procedures have verified that seaming can be performed according to these Specifications and approval has been received from the Engineer.
- H. Ballast Against Wind Uplift:
1. Adequate loading shall be placed on the FML to prevent uplift due to winds. Loading may be temporarily achieved through the use of sand bags filled with clean sand and securely tied. The bags shall not be tied with any type of material that will potentially damage the FML. The removal of spilled sand bag contents will be the responsibility of the Installation Subcontractor.
 2. Permanent liner ballast will be supplied through the installation of 8-inch-diameter sand-filled ballast tubes as shown on the drawings. All temporary sand bag ballast will be removed and properly managed following the installation of permanent ballast.
 3. Loose piles of material will not be allowed for use as ballast.
 4. Sand bags shall not be thrown on top of or allowed to slide down slopes on top of the FML.

5.8.3.4 General Workmanship

- A. The Installation Subcontractor shall perform all installation Work to conform to the best recognized practice to achieve a neat and functional installation.
- B. The Installation Subcontractor shall exercise proper precaution to verify all measurements before laying out the work. He will be held responsible for any errors that otherwise might have been avoided. He shall carry on the Work systematically and so manage it at all times as to secure substantial progress.
- C. The Installation Subcontractor shall at all times work in such a manner as to not damage the FML.
- D. No equipment will be allowed upon the FML that has not been previously approved. Additional equipment shall only be placed upon the FML with the prior written approval of the Engineer.
- E. Splash pads shall be placed beneath any type of equipment that may leak or splash gasoline, diesel fuel, oil or grease upon the FML. The splash pad shall be large enough to contain any splash or leak. Prior to placing the splash pad the FML shall be swept clean of any material that may puncture or abrade the FML.
- F. Rub sheets shall be placed beneath any piece of equipment that comes in contact with the FML. The rub sheet shall be large enough to fully protect the FML. Prior to placing the rub sheet, the FML shall be swept clean of any material that may puncture or abrade the FML.
- G. All hoses or cords that are used upon the liner shall be handled such that they will not damage the FML. Hoses and cords shall not be dragged across material that may abrade the FML.
- H. If tired equipment is approved for use upon the FML, the tired equipment shall be moved with extreme care. The tired equipment shall be lifted over berms and wrinkles in the FML.
- I. There shall be no smoking on the FML.
- J. There shall be no hard objects allowed to come in contact with the FML without the use of a rub sheet.
- K. The liner shall be swept clean in high traffic areas. These include, but are not limited to, areas that are being seamed, areas that are being tested, and areas that are being repaired.

5.8.3.5 Survey Control

- A. It shall be the responsibility of the Contractor and Installation Subcontractor to secure proper horizontal and vertical control such that the locations of the FML material conform to the dimensions shown on the Drawings.
- B. The dimensions shown on the Drawings shall hold precedence over scaled measurements.

- C. If necessary dimensions are not shown on the Drawings, no work affected thereby shall be performed until the required dimensions have been obtained from the Owner.
- D. The Owner will provide surveying control (three points) for the project in the form of monuments, bench marks and reference points. The Installation Subcontractor shall be responsible for the proper preservation of the above mentioned points with respect to the Subcontractor's activities. If, in the opinion of the Owner, any surveying control has been carelessly or willfully disturbed or destroyed by the Installation Subcontractor or the Contractor's employees, the cost of replacing such control points shall be incurred by the Contractor.

5.8.3.6 Seaming

A. Welding and Related Equipment:

Only welding equipment that is on the equipment list and has been approved shall be used to seam the FML. As a minimum the welding and related equipment shall meet the following requirements:

1. The welding equipment shall be equipped with a means of measuring and displaying the temperature within the apparatus and at the nozzle for extrusion welders and hot air welders, and at the wedge(s) for fusion welders.
2. The power source shall be capable of providing a constant voltage under varying line loads.

B. Start Up and Test Seams:

1. Each seamer shall perform trial seams at the beginning of each day prior to beginning seaming of permanent materials. No seamer shall perform production seaming until the start up seams have been performed, tested and approval given by the Engineer. All test seams shall be marked with the sample number, the date welded, the machine and welder I.D. and the seam number.
2. Test seams shall be performed a minimum of once during the middle of the shift. More frequent test seams shall be performed at times as is deemed necessary, such as during cold weather or if the seams are observed to be of questionable quality. The criteria for a passing test seam will be the same as the criteria for a passing start-up seam.
3. All start-up and test seams shall be performed in a designated area. The start-up and test seams shall be performed in contact with the same subgrade conditions and under the same environmental conditions that production seaming will be performed under. Performing start-up or test seams upon rub sheets will not be permitted unless approved, and rub sheets are used during all production seaming.

4. Each start-up or test seam shall consist of seaming two (2) pieces of FML together of the same type and thickness that the seamer will be seaming during production. The start-up or test seam shall be a minimum of 24 inches long and 12 inches wide with the seam centered lengthwise.
5. Four (4) 1-inch-wide strips shall be cut, two (2) each from each end of the trial seam. Two (2) of the strips shall be tested in shear and two (2) shall be tested in peel in accordance with ASTM D 4437.
6. A tensiometer with a calibrated load measuring device and means to apply the required loading rate shall be used to test the start up and test seams at the project site, where appropriate. The width of each of the strips shall be measured to within one-hundredth (0.01) of an inch and recorded. The temperature at the time of the test shall be recorded.
7. Where chemical welds are used, a cure time between seven (7) and thirty (30) days is required. This time may be accelerated using oven aging in accordance with ASTM standards
8. The results of the start-up and test seams shall include the load at failure, the load at failure in pounds per inch (ppi) determined by dividing the total load at failure by the measured width of the strip, and type of failure in terms of Film Tearing Bond (FTB) or Non-Film Tearing Bond (Non-FTB) as shown in Appendix N of EPA/600/2-88/052.
9. A start-up or test seam will be considered as passing only if the load at failure meets or exceeds the minimum values specified in this section for all samples in peel and shear, and all samples achieve a FTB at failure.
10. In the event that a particular seamer fails a start-up or test seam, the entire procedure shall be repeated. If the particular seamer fails the start-up or test seam the second time, that particular seamer shall not be used until the cause of failure has been identified, corrected, and a passing start-up or test seam achieved.

