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Appendix C: Resumes: Certifying Engineer and Monitors

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Richard A. Isaac, P.E.

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Experience Summary

Rick Isaac has 34 years of extensive experience managing, performing, and certifying engineering design, permitting, and construction quality assurance (CQA) programs for new land disposal and other solid and hazardous waste management facilities. Mr. Isaac's CQA experience includes landfills in Ohio, Virginia, West Virginia, Pennsylvania, Maryland, Mississippi, and Louisiana for new cell construction, final cover system construction and final landfill closure, and landfill gas collection and control system (GCCS) installations. Mr. Isaac has prepared and certified construction quality assurance plans (CQAPs) for landfills used as the basis for performing field oversight and CQA services. Mr. Isaac has managed and certified the CQA activities on recent projects for Republic in Ohio at the Lorain County II Landfill, Lorain County I Landfill (Closed), Countywide Recycling and Disposal Facility, County Environmental of Wyandot Landfill, County Land Development (CLD) Landfill, and Lewis Landfill (Closed) and Imperial Landfill in Pennsylvania. He has successfully completed and received approval of Construction Certification Reports from the Ohio Environmental Protection Agency (Ohio EPA) and the Pennsylvania Department of Environmental Protection (PADEP) for various types of construction at each of these landfills.

In addition, Mr. Isaac brings to his work extensive experience in managing feasibility studies (FS) and remedial design/remedial action (RD/RA) for Superfund sites under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and state-led remedial sites, as well as managing corrective measures studies (CMS) and implementation of remediation systems for operating facilities under Resource Conservation and Recovery Act (RCRA). He also possesses extensive experience with bid procurement services including preparation of contract documents, technical specifications, and construction drawings for a wide variety of projects including solid and hazardous waste facilities, remediation, and the cleaning and demolition of buildings, both municipal and industrial. He participates in and/or conducts pre-bid and pre-construction meetings, bid review, evaluation, recommendation, and contract award.

Assignment

Certifying Engineer

Education

B.S. Civil Engineering, West Virginia University, Morgantown, 1978

Registration

Professional Engineer in Ohio, Michigan, Pennsylvania, Mississippi, Louisiana, and West Virginia; Virginia (retired status); Colorado (retired status); Wyoming (retired status); and Montana (retired status)

Experience

34 years

Joined Firm

2007

Training

OSHA 29 CFR 1910.120, Health and Safety Training

Relevant Expertise

- *Solid and Hazardous Waste Management*
- *CQA Oversight and Management*
- *CERCLA, RCRA, and Remediation*
- *Site Assessments and Investigations*
- *Regulatory Compliance*
- *Storm Water/Surface Water Management*
- *Abandoned Mine Lands and Mining*

Solid and Hazardous Waste Management

Reservoir Liner and Earthwork CQA Services, City of Fremont, Fremont, Ohio

Certifying Engineer. Managed the CQA for the installation of a 96 acre liner system for a raw water reservoir in Fremont, Ohio. The liner system included, in ascending order, Bentomat 200R geosynthetic clay liner (GCL), 40-mil smooth linear low density polyethylene (LLDPE) geomembrane, 10 oz./sy. nonwoven geotextile, and 18-inches of protective soil on the reservoir floor and Bentomat DN GCL, 40-mil textured LLDPE geomembrane, 10 oz./sy. nonwoven geotextile, 12-inches of sand material, 4-inch bedding stone, and 24-inch dumped rock riprap on the reservoir slopes. Provided direction to the field inspectors who were onsite full-time throughout the duration of the liner installation activities. Perform review and approval of the quality control (QC) testing for the liner materials and oversight for the quality assurance (QA) sample collection and testing of the liner materials. The CQA inspectors performed field density/moisture testing for the liner system subgrade and replacement of the reservoir dam to facilitate the liner anchor trench. Prepared and served as the "Engineer of Record" for the Certification Report submitted to the Ohio Department of Natural Resources (ODNR) to document the reservoir liner installation.

Lorain County II Landfill Gas CQA Services, Republic Services, Inc., Oberlin, Ohio

Certifying Engineer. Managed the CQA for the installation of a 24-inch diameter high density polyethylene (HDPE) header pipeline to connect onsite enclosed flares to a gas plant at a landfill in Oberlin, Ohio. Provided direction to

the field inspectors who were onsite full-time throughout the duration of the pipeline installation activities. The header installation included the 24-inch diameter HDPE pipeline with a 3-inch by 6-inch diameter HDPE force main, 3-inch diameter HDPE airline, and 3-inch diameter HDPE communications conduit. Seven 48-inch diameter HDPE condensate pump station were installed along the header. Assisted in the preparation, performed QA review, and served as the "Engineer of Record" for the Certification Report submitted to the Ohio EPA to document the header line installation.

Lorain County II Landfill Gas Design and CQA Services, Republic Services, Inc., Oberlin, Ohio

Certifying Engineer. Managed the CQA for the expansion of the landfill gas management system at a landfill in Oberlin, Ohio. Provided direction to the field inspectors who were onsite full-time throughout the duration of the expansion implementation activities. The expansion activities included installation of an enclosed flare station, condensate sumps, 24-inch and 18-inch diameter HDPE header pipelines, laterals to new and re-drilled gas extraction wells, condensate and airlines, and road crossings. Managed the preparation and provided QA review of the construction drawings for the landfill gas management system expansion. Assisted in the preparation, performed QA review, and served as the "Engineer of Record" for the Certification Report submitted to the Ohio EPA to document the landfill gas system expansion installation.

Lorain County I Landfill (Closed) Gas CQA Services, Allied Waste Industries, Inc., Oberlin, Ohio

Certifying Engineer. Managed the CQA for the expansion of the landfill gas management system at a closed landfill in Oberlin, Ohio. Provided direction to the field inspectors who were onsite full-time throughout the duration of the expansion implementation activities. The expansion activities included installation of 8-inch diameter HDPE header pipelines, laterals to new and re-drilled gas extraction wells, installation of Landtec combination wellheads, leachate system force main, condensate and airlines, and road crossings. Assisted in the preparation, performed QA review, and served as the "Engineer of Record" for the Certification Report submitted to the Ohio EPA to document the landfill gas system expansion installation.

County Land Development Landfill Closure CQA Services, Republic Services, Inc., Salem, Ohio

Project Manager/Certifying Engineer. Managed the CQA for the implementation of final closure activities at a sanitary/construction demolition debris (C&DD) landfill in Salem, Ohio. Provided direction to the field inspectors who were onsite full-time throughout the duration of the final closure implementation including final cover construction, landfill gas management system expansion, and storm water controls. Managed and assisted in the preparation, performed quality assurance (QA) review, and served as the "Engineer of Record" for the Final Closure Certification Report submitted to the Ohio EPA to document the implementation of the final landfill closure construction.

County Environmental of Wyandot Landfill Gas Design and CQA Services, Republic Services, Inc., Carey, Ohio

Certifying Engineer. Managed the CQA for the expansion of the landfill gas management system at a landfill in Carey, Ohio. Provided direction to the field inspectors who were onsite full-time throughout the duration of the expansion implementation activities. The expansion activities included installation of an enclosed flare station, condensate sumps, 24-inch diameter high-density polyethylene (HDPE) header pipeline, laterals to new and re-drilled gas extraction wells, condensate and airlines, and road crossings. Managed the preparation and provided QA review of the construction drawings for the landfill gas management system expansion. Assisted in the preparation, performed QA review, and served as the "Engineer of Record" for the Certification Report submitted to the Ohio EPA to document the landfill gas system expansion installation.

Cherokee Run Landfill Gas Design Services, Republic Services, Inc., Bellefontaine, Ohio

Certifying Engineer. Managed the design of the expansion of the landfill gas management system at a landfill in Bellefontaine, Ohio. Provided direction to the design engineers who prepared the construction drawings and details for use by the installer to construct the landfill gas management system expansion. The expansion activities included installation of a condensate sump, 18-inch diameter HDPE header pipeline, laterals to new and re-drilled gas extraction wells, and condensate and airlines. Provided QA review of the construction drawings for the landfill gas management system expansion.

