

TECHNICAL SPECIFICATION BIO-POLYMER SLURRY DRAINAGE TRENCH CONSTRUCTION GROUNDWATER COLLECTOR TRENCH

(This technical specification is to be used to guide the writer in the contract requirements for Bio-Polymer construction for a specific site. Included are _____ to be filled in with project specific data. Optional subsections are denoted by*. Parenthetic remarks () are included when appropriate to provide the writer with additional, nonessential information. Most [] and * are used to include groundwater collector trench designs which go beyond the standard design and may include stainless steel well casings, pitless adapters, and/or perforated drainage pipe. All [], (), and * should be filled in or omitted from the writer's specification.)

SCOPE OF WORK

This section of the specifications includes the minimum requirements for the Groundwater Collector Trench (for groundwater interception, extraction, and/or injection) and related work as constructed by the Bio-Polymer Slurry Drainage Trench method (B-P Drain) and as indicated on the drawings and specified hereinafter. The contractor shall provide and furnish all plant, labor, equipment, material, and expertise for performing all operations as required to construct the groundwater collector trench.

The Groundwater Collector Trench shall be constructed with essentially vertical trench walls which shall be supported by an engineered, biodegradable slurry. A gravel backfill, [drainage pipe, filter fabric], and extraction wells/sumps shall be placed into the trench, through the slurry. The slurry shall be degraded by the contractor and the collector system fully developed to eliminate any residual effects of the slurry.

Reference Standards

Following is a list of standards which will be referenced in this specification. Such referenced standards shall be considered part of these specifications as if fully repeated herein.

<u>REFERENCE</u>	<u>TITLE OR DESCRIPTION</u>
API RP 13B	API Recommended Procedure for Field Testing Drilling Fluids
ASTM C 136	Particle-Size Analysis for Fine and Coarse Aggregates
ASTM F 480	Standard Specification for Thermoplastic Water Well Casings and Couplings

[ASTM A 312]	[Standard Specification for Seamless and Welded Stainless Steel Pipe]
[AASHTO M 252]	[Standard Specification for Corrugated Polyethylene Drainage Tubing]
[ASTM F 405/667]	[Standard Specification for Corrugated Polyethylene Tubing and Fittings 3"-6"/8"-15"]

Definitions and Abbreviations

- API - American Petroleum Institute
- ASTM - American Standards of Testing Materials
- B-P - Bio-Polymer
- Owner - The Owner as referenced to herein is
- Owner's Representative - The Owner's Representative is designated by the Owner to act on its behalf in the execution of these specifications.
- Bio-Polymer Slurry Drainage Trench Technique - A modification of the slurry trench method which uses a biodegradable material instead of bentonite to support narrow, vertical excavations. Abbreviated as B-P Drain.
- Backfill - A freely-draining gravel used as the final fill for the Groundwater Collection Trench.
- Working Platform - The work platform is the surface of compacted fill and/or excavated surface from which the slurry wall is constructed. The work platform is relatively level, stable and well drained with a specified minimum width and specified minimum clearance above the groundwater table.
- Degraded Slurry - Bio-Polymer slurry which through natural or artificial means has degraded to water and a minute amount of a nontoxic residual.
- Extraction Wells/Sumps - Vertical casings (PVC or Stainless Steel) with well screens [and/or pipe connections] suitable to accept groundwater pumps for the removal of liquids from the completed trench.
- Groundwater Collector Trench - The completed groundwater extraction/interception trench constructed by the B-P Drain method.
- Drain Activation - The process by which the Bio-Polymer is degraded to permit the free flow of groundwater into and through the groundwater collector trench.

Qualifications of Contractor

The contractor shall submit evidence and references from at least five similar projects to document his successful use of the B-P Drain technique. This evidence will ensure that the Contractor will have sufficient expertise, experienced personnel, proven methodologies and equipment to carry out the work as specified.

In particular, a B-P slurry specialist shall be submitted, and approved by the Owner's Representative to supervise the construction, slurry preparations, slurry degradation and quality control. The name and qualifications of the contractor (or specialty subcontractor) shall be submitted with the bid.

Groundwater Collector Trench

A freely-draining groundwater collector trench shall be constructed to the lines, grades and cross sections as indicated on the drawings. The trench shall have essentially vertical walls, a minimum width of _____ inches, and shall extend through the overburden to a maximum depth of _____ ft. A generalized description of the overburden through which the trench is to be excavated is indicated in the soil boring logs, attached.

SUBMITTALS

Qualifications

The contractor shall be a specialist in the construction of groundwater collector trenches by the B-P Drain Method.

The contractor shall submit evidence and references from at least five similar projects. Project descriptions shall include depth, width, and length of the trench as well as a description of the permanent materials placed in the trench for groundwater extraction. A brief history of each project shall include the type of slurry used, soil conditions and any difficulties encountered in construction and drain development. Submit with the bid.