C. Overlap:

1. Panels shall overlap a minimum of 5 inches unless otherwise approved in writing. Greater overlap for production (and the same overlap for test seams) may be specified on the drawings. The overlap shall be measured and marked on the underlying panel.
2. If trimming of the FML is required to maintain the overlap, the underlying panel shall be trimmed and remarked. Trimming of the overlying panel will not be allowed.

D. Marking of Seams and Welds:

The seamer or welder shall write upon the FML, in permanent marker, the following information at the beginning and end of each seam:

1. Seam or weld number.
2. Seamer's or Welder's name.

3. Temperature of the wedge(s) for fusion welders, or temperatures of the inside of the welder and at the tip for extrusion welders associated with HDPE liner installation.
4. The date.
5. The time.

E. Welding Procedures for HDPE:

Welding shall only be performed when the FML is clean and free of dust, dirt, grease, oil, other foreign substances, and dry. Solvents or adhesives shall not be used unless the specific product is approved, in writing, by the Engineer.

1. Extrusion Welding:

- a. Surface of FML to be extrusion welded shall be ground.
- b. Grind surface no more than thirty (30) minutes prior to seaming.
- c. Grind such that surface oxidation is removed, no more than 5 percent of the liner thickness is removed, and the ground area shall extend no more than 1/4 inch beyond the edge of the extruded bead.
- d. Extruded bead shall be placed over excess grinder marks.
- e. Grinder marks shall be perpendicular to the seam.
- f. The edge of the overlying panel shall be beveled.
- g. The two pieces to be seamed together shall be tack bonded together such that they will be held in place during seaming, there is no damage to the FML, seaming operations can be effectively performed, and construction quality control CQC testing can be effectively performed.
- h. Extrudate shall be extruded from the welder to expose fresh extrudate prior to welding.

2. Restarting Procedures:

- a. Overlap existing weld a minimum of 2 inches.
- b. Grind existing weld prior to initiating welding.
- c. Resume welding where the grinding starts.
- d. Resuming seaming operations on any weld that is over five (5) minutes old shall be considered a restart.

3. Reseaming Procedures:

- a. Grind existing seam prior to rewelding.
- b. Beveling shall be performed during grinding.
- c. No seam shall be re-seamed without grinding prior to initiating reseaming operations.

F. T-Welds:

No T- welds will be allowed and all intersections of liner that form a T or + shall be capped with no exceptions.

G. Fish-Mouths and Wrinkles:

Fish-mouths and excessive wrinkles shall be cut and overlapped a minimum of 5 inches and seamed. Where the 5-inch overlap cannot be achieved, a cap shall be seamed in-place extending a minimum of 6 inches beyond the cut.

5.8.3.7 Construction Quality Assurance and Quality Control Testing

A. Construction Quality Control testing shall consist of:

1. The Contractor's observation of the unrolled sheet and marking for repair or rejection if necessary.
2. The Contractor's destructive sample testing.
3. The Contractor's non-destructive testing.

B. Construction Quality Assurance shall consist of the following activities by the Quality Assurance Team:

1. Review of required documentation.
2. Approval of rolls of FML for deployment.
3. Review of compliance testing as required.
4. Observation of the unrolled panels for holes, blisters, undispersed raw materials, and marking for repair or rejection.
5. Observation of CQC testing.
6. Location of destructive sample locations.
7. Observation of random destructive testing.
8. General observation of materials and workmanship.

C. Engineer has final authority for the CQA of the project.

D. Compliance Testing:

1. At the option of the Engineer, compliance testing may be performed at any time prior to, during or after the installation.
2. The cost of the compliance testing shall be negotiated between the Owner and Contractor.
3. The tests performed during compliance testing shall be determined by the Engineer.
4. Compliance testing shall not include any tests that are not listed in these Specifications as a basis for evaluating compliance of the FML to these Specifications.
5. Sampling for Compliance Testing:

- a. Samples shall be obtained by the Engineer.
 - b. The sample for a roll shall be 3 feet long and cut across the entire width of the roll.
 - c. Taken as close to the middle of the roll as practical but shall, as a minimum, be sampled no closer than 3 feet to the end of a roll.
6. The sample shall be labeled by the Engineer, in permanent marker, with the following information:
- a. Roll number.
 - b. Machine direction.
 - c. Date sampled.
 - d. Name of individual that sampled the material.
- E. Non-Destructive Testing for LDPE:
1. Contractor shall perform non-destructive testing on 100 percent of all seams for this project.
 2. Non-destructive testing for HDPE shall consist of air channel testing for double wedge fusion welds or vacuum box testing on extrusion welds.
 3. Other types of non-destructive testing will be performed only upon written approval for the Engineer.
 4. No areas of the FML installation will be approved and finalized that have not been non-destructively tested with passing results, or that have not been repaired and retested.
 5. Air Channel Testing:
 - a. Air channel testing consists of sealing both ends of the seam, pressurizing the channel, and monitoring the pressure with time.
 - b. The Engineer shall observe 100 percent of all air channel testing.
 - c. Testing performed without the observation of the Engineer will be required to be retested.
 - d. Tests that are terminated prior to the specified time interval shall be retested.
 - e. Propane torches will not be allowed to fuse the ends of the seam closed.
 - f. Equipment that is used to fuse the ends of the seam closed shall be used with extreme care to avoid damaging the FML.
 - g. Areas that are damaged shall be marked for repair.
 - h. The Engineer shall affirm that the entire air channel under test is clear by observing air flowing out of the end of the channel opposite the end with the pressure gauge, prior to the test being performed.