Noble Road Landfill Vertical Expansion Perimeter Berm Design, Republic Services, Inc., Shiloh, Ohio

Project Manager/Certifying Engineer. Managed the design of a perimeter berm used to expand the available air space at a landfill in Shiloh, Ohio. Provided direction and assisted staff engineers in the preparation of "construction-ready" design drawings for use by contractors in preparation of bids. The drawings included grading plans, construction sequence plans, leachate management system plans, storm water management plans, and details. Prepared the contract documents and technical specifications for use by contractors in preparing bids. Participated in the bid procurement, bid review, and contractor selection for construction of the perimeter berm. Performed QA review, and served as the "Engineer of Record" for the berm design.

Hazardous Waste Landfill Remediation, Laufen International, Inc., East Sparta, Ohio

Project Manager/Certifying Engineer. As part of a RCRA Corrective Action through a Consent Decree with the U.S. EPA Region 5, prepared an Interim Measures Work Plan for the remediation of a hazardous waste landfill at a facility in eastern Ohio. The Interim Measures included landfill cap enhancements, leachate management system modifications, construction of a flood protection levee, modification of the perimeter surface drainage system, and modification of the settlement monitoring program. Managed and prepared the contract documents, technical specifications, and drawings to procure a geosynthetics installer for the synthetic components of the new final cover system. Managed the implementation and CQA for the construction of the Interim Measures including construction of a new final cover system to encapsulate the existing landfill and the geotechnical program and construction of the flood protection levee. Prepared the construction certification report for submittal to the U.S. EPA following completion of the remediation activities.

Design, Permitting, and Construction of a Solid Waste Transfer Station, Rumpke Waste, Inc., Ironton, Ohio

Project Manager/Certifying Engineer. Managed the design, permitting, and construction of a solid waste transfer station for a major solid waste company in southeast Ohio. The facility permit was through the Ohio EPA Southeast District Office in accordance with the Ohio Administrative Code rules and regulations pertaining to transfer stations. Coordinated and managed the transfer facility design by assembling a team of design professionals including site work, geotechnical and structural, environmental management systems, architectural, and mechanical, electrical, and plumbing including both wet and dry fire suppression systems. Prepared and obtained the required building permits through the Ohio Department of Commerce, Bureau of Building Code Compliance office. Managed the preparation of the contract documents, technical specifications, and construction drawings including QA/QC of the final bid documents and was responsible for the bid procurement including pre-bid meeting, bid evaluation, recommendation, and contract award. Performed limited CQA during the facility construction including project progress meetings, contractor requests for information, pay application review and approval, and change order requests.

Design and Permitting for a Type I Restricted Waste Landfill, Mittal Steel USA, Burns Harbor, Indiana

Project Manager/Certifying Engineer. Managed the design and permit preparation for a Type I Restricted Waste Landfill for disposal of secondary wastewater treatment plant sludge at a major steel manufacturing facility in Indiana. Performed the leachate management system evaluation including landfill floor configuration, HELP Model to determine leachate volumes, and design calculations for pipe sizes, perforation openings, sumps, and pumps. Assisted with the preparation of the Special Exception to the Zoning Application required for the facility.

C&DD Landfill Closure Certification, Stambaugh Properties Ravenna, Ohio

Project Manager/Certifying Engineer. Managed the closure and closure certification of a C&DD landfill in Ravenna, Ohio. Performed field oversight services including soil sample collection for geotechnical analysis. Prepared the Closure Certification Report and served as the Engineer-of-Record. Submitted the Closure Certification Report to the Portage County Health Department.

Hazardous Waste Facility Post – Closure Plan, ESAB Welding & Cutting Ashtabula, Ohio

Design Engineer. Prepared and submitted to the Ohio EPA a hazardous waste facility post-closure plan for former lime ponds and associated impoundments at a welding wire manufacturer in Northeast Ohio. Post-

closure plan included discussions on site security, inspection plan, monitoring plan, maintenance plan, and financial assurance.

Design and Permitting of a Solid Waste Transfer Station, Waste Management, Inc., Wooster, Ohio

Design Engineer. Managed the design and permitting of a solid waste transfer station for a major solid waste company in central Ohio. The design included grading and storm water control plans, vehicle sequencing and staging plans, and detailed design of the transfer building structure and operating pad.

Design and Permitting for the Vertical Expansion of a Sanitary Landfill, Mid-American Waste Systems, Gary, Indiana

Design Engineer. Managed the design and permitting for the vertical expansion of an existing sanitary landfill. Project included the design of leachate management, gas management, grading, closure and post-closure, and erosion and sediment control plans. Coordinated site remediation activities, including a toe drain collection and conveyance system and a groundwater cut-off slurry wall.

Design and Permitting for the Upgrade and Compliance of a Large Sanitary Landfill, City of Virginia Beach, Virginia

Project Manager/Design Engineer. Managed the design and permitting for upgrade and compliance of a large existing sanitary landfill located in the Tidewater region of Virginia with new Subtitle D regulations. The design included plans for grading, leachate collection system and groundwater underdrain, closure and post-closure, and storm water management. Wetlands associated with expansion were permitted through the US Army Corps of Engineers Nationwide 26 Permit process.

Design and Closure of an On-Site Waste Disposal Site at an Aluminum-Processing Facility, Alcoa Cleveland Works, Cleveland, Ohio

Design Engineer. Managed the design and closure of an on-site waste disposal site at an aluminum processing facility. Closure plan included grading, storm water management, gas management, post-closure care, and land-use plans.

Design and Permitting for Closure of Three Disposal Units at a Coke Facility, Wheeling-Pittsburgh Steel, Follansbee, West Virginia

Design Engineer. Managed the design and permitting for the closure of three disposal units located at a coke facility along the Ohio River. Closure plans included grading, storm water management, gas management, and post-closure care and land use plans. Designed the closure plans and prepared permit applications as "fast track" projects in order to meet imposed regulatory deadlines.

Closure of a Hazardous Ash Disposal Impoundment at a Paint Pigment Facility, Cytec Industries, Inc., Washington, West Virginia

Design Engineer. Managed the closure of a hazardous ash disposal impoundment at a paint pigment facility located along the Ohio River in West Virginia. The closure included final grading plan; final cover system configuration, including geogrids to allow construction equipment access to the ash material during the construction phase; and surface water management.

Design and Preparation of Permit Application Drawings for the Vertical Expansion of a Landfill, City of Barnstable, Massachusetts

Design Engineer. Managed the design and preparation of permit application drawings for the vertical expansion of an existing landfill in Massachusetts. The project included the design of grading plans, disposal cell phase and sequence plans, storm water management, leachate collection and treatment systems, landfill gas management system, liner and fill cap system configurations, and closure and post-closure care plans. The existing site is located on Cape Cod within a Zone II Aquifer system, which required specialized engineering designs to ensure zone environmental protection of the groundwater systems at the site.

Preparation of a Waste Alternatives Study for a Large Paper Mill Facility, WESTVACO, Luke, Maryland

Design Engineer. Managed the preparation of a Waste Alternatives Study for a large paper mill facility located in western Maryland. The study compared the development, design, permit preparation, and construction of two potential landfill sites: one located in West Virginia and the second located in Maryland. The study

evaluated operations, design, permitting, material hauling to each site, and construction of each potential site for a study period of 20 years, with present worth analysis performed to determine capital required to finance the project. Each potential site was also compared to contract waste collection, transportation, and disposal by an independent waste contractor.

Design and Permitting for a Construction and Demolition Debris Landfill, Warren Recycling, Inc., Warren, Ohio

Project Manager/Design Engineer. Managed the design and permitting for a C&DD landfill located in Warren, Ohio. The project included License Application forms, grading plans, leachate management plans, storm water management plans, and fill sequence plans. Applied for and received a variance from groundwater monitoring from the City Health Department.

Design and Permitting for a Construction and Demolition Debris Landfill, Iron Valley, Chesapeake, Lawrence County, Ohio

Project Manager/Design Engineer. Managed the design and permitting for a C&DD landfill located in Lawrence County, Ohio. The project included License Application forms, grading plans, leachate management plans, storm water management plans, and fill sequence plans.

Design and Permitting of the Closure for a Residual Carbon Waste Disposal Facility, The Stackpole Corporation, St. Marys, Pennsylvania

Design Engineer. Managed the design and permitting of the closure for a residual carbon waste disposal facility in Pennsylvania. Design included a combination RCRA-style final cover system and standard State of Pennsylvania cover system.