The Bio-Polymer Slurry Specialist shall be knowledgeable and experienced in drainage trench construction using Bio-Polymer slurry. This experience shall include, but not necessarily be limited to: 1) the use and control of Bio-Polymer slurry in trench construction; 2) methods required to properly mix and degrade the Bio-Polymer slurry; 3) trench excavating and backfilling procedures; and 4) knowledge of construction equipment and materials testing as required for slurry trench construction. The specialist shall control the mixing, composition, placement, cleaning and maintenance of the Bio-Polymer slurry and backfill. The specialist shall supervise and ensure that the trench is continuous and freely-draining. The credentials of the trench specialist shall be submitted at least one week prior to starting trench construction.

Work Plan

The contractor shall submit a preconstruction work plan for approval by the Owner's Representative at least _____ days prior to the start of work under this section. The work plan shall include the following items.

Schedule: A schedule in sufficient detail to identify the major segments of the work. Starting and ending dates for all major work items shall be clearly identified.

Bio-Polymer Slurry Trench Construction Method: A detailed description of the methods of construction which shall include the excavation methods, slurry mixing and handling, material handling and placement, backfill placement, well/sump placement, [geotextile placement], [pipe placement] etc.

Equipment: A list of major equipment by type and capacity which shall include excavator, slurry mixer, material handler, [pipe layer] support, and transport equipment

Quality Control

The quality control plan shall be submitted along with the work plan. The plan shall include a list of test methods and minimum standards with which to gauge the quality of the work during construction including slurry viscosity, depth measurements, control of well/sump verticality, [control of pipe grades], etc.

The plan shall address the physical properties and manufacturer's stated properties for all permanent materials including manufacturer's certifications of quality, mill certificates, gradation test data, etc.

The plan shall state when all quality control data will be submitted to the Owner and the correction procedures to be employed in the case of substandard results.

MATERIALS REQUIREMENTS

Biodegradable Bio-Polymer

Biodegradable Bio-Polymer shall naturally degrade or be "broken" to a nontoxic water solution once backfilling of trench is complete. Degraded Bio-Polymer shall not materially reduce trench wall transmissivity. The contractor shall submit the physical and chemical characteristics and properties of the Bio-Polymer with the quality control plan. Substances prohibited by local, state or federal law shall not be contained in the Bio-Polymer. The biodegradable Bio-Polymer shall not form a filter cake on the trench walls which might decrease the transmissivity of the drainage trench/alluvium interface. Unused Bio-Polymer slurry shall convert to water containing a minute residual of nontoxic material once the drainage trench is completed.

Water

The water used in preparing the Bio-Polymer slurry shall be fresh or salt water. The water shall be free of excessive amounts of oil, acid, alkali, organic matter and other deleterious substances which could adversely affect the properties of the Bio-Polymer. Potential water sources shall be tested by the contractor prior to beginning trench excavation to assure that water of suitable characteristics for slurry preparation shall be used. Water used in preparing the Bio-Polymer slurry shall have the following minimum properties:

- a) pH between 6 and 8
- b) total dissolved solids less than 1,000 mg/l
- c) total hardness less than 250 mg/l

Slurry

The slurry for supporting the trench shall consist of a stable suspension of biodegradable Bio-Polymer in water. It is the responsibility of the contractor to insure that the slurry meets the necessary properties and monitor the slurry and the trench during excavation. The viscosity and pH of the slurry will additionally be monitored by the contractor to determine when breakdown of the slurry begins. The gel strength of the slurry shall be maintained at a high level so that hydrostatic pressure is transferred from the slurry to the trench walls.

Additives

Admixtures of softening agents, preservatives, or dispersants may be added to the slurry to permit efficient use of and proper workability of the slurry. The Bio-Polymer slurry may be modified as required for successful trench excavation. Any additives used must be biodegradable and broken down prior to completion of the trench cap. Chemical and physical properties and characteristics of any proposed additives shall be submitted with the quality control plan.

Backfill

Durable, clean, washed, and graded gravel shall be used to backfill the trench. (The designer should attempt to use readily available local materials, e.g., #2, #57 stone, etc. Note: If filter fabric is not used, backfill gradation may be based on filter criteria to minimize plugging.)

Perforated Drainage Tubing [Optional]

A slotted, high density polyethylene smoothwall pipe shall be furnished and installed to convey groundwater to the well/sumps. The pipe shall be Driscopipe 1000, or equivalent and shall be fusion welded in the field.

(Perforated drainage pipe is recommended for use in the groundwater collector trench when simpler designs are not acceptable. Closer well spacing, sloping of the drain, depressing the pump elevation, etc. may be added in lieu of a pipe in many cases. A drainage pipe maybe a necessity in cases of excessive hydrostatic pressures, flow rates greater than the capacity of the backfill or when the permeability of the native soils approaches that of the drain.)