- i. All penetrations into the FML, including including those made by the device used to apply the air pressure, shall be repaired by patching as described in these Specifications.
- j. Modifications to the Specifications for air channel testing shall not be made without prior written approval.
- k. Air Channel Testing Procedure:
 - 1) One end of the air channel shall be fused shut.
 - 2) A device capable of applying air pressure to the channel without leaking shall be installed.
 - 3) The device used to apply the air pressure shall also have a 60 pounds per square inch (psi) capacity pressure gauge, capable of being read to 1 psi, attached to it with a leak free connection.
 - 4) Pressurized air shall be applied to the channel to verify an open channel. If the channel is determined to be blocked, the obstruction shall be located and the test performed to that location. If an open channel is verified, the other end of the channel under test shall be fused shut.
 - 5) A pressure of 40 psi gauge shall be applied to the channel and held for five (5) minutes.
 - 6) A drop in pressure of 5 psi or less within a five (5) minute test period will constitute a passing test.
 - 7) If the pressure drops more than 5 psi within the five (5) minute test interval, the seam under test will be considered as failing.
- l. Failing Air Channel Tests:

Seams that fail the air channel test shall be repaired or remediated in one or more of the following manners:

 - 1) The cause of the leak shall be determined.
 - 2) The leak shall be repaired and retested.
 - 3) The entire seam will be extrusion welded and vacuum tested.
 - 4) The entire seam shall be capped and vacuum tested.
 - 5) If the seam is to be extrusion welded, the unattached portion of the overlying FML shall be tack bonded to the underlying liner prior to extrusion welding.
 - 6) The extrusion weld shall be performed in accordance with these Specifications.
6. Vacuum Box Testing:
 - a. Vacuum box testing shall be performed on 100 percent of all extrusion welded seams and patches.

- b. Engineer shall observe 100 percent of all vacuum box testing.
 - c. Testing performed without the observation of the Engineer shall be required to be retested at the sole expense of the Contractor.
 - d. The Engineer shall be the final authority on determining the presence of a leak as indicated by the vacuum box method.
 - e. If the vacuum box is moved too quickly, not evacuated to the required vacuum, or if the site glass is too dirty to allow effective testing, the seam or patch shall be retested.
 - f. Vacuum Box Testing Procedures:
 - 1) A soapy solution shall be applied to the section of seam to be tested.
 - 2) Excess FML shall be trimmed prior to vacuum testing. A rub sheet and extreme care shall be used while trimming excess FML for vacuum box testing. Nicks made in the installed FML while trimming shall be repaired as determined by the Engineer.
 - 3) The vacuum box shall be placed over the seam and adjusted so that an effective seal against the FML is achieved.
 - 4) A minimum vacuum of 5 psi (gauge) shall be applied and held for a minimum of fifteen (15) seconds.
 - 5) The seam shall be observed through the site glass for the presence of bubbles indicating a leak.
 - 6) Sections of the seam that indicate a leak for repair shall be marked.
 - g. Failing Vacuum Box Tests:
 - 1) Areas failing vacuum box testing shall be ground and rewelded or repatched as determined by the Engineer and retested until a passing result is achieved.
7. Seams Unable to be Non-Destructively Tested:
- a. If the seam is accessible for testing prior to final installation such as with prefabricated appurtenances, the seam shall be tested prior to final installation.
 - b. If the seam cannot be tested prior to final installation, it shall be seamed under the constant observation of the Engineer.
 - c. The seam may be required to be cap stripped as determined by the Engineer.
- F. Destructive Testing:
- 1. Destructive samples shall be taken a minimum of every 500 lineal feet of seam or one (1) sample per seaming crew per day, whichever results in the greater number of samples.

2. More frequent samples may be taken as appropriate.
3. Destructive sample locations shall be determined by the Engineer, and shall not be revealed to the Installation Contractor prior to actual sampling.
4. Sampling times shall be determined by the Engineer.
5. The installation Contractor shall obtain all destructive samples.
6. The Engineer shall observe the obtainment of all destructive samples.
7. Destructive sample testing shall consist of peel and shear testing per ASTM D 413, ASTM D 3083, and ASTM D 4437, as appropriate.
8. Peel testing shall be performed on both seams of double wedge welds unless otherwise approved, in writing.
9. Seams that are not able to be tested in peel shall be cap stripped.
10. All penetrations into the FML during destructive sampling shall be repaired by the Installation Contractor by patching as specified in these Specifications and non-destructively tested as specified in these Specifications.
11. Samples shall be obtained and tested as the installation proceeds.
12. No areas of the FML installation shall be approved and finalized prior to the results of all destructive samples being reviewed by the Engineer.
13. No areas of the FML installation shall be approved and finalized that incorporate failing destructive sample results that have not been repaired and retested as required.
14. No areas of FML shall be approved and finalized that incorporate a set of destructive samples that have not been randomly tested by the Engineer with passing results.
15. No areas of the FML installation shall be approved and finalized that have not been patched as required in these Specifications and non-destructively tested as required in these Specifications, with passing results.
16. Destructive Sampling Procedures:
 - a. The destructive samples shall be a minimum of 12 inches wide by 42 inches long with the seam centrally located.
 - b. The destructive sample shall be distributed as follows:
 - 1) A 12-inch by 12-inch sample to the Installation Subcontractor.
 - 2) A 12-inch by 18-inch sample to the Engineer.
 - 3) A 12-inch by 12-inch sample to the Engineer.
 - c. If the Installation Subcontractor requires more sample to perform the specified testing, he shall inform the Owner and the Engineer of the Contractor's requirements and sample accordingly.