CERCLA, RCRA, and Remediation

RD/RA and Implementation of Closure for a Site in Elyria, Ohio

Certifying Engineer/Designer. Prepared the bid documents, technical specifications, and construction drawings for the construction of a steep slope (2:1) soil buttress from the river plain to the crest and installation of a 1976 Ohio EPA-compliant final cover system at a former landfill site. Soil buttress had specific strength requirements for the soil related to slope stability issues and the final cover system incorporated low permeability soil ($k \leq 1x10^{-5}$ cm/sec). The steep slope incorporated GreenArmour™ 7020 turf reinforcement mat with Flexterra® HP-FGM™ flexible growth medium with a steep slope seed mix developed for the site to control erosion. Bid documents and technical specifications were prepared to following the CSI 2004 format. Participated in pre-bid meetings, bid evaluation, and contractor recommendation and contract award. Served as the Engineer-of Record for the design and assisted with the field CQA program including contractor oversight, project progress meetings, and contractor requests for information.

Bid Documents, Technical Specifications and Construction Drawings for a Hydraulic Barrier Wall and Groundwater Extraction and Treatment System for a Site in Holland, Michigan

Certifying Engineer/Designer. Prepared the bid documents, technical specifications, and construction drawings for the installation of a hydraulic barrier wall and groundwater extraction and treatment system at a former manufacturing site. The hydraulic barrier wall consists of a soil-bentonite (SB) slurry wall and blast furnace slag- cement-bentonite (BFSCB) slurry wall. Groundwater extraction and treatment system consists of five extraction wells, water filtration treatment, and deep well injection under high pressure. Bid documents and technical specification were prepared to following the CSI 2004 format. Participated in pre-bid meetings, bid evaluation, and contractor recommendation and contract award. Served as the Engineer-of Record for the design and assisted with the field CQA program including contractor oversight, project progress meetings, and contractor requests for information.

Preparation of RD/RA for Former Tar and Chemical Facility, Reilly Industries, Inc., Dover, Ohio

Project Manager/Design Engineer. Managed the preparation of the RD/RA for a former tar and chemical facility located in Dover, Ohio. The remedial design included excavation of on-site soils and sediments contaminated with polycyclic aromatic hydrocarbons (PAHs), and benzene, toluene, ethylbenzene, and xylene (BTEX) for either off-site treatment by thermal destruction and disposal or placement within an on-site building foundation closed by the construction of an Ohio EPA- compliant solid waste final cover system; construction of

a groundwater recovery trench with recovered groundwater discharged to the local publically owned treatment works (POTW); and placement of soil cover.

Hydrogeologic Site Investigation and Preparation of a Focused FS for a Lagoon at a Major Coke-Producing Facility, US Steel, Clairton, Pennsylvania

Design Engineer. Managed the performance of a hydrogeologic site investigation and preparation of a "focused" FS for a lagoon contaminated with polynuclear aromatic hydrocarbons, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) at a major coke- producing facility. Performed the FS to adhere to the requirements of the Pennsylvania Department of Environmental Protection (PADEP). Alternatives evaluated included augmenting the existing groundwater pump and treat with lagoon sediment solidification/stabilization and construction of a PADEP-compliant final cover system.

Site Investigation, Permitting, Remedial Design, and Remediation Implementation at a Creosote Wood Treating Facility, Southern Wood Piedmont, Benson, North Carolina

Design Engineer. Managed the site investigation, permitting, remedial design, and remediation implementation at a creosote wood treating facility in North Carolina. Surface impoundments used for disposal of creosote and surface water were remediated by stabilization/solidification of the resulting sludge and covering with a solid-waste-style final cover system.

Preparation of a Feasibility Study for a Large Primary Aluminum Facility, Ormet, Hannibal, Ohio

Design Engineer. Managed the preparation of a FS for a large primary aluminum facility located along the Ohio River in the State of Ohio. Five impoundments, a former potash disposal area, a former spent carbon disposal area, a former construction material and demolition debris area, and the backwash area required remediation for fluoride, cyanide, and VOCs. The final proposed remedy included construction of RCRA-style final cover systems; soil washing/soil flushing aided by a Ranney well, which influenced the flow of groundwater; and river sediment dredging.

Preparation of a "Focused" Corrective Measures Study for a Hazardous Measures Recycling Facility, Safety-Kleen, Hebron, Ohio

Design Engineer. Managed the preparation of a "focused" CMS for a hazardous materials recycling facility in the State of Ohio. Implemented interim corrective measures including groundwater recovery wells and low-profile air stripper with a groundwater cut-off wall. The CMS evaluated alternatives for remediating VOCs that had entered the soils and groundwater as a result of a fire at the facility.

Design of an Ultraviolet Peroxidation Groundwater Treatment System, Honeywell, Annapolis, Maryland

Design Engineer. Managed the design of an ultraviolet (UV) peroxidation groundwater treatment system. The design included the UV system and associated groundwater recovery system for the remediation of VOCs, and SVOCs. Prepared contract documents, technical specifications, and construction drawings for use in the contractor bid procurement process.

Paint Sludge and Sediment Remediation in Lake Michigan, Flanders Industries, Inc., Menominee, Michigan

Design Engineer. Managed the design and preparation of contract documents, technical specifications, and construction drawings for paint sludge and sediment remediation in Lake Michigan. Project included the design and construction of an impermeable dike built in Lake Michigan to isolate the contaminated sediments, sediment removal plans, sediment staging and sequencing plans, sediment testing plans, and site restoration plans.

Design and Construction of a Recovery and Treatment System at a Carbon Graphitizing Facility, The Stackpole Corporation, St. Marys, Pennsylvania

Provided QA/QC and senior oversight for the design and construction of a recovery and treatment system at a carbon graphitizing facility in Pennsylvania. The system included 14 groundwater recovery wells and soil vapor extraction for chlorinated organics.

General Engineering

Implementation of Design/Build Services for Building Demolition, TRW, Inc., Cleveland, Ohio

Lead Engineer Responsible for providing direction and oversight to the onsite CQA inspector throughout the performance of the building demolition for a former automobile parts manufacturing facility. Site activities included asbestos abatement, multi-story building complex demolition consisting of steel and wood frame, concrete, block and brick buildings including removal, cleaning, and off-site disposal of tanks and pipelines containing residual materials, removal, cleaning, and off-site disposal of PCB-containing transformers, and segregation and recycling of steel, concrete, and brick materials. Provided interpretation of project specifications and conducted bi-monthly project progress meetings.

Design, Technical Specifications and Construction Drawings for Filter Press installation, Whirlpool Corporation, Marion, Ohio

Project Manager for the design and preparation of technical specifications and construction drawings for the installation of a filter press in an existing water treatment building. Prepared the civil component of the specifications and drawings and managed the preparation of the structural, mechanical, electric, and plumbing (MEP) components of the project. Installed the filter press in the existing filter press building by retrofitting the inside of the building and the existing structural components and MEP. Installation of the filter press allowed the client to realize a two-fold increase in filtering the effluent from the onsite wastewater treatment plant (WWTP).

Technical Specifications and Construction Drawings for Building Demolition, City of Dayton, Office of Economic Development, Dayton, Ohio

Design Engineer. Prepared the contract documents, bidding documents, technical specifications, and construction drawings for the demolition of a 845,000 square foot, multi-story building complex consisting of steel frame, concrete, block and brick buildings including removal and off-site disposal of tanks and pipelines containing residual materials. Contract and bidding documents were prepared to adhere to client's (municipal) preferred formats. Participated in pre-bid and pre-demolition meetings, bid evaluation, and contractor recommendation and contract award. Managed the CQA program including contractor oversight, project progress meetings, and contractor requests for information.

Technical Specifications and Construction Drawings for Building Demolition, Columbus Recreation and Parks, Columbus, Ohio

Project Manager/Design Engineer. Prepared the contract documents, bidding documents, technical specifications, and construction drawings for the demolition of a 25,500 square foot, three-story, steel frame, concrete, block and brick building including removal and off-site disposal of an underground storage tank (UST). Contract and bidding documents were prepared to adhere to client's (municipal) preferred formats. Participated in pre-bid and pre-demolition meetings, bid evaluation, and contractor recommendation and contract award. Project included field survey and verification of existing utilities associated with the building and preparation of a site grading plan following removal of the building debris from the site.