Recovery and Observation Wells/Sumps

Vertical well/sumps shall be furnished and installed to accept the extraction pumps and permit the free flow of groundwater into the pumps. The well/sump casing shall be constructed of _____ inch diameter Schedule 80 PVC [Type 304 Stainless Steel] pipe. The casing shall be factory slotted or fitted with well screens with 0.010 inch slots or larger and capped on the bottom. The casing shall be slotted from the elevation of the trench bottom to a distance of _____ ft above the bottom, recommended to the natural water table elevation.

EQUIPMENT

General

The contractor shall furnish necessary plant and equipment for construction of the facilities shown on the contract documents. The equipment shall be of type and capacity to complete the work in an efficient manner, and shall be maintained in operable condition at all times.

Trench Excavation

Equipment for excavating the slurry trench shall be approved earthmoving equipment such as a backhoe and/or clamshell capable of performing the indicated work on the drawings and/or as specified herein. The equipment shall develop a live load surcharge that will produce no significant contribution to the instability of the trench. The equipment shall be capable of excavating to the required trench depth from the working platform. It shall be capable of excavating the required minimum width of the trench in a single pass of the excavating equipment, except where a wider excavation is made to install either a large diameter sump or manhole.

Slurry Mixing Plant

The contractor shall provide a slurry mixing plant containing the necessary equipment for preparing the Bio-Polymer slurry including a high-shear colloidal mixer capable of producing a stable suspension of Bio-Polymer in water. Pumps, valves, hoses, storage supply lines and other equipment shall be provided as required to adequately supply Bio-Polymer slurry to the trench. The slurry mixing plant shall be equipped with a high-speed/high-shear colloidal mixer [with a static agitator]. Hydration ponds shall not be permitted.

Backfill

The backfill shall be installed in the trench, through the slurry, by equipment which minimizes segregation of the gravel and the creation of voids. Initial backfill placement to bed piping/sumps/wells, etc. then via slope. All backfill placed around well sumps [and drainage pipes] shall be gently placed from the surface to ensure proper bedding of the structure. Subsequent backfill may be placed by filling continuously from the beginning and surface of the trench in the direction of the excavation until backfill slope develops.

EXECUTION OF THE WORK

General

The drainage trench shall be constructed to the elevations, lines, grades, and cross sections shown on the drawings and in accordance with these specifications, unless otherwise directed by the Owner's Representative.

Excavation

Trench excavation shall be maintained in an open condition by the biodegradable slurry method. Excavation shall be conducted in a manner which provides for a continuous minimum width trench to the required depth along the centerline of excavation. The contractor shall excavate the trench immediately to the minimum depth shown on the drawings at the point where excavation is started. The Owner's Representative may direct the contractor to deepen the trench based on examination of spoils and shall approve the depth of the trench immediately after excavation. The trench shall be constructed without undue interruption until complete.

Mixing and Placing Slurry

The Bio-Polymer slurry shall be prepared by mixing water and biodegradable polymer. No slurry shall be made within the trench. The Bio-Polymer slurry shall be prepared in the mixing plant and hydrated in a tank with circulation until the resulting slurry appears homogeneous and meets quality control standards. Additives may be added to the slurry at the mixing plant. The slurry shall be constantly agitated until introduced into the trench. Slurry shall be supplied to the trench through pipelines which shall be extended as necessary to supply the excavation.

After the initial 3 ft of soil has been excavated, slurry shall then be introduced into the trench at the time excavation begins. The level of the slurry in the open trench shall be maintained at a level sufficient to maintain trench stability and no more than 3 ft below the ground surface or less than 2 ft above the groundwater table until the placement of [drainage pipe, and] backfill material is complete. The contractor shall have sufficient personnel, equipment, slurry storage equipment and stored slurry materials ready to raise the slurry level in the excavated trench during construction. Dilution of slurry by surface water shall be prevented. The quality of the slurry shall be maintained at all times, including periods of work stoppage.

Trench Stability

The contractor shall be responsible for maintaining the stability of the excavated trench for its full length and depth and shall be responsible for maintaining slurry densities and levels within specified limits. The contractor shall control surcharges from excavation and backfilling equipment, waste, berm construction, backfill stockpiles, and any other loading situations that may affect trench stability. It is the contractor's responsibility to ensure that any stockpiles do not affect the open trench stability and that open trench stability is maintained at all times. In the event of failure of the trench walls prior to completion of backfilling, the contractor shall at his expense re-excavate the trench and remove all material displaced into the trench and take corrective action to prevent further deterioration as directed by the engineer.

Pipe Laying [Optional]

The drainage pipe shall be placed into the trench from the surface. The pipe shall be bedded with at least 6 inches of gravel and covered with a minimum of 3 ft of additional gravel.