- d. Each sample shall be legibly marked by the Installation Subcontractor, in permanent marker, with the following:
 - 1) Destructive sample number.
 - 2) Date sampled.
 - 3) Name of individual who obtained the sample.
 - 4) Seam number.
17. Installation Subcontractor's Destructive Sample Testing:
 - a. The Installation Subcontractor shall test in peel and shear 100 percent of the destructive samples obtained in accordance with the procedures specified in these Specifications.
 - b. Results shall be submitted, in writing, to the Owner and Engineer.
18. Owner's Representative Destructive Sample Testing:
 - a. The Owner's representative shall test 100 percent of the destructive samples obtained from FML installation.
 - b. The Owner's representative may randomly select up to 100 percent of the destructive samples for testing from the FML installation in other areas.
 - c. Test procedures shall be according to those specified in these Specifications.
19. Destructive Sample Test Procedures:
 - a. Destructive samples shall be tested in accordance with ASTM D 413, ASTM D 3083, and ASTM D 4437, as appropriate.
 - b. Five (5) specimens from each coupon shall be tested in both shear and peel. The specimens used as peel and shear test specimens shall alternate as the specimens are cut from the sample.
 - c. A tensiometer with a calibrated load measuring device and means to apply the required loading rate shall be used to test the specimens.
 - d. The width of each of the specimens shall be measured to within one-hundredth (0.01) of an inch and recorded.
 - e. The temperature at the time of the test shall be recorded.
 - f. Results of the destructive sample tests shall include the load at failure in pounds, the load at failure in ppi determined by dividing the total load at failure by the measured width of the strip, and the type of failure in terms of Film Tearing Bond (FTB) or Non-Film Tearing Bond (Non-FTB) as shown in Appendix N of EPA /600/2-88/052.
20. Pass or Failure Criteria For Destructive Samples:
 - a. Destructive sample will be considered as passing only if all of the following criteria are met:

- 1) The minimum strength specified in these Specifications is met or exceeded in at least four (4) of the specimens tested in peel and these same four (4) specimens achieve a film tearing bond as shown in Appendix N of EPA/600/2-88/052; and
 - 2) The minimum strength specified in these Specifications is met or exceeded in at least four (4) of the specimens tested in shear and these same four (4) specimens achieve a film tearing bond as shown in Appendix N of EPA/600/2-88/052.
- b. If either the Installation Subcontractor's or the Owner's representative destructive sample test fails, the seam will be considered as failing.
21. Failing Destructive Sample Tests:
- a. In the event that a destructive sample fails the Installation Subcontractor shall either:
 - 1) Reconstruct the seam between any two passing test locations.
 - 2) Obtain small samples a minimum of 50 feet on either side of the failing sample for field testing by the Installation Subcontractor. When the Installation Subcontractor determines that a passing result has been achieved on both sides of the failing test location, the Installation Subcontractor shall then sample according to these Specifications. The Owner's representative shall then test both samples. If both samples tested by the Owner's representative pass, the seam shall be reconstructed between the two (2) passing test locations. If one or both of the samples fail, additional samples shall be obtained until passing results are achieved and the seam shall be capped between the passing test locations.
 - b. Consideration shall be given to the particular piece of welding equipment and welder that welded the particular seam that failed. Additional destructive samples may be obtained as appropriate.
 - c. Reconstruction of the seam shall include cutting out the failed seam, repositioning the panels and reseaming, or capping the entire failed seam, or in the case of fusion welds, extrusion welding the entire seam as specified in these Specifications.
 - d. After reconstruction, destructive samples of the reconstructed seam shall be obtained at locations determined by the Owner's representative. These samples will be tested and evaluated as described in Specifications.
 - e. Caps shall be non-destructively tested. Caps may require destructive testing.

5.8.3.8 Defects and Repairs

- A. The FML sheet and the seams shall be observed by the Engineer and Installation Subcontractor for holes, creases, underlying projections, blisters, undispersed raw materials, contamination by foreign material, and other damage.
- B. If installed FML becomes covered or too dirty for effective inspection, the Installation Subcontractor shall clean the FML such that effective inspection can be made.
- C. Repairs made due to damage resulting from the Installation Subcontractor's activities shall be at the sole expense of the Installation Subcontractor.
- D. Areas of the FML installation that cannot be effectively repaired, shall be capped or the damaged FML removed and replaced, as determined by the Engineer.
- E. Areas of HDPE FML requiring repair shall be ground prior to welding as required in these Specifications.
- F. All FML surfaces shall be clean and dry prior to repairing.
- G. All LDPE patches and caps shall be ground, beveled, extend at least 6 inches beyond the cut or defect, and have rounded corners.
- H. Repair methods are listed below for specific types of damage. Types of damage that are not covered in these Specifications shall be repaired as determined by the Owner.
 1. Small Holes:

A hole or defect smaller than 1/4-inch in diameter in its largest dimension shall be considered a small hole. Small holes shall be repaired by grinding and extruding a bead for LDPE. The repair shall be non-destructively tested.
 2. Large Holes:

A hole or defect larger than 1/4-inch in its smallest dimension shall be considered a large hole. Large holes shall be repaired by patching. The repair shall be non-destructively tested. For large patches, the repair may be destructively tested.
 3. Projections Under the FML:

Projections under the FML shall be removed by making as small a cut as possible and removing the object. The cut shall be patched. The repair shall be non-destructively tested.
 4. Abrasions and Nicks:

Abrasions and cuts requiring repair shall be determined by the Engineer, and will include grinding and extruding a bead for LDPE.
 5. Creases:

Creases requiring repair shall be determined by the Engineer, and will include grinding and extruding a bead for LDPE.

6. Bridging of the FML:

Excessive bridging (trampolining) of the FML will not be allowed. The degree of excessive bridging will be determined during cool morning weather. Excessive bridging of the FML liner will be determined by the weight of a 180-pound man standing on the bridged FML. If the imposed weight does not force the liner to the underlying subgrade during the coolest site conditions encountered during construction, bridging must be removed. The installation Contractor will take steps to remove excessive bridging without cutting and patching the FML, unless approved by the Owner. Such steps will include temporarily sandbagging the toe of the slopes over a period of a day or more, and/or temporarily removing material from anchor trenches to allow adjustment.