Cleaning, Asbestos Abatement, and Demolition of Aboveground Storage Tanks, Buildings, Process Equipment, and Pipelines at a Large Coal Tar Refining Facility, Reilly Industries, Inc., Cleveland, Ohio

Project Manager/Design Engineer. Managed the cleaning, asbestos abatement, and demolition of aboveground storage tanks (500 to 1,000,000 gallons) and pipelines and demolition of facility buildings and process equipment at a large coal tar refining facility under the Ohio EPA Cessation of Regulated Operations (CRO) Program. Products produced at the site included coal tar and coal tar distillates, creosote, naphthalene, and oils. Directly prepared technical specifications and construction drawings for use in bid procurement, conducted pre-bid and pre-demolition meetings, bid review and evaluation and assisted client with contract award. Managed the field oversight services throughout performance of the field activities.

Site Assessments and Investigations

Preparation of Phase I Environmental Site Assessment, City of Steubenville, City Engineer, Steubenville, Ohio

Project Manager. Performed the Phase I Environmental Site Assessment (ESA) in accordance with ASTM E1527-00 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process. The Phase I ESA included environmental database searches, interviews with past property owners, limited title searches, site reconnaissance, agency information reviews, and report preparation.

Preliminary Phase II Site Screening, Whittier Peninsula Properties, Columbus Recreation and Parks, Columbus, Ohio

Project Manager. The purpose of the site screening was to review historical information and data related to environmental issues and concerns associated with the Peninsula properties, develop a site ranking system, and develop preliminary recommendations and costs for performing Phase II site investigation activities to identify potential impacts to the soils and groundwater at the Whittier Peninsula.

Phase II Environmental Site Investigation, Whittier Peninsula Properties, Columbus Recreation and Parks, Columbus, Ohio

Project Manager. The Phase II ESI included field work, laboratory analysis, and reporting writing in accordance with the Ohio EPA Voluntary Action Program (VAP) rules and regulations. Field work included collection of soil samples using the Geoprobe® Direct-Push Technology and installation and sampling of groundwater monitoring wells. Prepared the report narrative text, tables, and drawings.

Preparation of Phase I Environmental Site Assessment, City of Columbus, Street Design Department, Columbus, Ohio

Managed and provided QA/QC for a Phase I ESA of Short Street in Columbus, Ohio. Performed the Phase I ESA for the City of Columbus Street Design Department as part of the street-widening program. Used ASTM E1527-00 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process in the performance and preparation of the Phase I ESA report.

Preparation of Phase II Environmental Site Investigation, City of Columbus, Street Design Department, Columbus, Ohio

Managed and provided QA/QC for a site investigation performed at Reynolds Avenue in the City of Columbus, Ohio. Performed work for the City of Columbus Street Design Department as part of the street-widening program. The site investigation included the performance of Geoprobe holes to collect soil samples for laboratory analysis prior to initiation of construction activities. Prepared a Phase II Environmental Site Investigation Report presenting the results of the investigation and conclusions that no subsurface contamination was present within the construction limits.

Preparation of Phase II Environmental Site Investigation, City of Columbus, Street Design Department, Columbus, Ohio

Managed and provided QA/QC for a site investigation at an intersection along Hudson Street in the City of Columbus, Ohio. The intersection was being modified to include turning lanes and Geoprobe holes were performed to collect subsurface soil samples. Performed work for the City of Columbus Street Design Department as part of the street-widening program.

Phase II Environmental Site Investigation and Remediation, City of Columbus, Street Design Department, Columbus, Ohio

Managed and performed QA/QC for a site investigation and remediation of a former dry-ice manufacturing facility along McKinley Avenue in Columbus, Ohio. The City of Columbus Street Design Department was widening McKinley Avenue. Used Geoprobe technology to collect subsurface soil samples for purposes of determining the presence of contamination within the construction limits. A former dry ice manufacturing facility, located along the revised road centerline, required remediation of an existing concrete vault prior to demolition to allow construction to proceed. Cleaned the vault by power washing and vacuuming with off-site disposal of the resulting sludge and rinsate waters.

Compliance

Spill Prevention, Control, and Countermeasure Plans – Medical Center, The Ohio State University, Columbus, Ohio

Prepared the Spill Prevention, Control, and Countermeasure (SPCC) Plans for the OSU Main Campus Medical Center and the Hospital East Complex in accordance with the requirements of 40 CFR 112 for The Ohio State University (OSU) in Columbus, Ohio. Reviewed facility specific oil storage areas, performed facility inspections, and prepared the SPCC Plans using the "poster-format" with cross-references and supporting documents.

Spill Prevention, Control, and Countermeasure Plan, The Ohio State University, Columbus, Ohio

Performed the "five-year" review and evaluation of existing Spill Prevention, Control, and Countermeasure (SPCC) Plans for re-certification in accordance with the requirements of 40 CFR 112 for The Ohio State University (OSU) in Columbus, Ohio. Reviewed, revised, and re-certified the Master SPCC Plan for the OSU main campus. Reviewed facility specific SPCC Plans, performed facility inspections, and revised the SPCC Plans using the "poster-format" with cross-references and supporting documents for four facilities within the OSU main campus: Center for Automotive Research, McCracken Power Plant, Transportation and Parking Services, and the Scarlet and Gray Golf Course. Also reviewed the SPCC Plan for the Wooster Campus of OSU in Wooster, Ohio, performed a site inspection, and prepared and certified the "poster-format" with cross-references and supporting documents.

Integrated Contingency Plan (ICP), The Ohio State University, Don Scott Field, Columbus, Ohio

Prepared an ICP for The Ohio State University Airport, Don Scott Field. Combined the existing Storm Water Pollution Prevention Plan (SWP3) and the existing SPCC Plan into one document that also included a new emergency response plan for the airport. The ICP addressed the onsite Avgas and Jet A aviation fuel storage facility, mobile aircraft refuelers, and two maintenance facilities resident on the airport property. Prepared the ICP in accordance with the National Interagency Incident Management System (NIIMS) Incident Command System (ICS) that is a nationally recognized system that provides a commonly understood framework that allows for effective interaction among response personnel, thus facilitating its ease of use during an emergency situation.

Spill Prevention, Control, and Countermeasure Plan, Denison Hydraulics, Marysville, Ohio

Prepared SPCC Plan to bring the Denison Hydraulics facility in compliance with the requirements of 40 CFR 112 for a specialty hydraulic equipment manufacturing facility in Marysville, Ohio. Prepared the SPCC Plan text, drawings, and appendices based on review of historic records, conversations with facility personnel, and site inspections. Served as the "Engineer-of-Record" for certification of the SPCC Plan.

Spill Prevention, Control, and Countermeasure Plan, Koneta Rubber, Wapakoneta, Ohio

Prepared SPCC Plans to bring two facilities in compliance with the requirements of 40 CFR 112 for a specialty rubber manufacturing facility in Wapakoneta, Ohio. Prepared the SPCC Plan text, drawings, and appendices based on review of historic records, conversations with facility personnel, and site inspections. Served as the "Engineer-of-Record" for certification of the SPCC Plans.

Notice of Intent and Storm Water Pollution Prevention Plan, United Precast, Mount Vernon, Ohio

Prepared and submitted the Notice of Intent (NOI) for a concrete manufacturing facility in central Ohio to provide coverage of the facility under the General Permit Authorization to discharge Storm Water Associated with Industrial Activity (General Permit No. OHR000003) Under the National Pollutant Discharge Elimination System (NPDES) as administered by the Ohio EPA. As a condition of the General Permit, prepared the SWP3 for the facility including a site walk over, material inventory, preliminary development of "Best Management Practices (BMPs)", certification of non-storm water discharges, and recommendations for implementing BMPs to minimize contact with storm water.

Spill Prevention, Control, and Countermeasure Plan, Campbell Soup Company, Napoleon, Ohio

Reviewed and revised existing SPCC Plan for re-certification in accordance with the requirements of 40 CFR 112 for a food manufacturing facility in Napoleon, Ohio. Prepared revisions to the SPCC Plan based on the site inspection and updated the existing plan to adhere to the revised SPCC Plan Rules and Regulations effective as of August 16, 2002.