Backfilling

Backfilling of the trench shall commence as soon as practical and be continuous to minimize the area of trench supported only by slurry. The areas for the storage of backfill material shall be approved by the Owner and restored upon completion of the work.

The contractor shall backfill continuously from the beginning of the trench in the direction of the excavation to the end of the trench. The backfill shall be placed into the trench in a manner that avoids trapping pockets of slurry and segregation of the gravel. Free dropping of backfill through the slurry will not be permitted, other than bedding of structures.

Slurry Breakdown and Activation

After completion of backfilling, the slurry shall be degraded to water and residual material. Slurry modifiers shall be added as necessary to destroy the viscosity and filtrate properties of the slurry. The broken slurry shall be oxygenated and pH adjusted to promote slurry degradation and drain activation. Water shall be flushed through the trench backfill material in order to remove residual material and to insure satisfactory hydraulic conductivity through the trench media.

Treatment of Top of Groundwater Collector

After the trench is developed, the top of the trench shall be covered and backfilled to grade. [The geotextile shall be trimmed and overlapped to cover the backfill.] [A layer of [geomembrane] [or geotextile] shall be placed over the backfill to separate the backfill from subsequent soil layers.] A minimum of _____ (three to five) ft of suitable (clayey) native soils, from the trench spoil, shall be recompacted over the backfill to bring the trench to the elevation of the working platform.

QUALITY CONTROL

The contractor shall be responsible to ensure that all work is performed to the standards established herein, subject to review and inspection by the Owner. All quality control records, routine tests, observations, and measurements shall be available for inspection by the Owner's Representative. The contractor shall bear the cost of all specified tests.

Submittals

The contractor shall make timely submittal of all information required by Section 2.0 to the Owner's Representative. The Owner may review and approve these submittals. Approval of any submittal does not relieve the contractor of the duty to perform the work to the standards specified.

Materials

The contractor shall submit data, tests, manufacturer's certificates, etc., to document the compliance of all materials to these specifications.

Bio-Polymer - The contractor shall submit Material Safety Data Sheets for the Bio-Polymer materials and additives. Test data shall be submitted to document the physical and chemical properties of the Bio-Polymer slurry and degraded slurry.

Water - The water shall be tested in accordance with API RP 13B as established in Section 3.2.

Gravel - The supplier shall provide test results documenting the gradation of the gravel prior to construction. The contractor shall perform one additional test for each 500 tons of backfill placed into the trench.

Well/Sump - The supplier shall provide a letter of certification indicating that the material delivered to the site complies with the specified properties.

Drainage Pipe [Optional] - The manufacturer shall supply a certificate indicating that the pipe complies with the specifications.

Bio-Polymer Slurry

The slurry used in trenching shall be tested each shift in accordance with API RP13B to ensure the ability of the slurry to stabilize the trench. The following tests shall be performed at the indicated minimum frequencies:

Viscosity	2 per shift
Density (only if specified)	2 per shift
pH	2 per shift

Samples of the slurry shall be obtained from both the trench and mixing plant for testing. Equipment and personnel for performing these tests shall be supplied by the contractor.

The degraded slurry and water in the trench shall be tested by the contractor to demonstrate that the slurry has been broken. The contractor shall test and monitor the viscosity and pH of the slurry to verify degradation. In addition, the contractor shall pump and flush the trench until the pore volume of the trench has been circulated at least three times.

Excavation

The contractor shall make measurements of the trench depth at least every 10 lineal ft. All depth measurements shall be made from the working platform to the bottom of the trench. The contractor shall generate and maintain on site an as-built profile of the trench depth.

Drainage Pipe Placement [Optional]

The contractor shall verify the elevation to which the drainage pipe is placed.

System Performance

The contractor shall verify the continuity of the system by pumping from a centrally located well/sump and observing an immediate drawdown in other well/sumps in the system.

Records

Records shall be maintained by the contractor for all testing, measurements, observations, and inspections. Quality Control Reports shall be submitted to the Owner's Representative each day on a form acceptable to the Owner. These reports shall list all test results, measurements, and observations made of the work for that day.

Quality Assurance

The Owner reserves the right to perform additional tests, using his own forces, on the slurry and backfill. The Owner's testing will in no way relieve the contractor of the responsibility to perform tests as necessary to meet this specification.

MEASUREMENT

The groundwater collector shall be measured based on the actual length of trench installed and the depths excavated. Measurements shall be based on surveys of the length and the depth of the trench as measured from the working platform and approved by the Owner's Representative.

PAYMENT

Payment for the groundwater collector shall be made at the contract unit prices for groundwater collector trench, [drainage pipe] and well/sumps. The price shall include all costs for excavating by the slurry trench method, stockpiling trench spoils, supply and blending slurry, supplying and placing backfill [supply and installing drainage pipe] and supplying and installing well/sumps. No separate payment will be made for other items incidental to the construction.