5.9 Geotextile

Geotextile shall be minimum 8-ounce-per-square-yard (oz/sy), non-woven, needle-punched geotextile. All seams for the geotextile shall be overlapped in accordance with manufacturer's recommendations, or as approved by the Engineer. The Engineer or Engineer-authorized representative of the Installation Contractor shall obtain and review the roll certifications of the geotextile prior to deployment of the roll and shall observe the deployment of the material to ensure the material is not damaged, is installed in accordance with manufacturer's specifications, and that the required overlaps are achieved.

6.0 BORROW AREAS

Borrow material shall be derived from on-site excavation or other locations as approved by the Engineer. If stockpiling of salvaged soil or borrow material is performed, materials shall be stockpiled at locations designated by the Owner or Engineer. Any unused stockpiled material shall be returned to borrow area. After use, borrow areas shall be final graded to prevent freestanding surface water at maximum slopes of 3H:1V. Borrow areas shall be left in a clean and neat condition.

APPENDIX J

Construction Quality Assurance Plan

2010 Report of Waste Discharge, Bishop Mill Project

0877887 BC Ltd. / CMC Metals Ltd.

CONSTRUCTION QUALITY ASSURANCE PLAN

REPORT OF WASTE DISCHARGE

BISHOP MILL GROUP A MINE WASTE MANAGEMENT UNIT

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June 30, 2010

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BISHOP MILL WASTE MANAGEMENT UNIT CONSTRUCTION QUALITY ASSURANCE PLAN

1.0 INTRODUCTION

1.1 General

This Construction Quality Assurance (CQA) Manual has been prepared for 0877887 BC Ltd. (Owner) in accordance with Title 27 of the California Code of Regulations (CCR), Division 2, Sections 20323 and 20324. This manual was prepared by a registered civil engineer and describes construction quality assurance procedures to be followed in testing and documenting the construction of the construction of the Bishop Mill Waste Management Unit (WMU). This manual outlines the specific field and laboratory testing and monitoring procedures required to demonstrate that the final cover is constructed in accordance with the Report of Waste Discharge (RoWD).

Execution of this CQA plan shall be supervised by a registered civil engineer or certified engineering geologist who shall act as the designated CQA officer. Following the completion of the work, the CQA officer shall prepare a Final CQA Report. The Final CQA Report will provide a detailed description of the level of experience and training for the contractor, the work crew, and CQA inspectors for every major phase of construction in order to ensure that the installation methods and procedures required in the containment system design have been properly implemented.

1.2 Facility Description

The Bishop Mill site is located approximately one mile west of Highway 6 on Rudolph Road, approximately 9 miles northeast of the town of Bishop, California. The site is situated on public lands administered by the U.S. Department of the Interior, Bureau of Land Management, Bishop Field Office (BLM) within the SW $\frac{1}{4}$ of Section 4, Township 6 South, Range 33 East, Mount Diablo Baseline and Meridian.

The Operator intends to transport up to 75 tons per day of ore to stockpile at the site for processing. The ore will be processed through the existing gravity mill at an estimated throughput rate of 4 tons per hour (up to 96 tons per day). The waste derived from ore processing (tailings) will be deposited in the proposed new waste management unit (WMU) for Group A mining waste disposal constructed at the site of an existing, but inoperative, tailings impoundment. The mill and proposed WMU will be operated for a period of up to 5 years with a projected total of up to 32,000 tons of tailings deposited in the WMU based on

the project design described herein. Detailed drawings of the existing topography and existing and proposed facilities at the Bishop Mill site are provided in the Engineering Design Report.

Mr. Don Wedman is the authorized representative of the Operator, 0877887 BC Ltd. Contact information is provided below.

Mr. Don Wedman – President, CEO
0877887 BC Ltd. / CMC Metals Ltd.
369 Terminal Avenue, Suite 305
Vancouver B.C. V6A 4C4
(604) 637-4673 – Work,
(604) 692-0117 – fax
cmcmetals@shaw.ca

2.0 CHAIN OF COMMAND AND RESPONSIBILITIES

The Owner will appoint a Construction Manager, who shall oversee the Contractor, track the Contractor's progress with respect to an agreed-upon construction schedule, and review the Contractor's invoices. Prior to winning the project, the Contractor shall provide documentation demonstrating his/her experience and capability to construct the project components in accordance with the specifications and approved design, in addition to providing evidence of his/her license to contract within the State of California. The Contractor shall have a minimum of five years of experience conducting construction projects with similar components.

The Owner will also provide a third-party construction quality assurance team, consisting of a CQA Manager and CQA Inspectors. CQA shall be performed by a third party in accordance with this Construction Quality Assurance Plan and subsequent addenda. The CQA Manager shall have formal academic training in engineering, engineering geology, or a closely-related discipline and will be a civil engineer or certified engineering geologist registered in the State of California. The CQA Manager will oversee the CQA Inspectors and all aspects of CQA execution and will review and approve all CQA test reports and documentation.

CQA inspection personnel will have formal training, certification and practical experience in inspecting and testing construction work, including conducting and recording inspection activities, preparing daily reports, and performing field testing. In addition, knowledge of applicable codes and regulations governing material handling, observation of testing

procedure, equipment, and reporting procedures will be required. CQA inspection personnel will perform various tests and observations during construction, such as:

- Ensuring that all testing equipment is properly calibrated on a regular basis and that the calibration is documented.
- Verifying earthwork locations, dimensions and specifications, coordination of field survey and construction scheduling.
- Accurately recording all test data and organizing them in a manner that allows easy reference.
- Evaluating the Contractor's construction quality control plan to ensure that it meets or exceeds the CQA Manual requirements.
- Reporting observations and test results as the work progresses.