Spill Prevention, Control, and Countermeasure Plan, Lumi-Lite Candle Factory, Norwich, Ohio
Reviewed and revised existing SPCC Plan for re-certification in accordance with the requirements of 40 CFR 112 for a candle manufacturing facility in Norwich, Ohio. Prepared revisions to the SPCC Plan based on the site inspection and updated the existing plan to adhere to the revised SPCC Plan Rules and Regulations effective as of August 16, 2002.

Spill Prevention, Control, and Countermeasure Plan, Confidential Client, Bucyrus, Ohio
Reviewed and revised existing SPCC Plan for re-certification in accordance with the requirements of 40 CFR 112 for a rubber and plastic hose manufacturing facility in Bucyrus, Ohio. Prepared revisions to the SPCC Plan based on the site inspection and updated the existing plan to adhere to the revised SPCC Plan Rules and Regulations effective as of August 16, 2002.

Conditional No Exposure Exclusion for Industrial Activity, Delphi Automotive Systems, Warren, Ohio
Performed site inspections and developed inspection forms for five automotive parts manufacturing facilities to determine compliance with the NPDES, Storm Water Phase II Final Rule – Conditional No Exposure Exclusion for Industrial Activity as administered by the Ohio EPA. Used the initial facility inspections to develop forms that the client could use to perform subsequent annual compliance inspections. Provided a summary of issues to be addressed prior to submitting Conditional No Exposure Exclusion requests to the Ohio EPA.

Spill Prevention, Control, and Countermeasures Plan Re-Certification, Delphi Automotive Systems, Warren, Ohio
Perform review, prepared revisions, and re-certified SPCC Plans in accordance with the requirements of 40 CFR 112 for a major automotive parts manufacturer in Northeast Ohio. Performed site inspections for two facilities, updated the SPCC Plans, and signed as the "Engineer of Record".

Storm Water Pollution Prevention Plans, Delphi Automotive Systems, Warren, Ohio
Performed site inspections, review of existing plans, and prepared required revisions of SWP3s for a major automotive parts manufacturer in Northeast Ohio. Reviewed and revised the SWP3s in accordance with the facilities General Permit Authorization to Discharge Storm Water Associated with Industrial Activity under the NPDES.

Aboveground Tank Compatibility Certification, Yenkin-Majestic Paint Corporation, Columbus, Ohio
Certified the compatibility of an aboveground storage tank (AST) for use in storing waste solvents in accordance with Ohio Administrative Code (OAC) Rules and Regulations, Chapter 3745-66-92. Certification included inspection of the AST including overflow and automatic shut-off controls, preparation of the certification report and submittal to the Ohio EPA.

Storm Water/Surface Water Management

Design and Implementation of a "Class A" Trout Stream, Cerro Metal Products, Company, Bellefonte, Pennsylvania
Managed the design and implementation of a "Class A" trout stream in central Pennsylvania. Lead, copper, zinc, and PCBs contaminated the stream banks and sediment. Modeled 20+ square mile drainage area utilizing SEDCAD 4 software for the design of riprap/gabion baskets to stabilize the stream banks, following excavation and off-site removal of the contaminated soils and sediments. Prepared contract documents, technical specifications, and construction drawings. Completed the project on a "fast track" schedule due to strict regulatory deadlines.

Evaluation of Sedimentation Basin at a Sanitary Landfill, Private Landfill in Minnesota
Prepared the evaluation of an existing sedimentation basin at a sanitary landfill utilizing SEDCAD+ computer software. Modeled the watershed for the basin and added 1000 GPM of inflow from a groundwater recovery/treatment system. Treated the basin as an infiltration structure, which saved the client $200,000 by not having to construct a second basin to handle water from the groundwater recovery/treatment system.

Abandoned Mine Lands and Mining

Acid Mine Drainage, Investigation and Remedial Design, Meigs County, Ohio, Ohio Department of Natural Resources, Columbus, Ohio

Managed the investigation and remedial design for acid mine drainage (AMD) from old underground mine openings in Meigs County, Ohio. Basements of houses located within 30- to 50-feet of the toe of the slope were flooding during rainfall events due to saturation of the soils caused by AMD from the mine openings. Resealed the openings and employed an underdrain system to drain the back yards of the houses and former mine openings. Designed the underdrain system and constructed taking into account the proximity of the toe of the slope and the need to protect the integrity of the slope by preventing slope failure. Technical specifications and drawings were prepared in accordance with the Ohio Department of Natural Resources (ODNR) protocols.

Reclamation and Surface Erosion Remediation, Gallia County, Ohio, Ohio Department of Natural Resources, Columbus, Ohio

Managed the reclamation and surface erosion remediation at an abandoned mine land site in Gallia County, Ohio. The reclamation design involved the regrading of the site, including highwall and slope reduction to minimize future potential surface erosion problems. Developed technical specifications, prepared in accordance with the ODNR protocols, grading plans, and surface water control plans, in a format suitable for contractors to perform the reclamation work.

Mine Reclamation and Surface Erosion Remediation, Gallia County, Ohio, Ohio Department of Natural Resources, Columbus, Ohio

Managed the reclamation and surface erosion remediation at an abandoned mine land site in Gallia County, Ohio. The reclamation design involved the regrading of the site, including highwall and slope reduction to minimize future potential surface erosion problems. The grading plans were required to incorporate access to an active natural gas well located on the site. Developed topsoil borrow area plans (from adjacent undisturbed properties), including sampling plans, volume estimates, grading plans, and surface water control plans. Developed technical specifications, prepared in accordance with the ODNR protocols, grading plans, and surface water control plans, in a format suitable for contractors to perform the reclamation work.

Reclamation Design for Control of Acid Mine Drainage, Peabody Coal Company, St. Louis, Missouri

Prepared the reclamation design for control of AMD from an old abandoned auger mining pit in Missouri. AMD from the auger pit was flowing into the Clairton River and causing discoloration problems. The reclamation design included the construction of a sedimentation basin at the mouth of the valley leading from the old auger pit and prior to entering the river. Sedimentation basin outfall was a corrugated pipe down the slope to the river to minimize potential surface erosion attributed to the outfall.

Mine Plans and Reclamation Plans for Two Large Coal Mines, Powder River Coal Company, Bill, Wyoming

Prepared mine plans and reclamation plans for two large coal mines in Wyoming (6,000,000 tons/year and 8,000,000 tons/year). Plans included sequencing of strip pits, overburden handling, backfill, and grading plans. Storm water management included design of sedimentation basins, diversion ditches, containment berms, and ditches.

Permit Revisions to an Existing Mine Plan, Powder River Coal Company, Bill, Wyoming

Managed the preparation of permit revisions to an existing mine plan to include the construction of a concentric loop track, silo, slot storage, and conveyor system for increased coal handling, storage, and loading capacity. Following approval of the permit revision, managed the preparation of technical specifications and construction drawings for the required facility upgrades, the bidding and contractor procurement activities, and construction oversight activities throughout the construction of the project.

Underdrain System to Control Groundwater Flow at a Mine in the Rocky Mountains, Peabody Coal Company, Denver, Colorado

Designed an underdrain system to control groundwater flow beneath backfilled overburden at a mine in the Rocky Mountains. The underdrain allowed mining of the coal seam from the bottom of the mountain to the top,

instead of contour mining, which increased the amount of recoverable coal. Used the slope stability program REAME developed by the University of Kentucky to aid in the design and backfill placement of underdrain materials and overburden to create a stable backfill as part of the reclamation.

Major Channel Relocation/Remediation, Powder River Coal Company, Bill, Wyoming

Participated in the design, material handling, stockpiling, and backfilling of a major channel relocation/remediation. During the early stages of opening a new mine, relocated a major creek to allow for maximum recovery of the coal seam. As the creek was being stripped, selectively handled and stockpiled the material comprising the creek, i.e., sands, gravels, etc., for reconstruction during the reclamation process for this area. Following coal removal, reconstructed the stream in its former location, with each lithologic unit replaced to recreate the stream before mining events took place.

Publications

"Construction and Demolition Debris Rules in Ohio," Concrete Connection, Ohio Ready Mixed Concrete Association (ORMCA), November 1998

"Simplifying Environmental Planning Requirements," FOUNDRY Management & Technology, pp. 20-23, April 1999.