3.0 MEETINGS

Meetings will be an essential component of the CQA process. The CQA Manager will begin duties by coordinating a pre-construction meeting with the Owner, the Construction Manager, the Contractor, and the Design Engineer. The purpose of the meeting will be to provide all parties with pertinent documents, establish chain of command and lines of communication, review the CQA Manual, specifications, testing procedures and equipment, establish a meeting schedule, and conduct a site tour.

Daily progress meetings will be held so the Contractor and CQA personnel can discuss test results, discuss and resolve issues, and review the Contractor's equipment and manpower assignments for the day.

Weekly progress meetings will include the Construction Manager, the CQA Manager, and potentially the Owner and Design Engineer and will be used to review project progress and discuss problems, schedule, changes, test data and any other issues requiring discussion or resolution..

4.0 DOCUMENTATION

CQA documentation will include at a minimum reports bearing unique identifying sheet numbers for cross-referencing and document control, the date, project name, location, descriptive remarks, the data sheets, inspection activities, and signature of the designated authorities with the concurrence of the CQA officer.

Construction quality assurance documentation shall include, at a minimum, Daily Summary Reports, Acceptance Reports, and a final Documentation Report. Daily Summary reports

shall be prepared in such a manner as to provide a chronological framework documenting construction activities and will form the basis of all other reporting. Daily Summary reports will document all laboratory and field testing and all changes to the scope of work. Any problems that arise and their resolutions will be recorded in the Daily Summary reports.

Acceptance reports will verify that materials and construction methods comply with the technical specifications and design. Acceptance reports will include inspection summary reports and data sheets, and documentation of problem or non-compliance identification and resolution.

The final Documentation Report will bring all lesser reports together into a comprehensive document which demonstrates compliance with the approved design and design specifications. Final copies of the Documentation Report will be provided for review and approval to the LRWQCB and BLM and be prepared by, or under the direct supervision of, the CQA manager.

5.0 SUMMARY OF CONSTRUCTION AND CQA

Construction components of the project include the following:

- Coordination of field survey by Contractor;
- Verification/modification of design elevations and grades;
- Remove a section of the 40-mil liner for use at the Ore Patio to underlay and cover the relocated tailings;
- Remove the existing tailings (approximately 100 tons) to the Ore Patio and cover them with an additional layer of liner;
- Remove and dispose of the remaining 40-mil liner in a permitted municipal solid waste facility;
- Re-construct the pond area to the proposed new double-lined WMU with 2H:1V sideslopes pond and a leachate collection and recovery system (LCRS) system;
- Moisture condition and compact new WMU base and sideslopes to a minimum of 90 percent of maximum dry density at ± 2 percent of optimum moisture content per ASTM D1557, modified Proctor testing – compacted density of existing pond sideslopes to be confirmed and reconstructed as required to meet Technical Specifications;
- Smooth roll final compacted soil surface and remove protrusions that could damage liner;
- Excavate LCRS sump and liner anchor trenches around pond perimeter;
- Place 60-mil Agru Super GripNet geomembrane secondary liner over compacted WMU base and sideslopes;
- Place 6-inch diameter PVC pipe and clean drain gravel in sump;

- Place geotextile over the gravel-filled sump (to protect primary liner);
- Place 80-mil smooth HDPE liner over secondary liner;
- Backfill and compact liner anchor trenches;
- Construct up-gradient diversion berm/channel around the top of the upgradient slope cut to divert the 100-year, 24-hour storm;
- Provide ballast as required to protect liner prior to start of operations; and
- Verify as-built elevations and grades.

5.1 Field Survey

Quality assurance personnel will coordinate with the Contractor to ensure the completion of an initial site survey. The survey will encompass all areas to be filled or regraded to verify existing topography and lay out design grades for construction. The Contractor will be responsible for survey completion.

5.2 Design Verification/Modification

The proposed design will be evaluated with respect to the results of the initial field survey. Design modifications will be made by the Engineer, as necessary, to ensure project goals are accomplished. Revised design drawings will be issued if necessary following the evaluation of initial survey data.

The Contractor shall adhere to the approved design details. Significant changes to the approved design shall depend on concurrence with the Engineer and Owner and shall be approved by the BLM and LRWQCB.

For significant changes to the approved plan, the Engineer or Construction Manager shall contact BLM and LRWQCB via telephone or e-mail for approval prior to implementation in the field. The following contact information was active at the time of report preparation.

Bernadette Lavato – Field Manager
U.S. Department of the Interior
Bureau of Land Management
Bishop Field Office
351 Pacu Lane, Suite 100
Bishop, CA 93514
760-872-5000 office
760-872-5050 fax
Bernadette_Lovato@ca.blm.gov

Tamerle M. Lundquist - Engineering Geologist, PG
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150
530-542-5420 office
530-544-2271 fax
tlundquist@waterboards.ca.gov

5.3 CQA Activity and Documentation

CQA activity and documentation will include documentation of subgrade preparation (including WMU excavation and containment berm construction with general soil fill), flexible membrane liner placement and seaming, and confirmation of geotextile suitability and placement. Laboratory testing will be conducted with suitable equipment calibrated in accordance with manufacturer's recommendations and applicable laboratory licensing authorities. Field testing will primarily involve relative density and moisture content testing using a nuclear density gage. Nuclear density gages will be calibrated in accordance with manufacturer's specifications at least twice per day during use.

TABLE 5.1. CQA ACTIVITY, DOCUMENTATION AND FREQUENCY

ITEM	CQA ACTIVITY	CQA DOCUMENTATION	FREQUENCY
Subgrade Preparation (excavation subgrade prep and placement of general soil fill)	Standard Classification – Visual/Manual Method - per ASTM D2488-93	Field Test Summary Sheets	Once per Material Type, Once Per Week, or Once per 5,000 cy, whichever is greater
	Particle Size Analysis per ASTM D422-63	Lab and Summary Sheets	Once per Material Type, Once Per Week, or Once per 5,000 cy, whichever is greater
	Atterberg Limits per ASTM D4318-93	Lab and Summary Sheets	Once per Material Type, Once Per Week, or Once per 5,000 cy, whichever is greater
	Standard Classification for Engineering Purposes per ASTM D2487-93	Lab and Summary Sheets	Once per Material Type, Once Per Week, or Once per 5,000 cy, whichever is greater
	Modified Proctor Testing per ASTM D1557-91	Daily Field Report	Once per Material Type, Once Per Week, or Once per 5,000 cy, whichever is greater
	Compacted Thickness – Visual	Daily Field Report	Daily Field Report
	Placed Density and Moisture – Nuclear Density Gauge per ASTM D6938	Field Test Summary Sheets & Daily Field Report	Once per Every 250 cy placed, at least 4 times per day
	Oversize Material – Visual	Daily Field Report	Daily Field Report
60 mil HDPE Agru Super Gripnet® and 80mil Smooth HDPE	Review of roll certification	Daily Field Report	Daily Field Report
	Observation of deployment	Deployment Record	Deployment Record
	Observation of welding	Welding Record	Welding Record
	Observation of Contractor's quality control	Seam Test Record	Seam Test Record
	Marking of repairs	Repair Record	Repair Record
	Verification of repairs	Repair Record	Repair Record
	Location of Destructive Samples and review of results	Destructive Sample Log and Daily Field Report	Destructive Sample Log and Daily Field Report
Geotextile	Review of material certification	Daily Field Report	Daily Field Report
	Observation of deployment and overlaps	Daily Field Report	Daily Field Report

6.0 SUBGRADE PREPARATION (SUBGRADE PREPARATION AND PLACEMENT OF GENERAL SOIL FILL)

Material will be placed or scarified and recompacted in place to form the prepared liner subgrade. Fill material to form the pond containment berms will be borrow materials derived from WMU excavation or from an approved borrow source.

The compacted density of all existing embankments and pond slopes must be verified to be within specifications prior to their acceptance. Verification is required to a minimum depth of 12 inches for all existing cut slopes and from existing ground surface down to native soil for all existing pond embankments. To be accepted, compaction must be shown by testing to be at least 90 percent of maximum dry density (as determined by ASTM D1557).

6.1 General

The CQA program for subgrade preparation and general soil fill placement shall include:

- Visual/manual classification;
- Particle size analysis;
- Plasticity index testing (Atterberg limits);
- Engineering classification;
- Laboratory compaction testing (modified Proctor);
- General observation of placement procedures;
- Observation of lift/compacted layer thickness;
- Field compaction and moisture testing (nuclear density testing); and
- Detection and removal of oversize material.

6.2 Interim Cover Specifications

The specifications of interim cover layer preparation and conditioning are as follows:

- Gradation --

<u>U.S. Standard Sieve Size</u>	<u>Percent Passing By Dry Weight</u>
3 inch	100
¾ inch	70-100
No.10	40-70
No. 200	10-40

- Plasticity Index: ≤ 15
- Maximum Loose Lift Thickness for fill placement – 8 inches ;

- Minimum scarification and recompaction depth for existing surfaces – 12 inches; and
- Minimum Compaction - 90 percent of maximum dry density at ± 2 percent of optimum moisture content as determined by modified Proctor testing (ASTM D 1557).

6.3 Observations of Lift Thickness/Scarification Depth

The uncompacted lift thickness shall be monitored during placement of fill, and the depth of scarification shall be monitored during reworking of in-place materials. The thickness of the uncompacted lifts and depth of scarification shall be noted on the daily field report for each day of fill placement.

6.4 General Observation of Surface Preparation Procedures

The Quality Assurance Team shall observe the fill placement or in-place conditioning to verify that the material is moisture conditioned as necessary such that the required compaction is achieved. The Quality Assurance Team shall visually inspect the material as it is being placed and spread for over-size material. The Quality Assurance Team shall observe the traffic patterns of the compaction equipment to verify that all areas of the fill are receiving the effort required to achieve the minimum specified compaction. Areas that appear to receive less effort shall be tested independently of the frequency criteria described in Section 5.3. As the fill is being placed, the Quality Assurance Team shall confirm that a laboratory compaction curve is available for the material being placed. If a representative sample of the material being placed has not been tested for laboratory compaction, a sample shall be obtained and tested. Any material that is obtained from a physical location that is separate from or different from the location of the previous material shall be considered a different material type and shall require separate sampling, testing, and reporting, in accordance with Table 1, Section 5.3.

6.5 Field Testing Locations and Failed Tests

Field density test locations should be established based on a grid pattern, with random locations interspersed. The CQA inspector should ensure that the CQA Technicians are searching out areas that look like they may fail, rather than looking for well compacted areas to test. Compaction tests should not be done on wheel tracks, access roads or areas where there is repeated vehicle traffic.

When a field compaction test indicates the compaction achieved does not meet the minimum criteria established in Section 6.2, two additional tests will be performed within approximately 5 feet of the original failing test. If both secondary tests pass, the original test

can be ignored. If either of the secondary tests fails, the area must be scarified, moisture conditioned, and recompacted to meet the minimum compaction specifications.

6.6 Index Testing and Classification

Material intended for use in WMU embankment construction shall be initially classified according to the visual/manual method per ASTM D2488-93. Particle size distribution (ASTM D422-63) and plasticity index testing (ASTM D4318-93) shall be performed at least once per day, once per material type, or once per 5,000 cubic yards placed, whichever is greater. The tests shall be performed on the same sample obtained for laboratory compaction testing. Once completed, the results of the particle size and plasticity testing shall be utilized to classify the material for engineering purposes in accordance with ASTM D2487-93.

6.7 Laboratory Compaction

A laboratory compaction (modified Proctor ASTM D1557) test shall be performed at least once per day during material placement, once per material type, or once per 5,000 cubic yards placed, whichever is greater.