Elena R. Goodhall, P.E.

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Experience Summary

Ms. Goodhall is a Project Manager with 16 years of experience in landfill environmental management and environmental remediation. For the five years prior to coming to Brown and Caldwell, she was the Ohio Environmental Manager and Regional Environmental Manager for Republic Services Inc. (Republic, formerly Allied Waste Services, Inc.). Ms. Goodhall began with Allied Waste as an Environmental Manager in Ohio and has successfully developed an excellent relationship with all levels of Ohio EPA personnel. As Regional Manager, Ms. Goodhall addressed compliance, engineering, and construction issues for the region and developed and implemented leachate tracking logs; soil tracking, soil usage and tonnage policy; and aerial calculation review procedures for the region. Ms. Goodhall has successfully handled environmental permitting, including solid waste and air permits-to-install and zoning and wetland permitting. She also obtained the first and second Director's Exemptions granted in Ohio for siting landfills over 100-gpm aquifers. Ms. Goodhall has served in an engineering and management role on landfill construction and development projects, including waste relocation, cell construction and expansion, landfill gas and leachate management systems, and hazardous waste landfill management. Ms. Goodhall also served as lead Compliance and Quality Assurance manager and lead Liner Manager on several construction and development projects. Her landfill management experience includes groundwater monitoring programs, stormwater management programs, and the development of emergency action plans. Prior to her solid waste work for Republic, Ms. Goodhall had 10 years of experience investigating hazardous waste and brownfield sites, developing corrective actions, and overseeing the implementation of corrective measures at numerous sites in California, Michigan, and Ohio.

Assignment

Project Manager

Education

M.S., Hazardous Waste Management, Wayne State University, 2003

B.S. Civil Engineering, University of Michigan, 1994

Registration

Professional Engineer, Michigan

Certification

40-hour HAZWOPER with current 8-hour Refresher

First Aid and CPR Training

Nuclear Densometer Gauge Certification

Experience

16 years

Joined Firm

2009

Relevant Expertise

- *Solid Waste Facility Design and Construction*
- *Hazardous Waste Management*
- *Brownfield Redevelopment*

Countywide Recycling & Disposal Facility Isolation Break, Gas System, and Leachate Construction Quality Assurance (CQA) Services, Republic Services, Inc., East Sparta, Ohio

Project Manager. Managed the oversight and documentation for this United States Environmental Protection Agency (USEPA) required project to create complete separation between the 88-acre remediation area and the remainder of the cells at the Facility. This project was necessary due to a chemical reaction that is believed to be attributed to aluminum dross waste that the facility historically received. The project involved the installation of 52 landfill gas wells and associated headers and laterals, relocation of the site flares, installation of 24 acres of high-density polyethylene (HDPE) geomembrane, construction of 2 pump stations and complete isolation of the remediation leachate system. To document this work 4 separate certification reports were required due to various regulatory drivers. The facility's Division Manager commended Ms. Goodhall on how she took care of the client at this facility and dealt with the ever-changing staffing needs during the course of this 9-month long project.

Lorain County Landfill Gas Construction Drawings and CQA Services, Republic Services, Inc., Oberlin, Ohio

Project Manager. Ms Goodhall served as the project manager for the development of landfill gas construction drawings for this facility and the related construction quality assurance for the project. This project involved the installation of additional gas wells, header and lateral piping, isolation valves and the second enclosed flare for the facility.

County Environmental of Wyandot Landfill, Gas Construction Drawings and CQA Services, Republic Services, Inc., Carey, Ohio

Project Manager. Ms Goodhall served as the project manager for the development of landfill gas construction drawings for this facility and the related construction quality assurance for the project. This project involved the installation of additional gas wells, header and lateral piping, air and force main piping and the 2nd utility flare for the facility.

Cherokee Run Landfill, Gas Construction Drawings and CQA Services, Republic Services, Inc., Bellefontaine, Ohio

Project Manager. Ms Goodhall served as the project manager for the development of landfill gas construction drawings for this facility and the related construction quality assurance for the project. This project involved the installation of additional gas wells and additional header and lateral piping. In addition, BC provided oversight of repair work to the site's utility flare condensate sump and associated piping.

Conestoga Landfill, Allied Waste, Inc., Pennsylvania

Environmental Manager and Construction Manager. Managed a 22-acre time-critical cell construction project, initiated in 2008. Numerous challenges were encountered and successfully overcome during construction in early spring, and the cell was certified in time to prevent waste diversion to another facility. Ground water seeps encountered in the cell floor required redesign in the field. Responsible for pursuing and obtaining permit modifications, saving the facility approximately $4,000,000. After the merger between Allied Waste and Republic Services, she continued to provide construction management services to the facility on their 2009 17-acre time critical cell construction involving 500,000 CY of structural fill placement.

Gas System Assessments, Republic Services, Inc., Nationwide

Project Manager and Assessor. Conducted landfill gas system assessments at 14 Republic landfills to determine compliance Republic's national Standard Operating Procedures for Landfill Gas Operations and Maintenance. These assessments involve a thorough review of landfill gas monitoring data, reporting, and maintenance followed by recommendations to the facility on how to improve the implementation of the SOP and the operations of the gas system.

Allied Waste Services, Inc., Erie, Michigan

As a Regional Environmental Manager for Allied Waste Services, responsible for the regional management of landfill capital, closure and post-closure budgets, landfill development and construction, environmental compliance, and facility expansions for the 27 active landfills, 36 closed landfills, two closed hazardous waste landfills, 44 transfer stations/recycling stations and 62 hauling companies located in the Northeast and Eastern regions of the United States. Also developed and implemented regional initiatives to conduct training sessions for environmental managers, operations personnel, and consultants.

In this role, accomplished several key activities including:

- Developing and implementing leachate tracking log spreadsheets for 35 active landfills,
- Drafting and enforcing regional soil tracking, soil usage, and non-deplete tonnage policies,
- Developing, implementing and reviewing aerial calculation review spreadsheets for 35 landfills.

Lorain II and Lorain I Landfills, Allied Waste Services, Inc., Oberlin, Ohio

Engineer. Completed a 20-acre closure project and substantial gas system improvements to address odor complaints at the Lorain County II Landfill. At Lorain I, completed engineering oversight on a cap improvement project to minimize infiltration and leachate generation from this landfill. Also completed installation of combination gas wells and publically owned treatment works (POTW) projects involving leachate collection and disposal systems.

County Environmental of Wyandot Landfill, Inc., Allied Waste, Inc., Carey, Ohio

Engineer. Managed the relocation of approximately 1.4 million cubic yards of waste from an unlined portion of the facility to the lined portion of the facility. This waste relocation was successful in reducing the groundwater impacts identified at the facility.

Celina Sanitary Landfill, Allied Waste, Inc., Celina, Ohio

Engineer. Efforts resulted in successful expansion of the Celina Sanitary Landfill, adding nine years of site life to the facility. This work included obtaining a host agreement, a zoning permit, solid waste and air permits-to-install, and the first Director's exemption for siting a landfill over a 100-gpm aquifer granted in Ohio.

Cherokee Run Landfill, Allied Waste, Inc., Bellefontaine, Ohio

Engineer. Responsible for the successful expansion of Cherokee Run Landfill, adding 10 years of site life to the facility. This work included obtaining solid waste and air permits-to-install, and the second Director's exemption for siting a landfill over a 100-gpm aquifer granted in Ohio.

Noble Road Landfill, Allied Waste, Inc., Shiloh, Ohio

Engineer. Responsible for the continued pursuit of a vertical expansion, including design completion, hydrogeologic investigations, and wetland and air permitting. Permit to install (PTI) approval is expected in March 2009. Managed the permitting, design, construction, and startup of the gas system at Noble Road Landfill, which recently triggered regulatory requirements for an active gas system.

Celina and Cherokee Landfills, Allied Waste, Inc., Ohio

Engineer. Responsible for the continued pursuit of two lateral expansions, including design completion, hydrogeologic investigations, and wetland, air, and zoning permitting.

Landfill Construction, Allied Waste, Inc.