6.8 Nuclear Density Tests

Nuclear density testing shall be performed for fill placed or conditioned in place at least once per every 250 cubic yards of material placed and at least four times per day during material placement activities. The nuclear density tests will be used to determine the materials in-place dry density and moisture content. The dry density shall be compared to the appropriate laboratory compaction curve and the relative compaction determined.

6.9 Documentation

Documentation in the Daily Summary Report shall include the uncompacted lift thickness or scarification depth, method of moisture conditioning, and the equipment used to place, moisture condition, and compact the fill material. Documentation of the field and laboratory testing shall be summarized on the appropriate summary sheets.

7.0 FLEIXBLE MEMBRANE LINER

7.1 General

A high-density polyethylene (HDPE) liner system (80mil smooth HDPE over 60mil Agru Super Gripnet®) will be installed to the final prepared WMU surface. The CQA plan includes:

- Review of Roll Certification;
- Observation of Deployment including placement of texturing;
- Observation of Welding;
- Observation of Contractor's Quality Control (QC);
- Marking of Repairs;
- Verification of Repairs;
- Location of Destructive Samples;
- Sending Destructive Sample to the third party testing laboratory; and
- Review of Destructive Test results.

7.2 Specifications

The HDPE liner shall conform to the minimum average roll values shown in Technical Specifications. The Quality Assurance Team shall study the specifications in detail and perform the CQA accordingly.

7.3 Review of Roll Certification

The Quality Assurance Team or Engineer shall obtain and review a copy of the roll and resin certifications for each and every roll of liner material before it is approved for deployment. The results of the QC testing on the roll certificates shall be carefully reviewed to verify that:

- All of the testing required by the Technical Specifications has been performed by the manufacturer; and
- All of the test results meet or exceed the specified requirements.

Rolls that are approved for deployment shall be stored separately from rolls that are not approved for deployment.

7.4 Observation of Deployment

The Quality Assurance Team shall observe the liner material as it is deployed, noting and marking liner defects due to manufacturing or handling. A log shall be maintained (deployment log) recording each day's deployment.

7.5 Observation of Welding

The Quality Assurance Team shall observe the seam welding as it progresses. With regard to the start up welds, the Quality Assurance Team shall observe 100 percent of all start up welding and testing performed on the start up weld seams to verify that they are being performed according to the Specifications. Specifically, the start up welds must be performed on the same supporting surface (subgrade) as the production welds will be made and with the same materials.

No welder or piece of welding equipment will be approved for production welding until the Quality Assurance Team has observed and accepted the start up process. If at any time a welder or piece of welding equipment fails two consecutive start up weld test seams, neither the welder nor the welding equipment will be approved for production welding until the problem has been identified and rectified to the Quality Assurance Team's satisfaction.

7.6 Observation of Contractor's QC

The Quality Assurance Team shall observe 100 percent of the Contractor's non-destructive (pressure and vacuum) testing. The Quality Assurance Team shall observe and record the pressures and times applied. It is the Quality Assurance Team's observations of times and pressures during non-destructive seam testing that will be used for quality assurance testing. Any non-destructive testing performed without the observation of the Quality Assurance Team will not be accepted.

If destructive samples are tested at the site, the Quality Assurance team shall observe the equipment and procedures used for the first series of tests. If the Quality Assurance Team determines that the testing is being performed according to the project Specifications and spot checking will be sufficient, it will notify the Engineer as such. If the Quality Assurance Team determines that the equipment and procedures are not meeting the project Specifications, it will immediately issue a non-compliance report and notify the Engineer.

7.7 Marking of Repairs

The Quality Assurance Team shall walk all panels and seams looking for objects under the liner, holes, creases, and other damage to the liner, mark and record them for repairs. It is extremely important that all required repairs are logged and repaired, tested and checked off on the log.

The Quality Assurance Team shall include on the repair log all required repairs as determined from the non-destructive testing and patches due to destructive sampling.

7.8 Verification of Repairs

The Quality Assurance Team shall observe all repairs and testing associated with repairs that are logged. The Quality Assurance Team shall also observe the repairs and testing associated with repairs that the Contractor has marked prior to the final walk through.

7.9 Location of Destructive Samples

The Quality Assurance Team shall mark the locations from which the destructive samples will be taken. The Contractor shall not be informed of the locations while the installation of that area is in progress nor will the contractor be allowed to influence the Quality Assurance Team in any way as to the location from which the destructive samples will be taken.

The specifications require that destructive samples be obtained at a maximum spacing of 500 lineal feet of seam. The Quality Assurance Team shall take more samples if it is suspect of specific areas, i.e. seams over interior berms, etc. The samples shall be marked with the sample number, the date welded, the machine and welder I.D. and the seam number.

7.10 Sending Destructive Samples to the Third Party Testing Laboratory

The destructive samples shall be sent to the third party testing laboratory on the same day the samples are obtained. The destructive samples shall be sent via the most expedient delivery service. The third party testing laboratory will have the results of their testing within 24-hours of receipt of the samples. The Quality Assurance Team shall record the reported results of testing on the destructive sample log to maintain a field summary of all testing.

8.0 GEOTEXTILE

Geotextile will be 8 ounces per square yard, non-woven, needle-punched geotextile installed in accordance with manufacturer's specifications. Quality assurance personnel will ensure that geotextile is properly pinned, overlapped and oriented in the correct direction and in accordance with manufacturer's recommendations.

9.0 QA/QC PROJECT DELIVERABLES

QA/QC project deliverables will include initial and as-built surveys of the Work areas to be performed and will be provided by the Contractor. The as-built survey will have a maximum contour interval of 2 feet and be provided in AutoCad or other approved digital format. CQA personnel will document field activities as detailed above. A final as-built report encompassing all required documentation will be prepared for submittal to regulatory agencies within 30 days of project completion.