Engineer. Managed landfill construction projects, including eight cells, three caps, ten landfill gas systems, two flare installations, and three leachate system improvements. Three of these were time-critical off-season cell construction projects. As Ohio District Engineer, responsible for the permitting, construction, and compliance for six active landfills, three closed landfills, seven transfer stations, and two recycling facilities. In this role, she completed landfill expansions and construction projects, and delivered cost savings and improvements to several landfill sites.

Type III Landfill Cell Redesign, Construction, and Interim Cover Staking Plan, CEMEX, Inc., Charlevoix, Michigan

Technical Lead and Certifying Engineer. Served as Technical Lead for this 8-acre cell construction for a cement kiln dust landfill that is located just north of CEMEX's limestone quarry on Lake Michigan. Responsible for a fast-track redesign of the Phase II cell due required by verification surveying revealing that the quarry wall had been mined 150 feet into the Phase II cell area. The redesign was accomplished while the contractor continued onsite work, with no resulting downtime. Also served as the Lead Liner during installation of the geosynthetic clay liner and 60-mil HDPE geomembrane.

Fort Gratiot Type II Landfill Remedial Design, Michigan Department of Environmental Quality, Port Huron, Michigan

Technical Lead, Engineer of Record. Served as Project Manager for remedial activities at this 18-acre Part 201 Landfill. These activities included installation of a passive landfill gas venting control system, geosynthetic cover system, storm water controls, and leachate control system. Also served as Lead Liner during installation of the 40-mil linear low-density polyethylene (LLDPE) geomembrane and geocomposite layer.

Gratiot County Landfill Cap Repair and Emergency Methane Corrective Action, Michigan Department of Environmental Quality, Gratiot County, Michigan

Project Manager for remedial activities at this 42-acre landfill containing municipal and industrial waste including polybrominated biphenyl wastes. Identified methane concentrations in the explosive range at the property boundaries, developed design of an emergency corrective action, and coordinated monitoring of the corrective action. Also responsible for the coordination of quarterly groundwater sampling associated with the operating groundwater extraction treatment system, and supervising cap repairs that were necessary due to differential settlement.

Tobico Marsh State Game Area Landfill Characterization Survey and Decommissioning Plan, Michigan Department of Natural Resources, Kawkawlin Township, Michigan

Responsible for the completion of the radiological characterization survey and decommissioning plan in pursuit of the termination of the client's Nuclear Regulatory Commission license at a three-acre low-level radioactive

waste landfill. Served as Field Operations Leader during the six-month site characterization field work, which was completed in Level B PPE with radiological controls.

Citizens Disposal Landfill Peat and Marl Removal, Cell Excavation, and Berm Construction, Allied Waste, Inc., Grand Blanc, Michigan

Project Manager and Certifying Engineer for the removal of a non-regulated wetland within the footprint of the landfill, as well as cell excavation and berm construction.

Former Eaton Transmission Facility Brownfield Redevelopment, Michigan Department of Environmental Quality, Kalamazoo, Michigan

Technical Lead. This demolition project involved a 645,000-sq. ft. former transmission facility. Served as the Field Operations Leader during the pre-demolition sampling event, which involved coordinating activities for two sampling crews and two Geoprobe® rigs across the 50-acre site. Also coordinated the preparation of the demolition bid specifications and assisted the client during the procurement process for the demolition Trade Contractor. Acted as a liaison between the client and the contractor, monitoring compliance with contract specifications, reviewing and negotiating change orders, and reviewing and approving payment requests and associated documentation.

Welcome Center for Ambassador Properties Brownfield Redevelopment, Michigan Department of Environmental Quality, Detroit, Michigan

Technical Lead. This Brownfield project encompassed nearly 200 residential and commercial lots that were proposed for development as a Michigan Department of Transportation (MDOT) Welcome Center. Developed the Focused Feasibility Study for the parcels identified as Michigan Part 201 facilities, coordinated additional sampling at the site to determine the boundaries of the area to be excavated, and prepared of bid specifications for the contaminated soil removal. Provided construction oversight services during the soil removal.

Toledo Tie Treatment Site, Kerr-McGee Corporation, Toledo, Ohio

Project Engineer. Supervised construction quality control and documentation of all field activities for a $7 million Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) directed, time-critical removal action. Negotiated with regulators during the implementation of the time critical removal action, and designed appropriate engineering controls to mitigate remaining contamination.

Miscellaneous Solid Waste Landfills in Michigan and Ohio

Design Engineer. Served as a Design Engineer for several landfill sites throughout Michigan and Ohio. Responsibilities included:

- Performing landfill construction quality assurance during geosynthetic liner installation,
- Designing landfill staking plans and landfill stormwater improvement projects,
- Preparing landfill construction documentation reports, and
- Performing engineering calculations required for landfill permit applications.

U.S. Army Forces Command Installation Restoration Program Support Manager

- Developed and analyzed Forces Command's Cost to Complete Budget totaling $550 million.
- Developed 26 Installation Action Plans to address 5,000 former hazardous waste disposal sites.
- Provided technical and program support to 28 Installation Restoration Project Managers.

Fort Irwin Installation Restoration Program Manager

- Investigated former hazardous waste disposal sites at Fort Irwin, a 1,000 square mile installation.
- Managed over $14.5 million of Defense Environmental Restoration Program funds.

- Negotiated with various California regulatory agencies on behalf of Fort Irwin and the U.S. Army.
- Developed and implemented the Installation Action Plan.
- Implemented the Community Relations Plan for the Installation Restoration Program.
- Coordinated the field work for site inspections, remedial investigations, and remedial actions.

Bridge Scour Analyses, Michigan Department of Transportation, Various Michigan Sites

Performed 160 Level I and 37 Level II Bridge Scour Analyses. These included developing cross sections of the river upstream and downstream of the bridge, calculating the depth of scour, comparing to bridge foundation depth, and determining if corrective actions are required.

Vandevenne Drain Improvements, City of New Baltimore, Michigan

Modeled the existing conditions using HEC-2 program and designed improvements to the drain cross section to facilitate additional development in the area.

Rouge River Valley Combined Sewer Overflow (CSO) Study, Southeast Michigan

Evaluated proposed surface water monitoring locations, installed sampling equipment, and conducted sampling events during rain events. Also conducted CSO studies for Michigan municipalities.

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James A. Peeples, P.E.

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Experience Summary

Jim Peeples has a background in remediation technology, project management, and industrial wastewater treatment. His experience includes management, design, and implementation for a wide variety of remediation technologies. Mr. Peeples has extensive experience completing feasibility studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and corrective measures studies under Resource Conservation and Recovery Act (RCRA) for sites in Ohio and throughout the Midwest. He is frequently involved in negotiations, on behalf of clients, with the Ohio Environmental Protection Agency (Ohio EPA) and most regional offices of the United States Environmental Protection Agency (USEPA). Mr. Peeples has designed, installed and operated numerous of remediation systems, including soil vapor extraction, air sparging, biosparging, dual phase recovery, free product recovery, bioventing, bioslurping, in-situ oxidation, reductive dechlorination, cometabolic bioremediation, natural attenuation, and groundwater pump and treat. His combined background in quantitative hydrogeology and remediation technologies allows him to apply an integrated approach to the processes of remedial investigation and treatment system design. His industrial wastewater treatment work has focused mainly on treatment systems for landfill leachate, but has also involved the design of ultrafiltration systems for industrial clients. He has managed most types of environmental projects ranging from small service station investigations to major remediation projects in excess of $5 million.

Assignment

Technical Advisor

Education

M.S., Agricultural Engineering, The Ohio State University, 1990

B.S., Biology, Kent State University, 1982

Registration

Registered Professional Engineer, Ohio, 1996

Registered Professional Engineer, Florida, 2001

40-hour OSHA certified under 1910.120

Experience

20 years

Joined Firm

2003

Relevant Expertise

- *Feasibility Studies*
- *Corrective Measures Studies*
- *CERCLA, RCRA*
- *Remediation System Design*
- *Quantitative Hydrogeology*

Remediation Experience

Bioremediation of Chlorinated Solvents in Groundwater, Rockwell International, Heath, Ohio

Project Engineer. Completed this major feasibility study (FS) based on the results of a remedial investigation (RI) and human health risk assessment (HRA) for this eight million dollar project. Completed all aspects of the FS from the development of remedial action objectives to the selection of final remedies for the site. This CERCLA project involved significant negotiations with the Ohio EPA from the development of the FS workplan through the selection of final remedies. Remedial alternatives were developed and evaluated for the removal of a six-acre polychlorinated biphenyl (PCB)-impacted liquid non-aqueous phase liquid (LNAPL) plume, treatment of a 35-acre chlorinated solvents plume, and treatment/isolation of metals-impacted soils. Final remedies negotiated and selected for the site included reductive dechlorination and institutional controls for the chlorinated solvent plume, an extensive system of recovery wells for the PCB-impacted LNAPL plume, and capping and institutional controls for the metals impacted soils. Full-scale treatment is currently occurring at the site. Partnered the Ohio EPA throughout the project to gain acceptance for the implementation of technologies that had not been widely applied at other sites and for which the Ohio EPA had no prior exposure.

DNAPL Source Zone Treatment with Reductive Dechlorination, Confidential Client – Michigan

Project Manager/Project Engineer. Evaluated options for treatment of two dense non-aqueous phase liquid (DNAPL) zones at a former chemical manufacturing site in Michigan. The DNAPL source zones at this site are a complex mix of several chlorinated solvents and two relatively unique chlorinated compounds, hexachlorocyclopentadiene (C-56) and octachlorocyclopentene (C-58). The source zones have impacted the groundwater, creating a one-mile long dissolved-phase plume consisting primarily of tetrachloroethene (PCE) and carbon tetrachloride (CT). A pump and

treat system is in place to intercept the end of the plume and to prevent migration of the plume to a protected surface water body.

Previous evaluations of the DNAPL source areas had focused on the removal or destruction of the major DNAPL components, C-56 and C-58, and had not identified a technology capable of cost-effectively treating or removing these components. The USEPA Administrative Order for the site, in addition to requiring the plume containment system, required treatment or containment of the DNAPL source zones. Because no viable treatment technology had been identified, the client was preparing to install containment pumping at each source zone at a present-value cost of approximately $10 MM.

Reviewed test data from previous site investigations, bench tests, and pilot tests. Developed a treatment strategy that targeted the plume-forming constituents (PCE and CT) with reductive dechlorination and allowed the C-56 and C-58 to remain untreated. The latter compounds were known to travel very slowly in the aquifer and to degrade abiotically within approximately 300 feet of the source areas. Designed and implemented a pilot test to test this strategy. Methods for safely conducting the pilot test and completing groundwater monitoring in the presence of the highly toxic compound, C-56, were developed. The methods allowed technicians to complete the work without contacting the impacted groundwater and eliminated the need for Level B personal protective equipment (PPE). If the testing and monitoring had to be completed in Level B PPE, it would have been cost prohibitive. Successfully completed the pilot test in a period of ten months. Developed cost estimates for expanding the technology to full scale and the client is currently considering this technology and other remedial measures evaluated during the same time frame for cleanup of the DNAPL source areas.

Risk-Based Closure of Two Former Surface Impoundments, Confidential Client, Kenton, Ohio

Project Engineer. A confidential chemical company had closed two impoundments at this site in the 1980's in a plant they had formerly operate din Central Ohio. However, the impoundments were not clean closed and were treated as landfills under the RCRA program in Ohio. The lagoons had been maintained in an interim regulatory status since closure and had not yet started into the 30-year post closure period. Review of the groundwater data for one of the lagoons suggested that it had not impacted groundwater in more than 15 years of monitoring. The status of the two lagoons was separated such that the lagoons could be evaluated individually. For the lagoon that had shown no groundwater impact through 15 years of monitoring, used groundwater modeling in conjunction with a risk assessment to demonstrate that the closed lagoon would not impact groundwater above target levels through the post-closure period. Completed a risk-based closure for the lagoon to allow the site to end monitoring of the lagoon. The Ohio EPA accepted this approach and is currently reviewing the lagoon closure.

Feasibility Study and Remedial Design, Ohio Department of Administrative Services, Coit Road Site, Cleveland, Ohio

Project Engineer. Based on results of a remedial investigation at this CERCLA Site, it was determined that soil and groundwater in a buried channel deposit were impacted with a large quantity LNAPL, and that other areas of the Site were impacted with PCBs and metals above limits established in the risk assessment. Completed a comprehensive feasibility study to evaluate remedial objectives and alternatives. Selected a bioslurping system as the preferred remedial technology for LNAPL recovery, while primarily treating the PCB and metal impacted soils by removal and/or soil covers and institutional controls. This brownfield site received closure and has been successfully redeveloped.

Negotiation of Remedial Alternatives with Ohio EPA, Simonds Industries, Newcomerstown, Ohio

Project Engineer. A chlorinated solvent plume was delineated under a large portion of this city in eastern Ohio as a result of activities at this Simonds Industries, Inc. (Simonds) facility. Completed comprehensive negotiations, on behalf of Simonds with the Ohio EPA Southeast District Office and the Ohio Attorney General's Office, to establish remedial alternatives for treating the source area and the offsite plume. Remedial alternatives selected and incorporated into the Consent Order for the Site included monitored natural attenuation for the extensive downgradeint plume and air sparging for the on-site source area. This settlement resulted in significant long-term savings for the client in comparison to alternatives that the Ohio EPA initially preferred.

Vegetable Oil Barrier for Reductive Dechlorination, U.S. Army

Design Engineer. A 3,000-foot plume of chlorinated solvents was present in a productive aquifer underlying an Army Base. The source area for the plume was well defined and was thought to contain DNAPL based on groundwater VOC concentrations. Designed a reductive dechlorination barrier system to contain the source area and prevent further generation of the solvent plume. Designed the system to utilize soybean oil injected into the aquifer in an emulsified form. Designed the wall to provide electron donor for reductive dechlorination for 10 years. The design also included a small pump and treat system to protect and environmentally sensitive area at the leading edge of the plume and a zone of natural attenuation between the treatment area and the leading edge of the plume.

Treatment System Design for Soil Impacted with Ammonia, Ethylene Glycol, and Petroleum Hydrocarbon, City of Cleveland Department of Port Control

Project Engineer. Soil at the Cleveland Hopkins International Airport had been impacted with deicing compounds and jet fuel over a period of many years. Deicing operations utilized ethylene glycol, propylene glycol, and urea. Urea breaks down in soil systems to ammonia. High ammonia concentration in surface water was the primary driver for the soil remediation. More than 400,000 cubic years of soil required treatment. A review of remediation technologies determined that no existing technologies could be used to simultaneously treat each of the chemicals of concern (COCs). Developed a new technology utilizing bioremediation for the jet fuel, glycol, and a portion of the ammonia, and used a soil additive to bind the excess ammonia.

Biosparging/Soil Vapor Extraction System, Wurtsmith Air Force Base, Michigan

Project Manager/Project Engineer. A large plume of fuel from a POL yard at the Wurtsmith Air Force Base in Michigan resulted in contamination to soil and groundwater. A previously installed LNAPL recovery system had removed some of the free phase fuel, but soil and groundwater remained impacted, and a pump and treat system was being operated to contain the groundwater plume. Work conducted under an AFCEE contract included the design and installation of a biosparging/SVE system to treat the soil and groundwater in areas surrounding the POL yard, allowing the pump and treat system to be abandoned in the future. The treatment system consisted of more than 100 air-sparging wells and 30 soil vapor extraction wells installed in two areas of the site. The systems have been very effective to date in treating groundwater and soil impact. Treated one of the two areas to target levels and closed within one year of operation. The other area, with a higher level of impact, remains in operation, but is providing effective treatment.

Liquid Delivery Bioremediation System for In Situ Treatment of Hydrocarbon Contaminated Soil, Ferro Industries, Cleveland, Ohio

Design Engineer. Soils surrounding a large underground chemical tank farm were found to be contaminated from a leak in one of the storage tanks and from surface spills that had occurred over a period of several years. The tanks could not be removed due to the location of structures close to and on top of the vault. The tanks were closed in place, and bioremediation system was designed and installed to treat soil within the vault. The bioremediation system utilized indigenous microorganisms to aerobically degrade a wide suite of contaminants. Used subsurface piping to carry hydrogen peroxide and nutrients into the system. Withdrew water from a separate piping network beneath the tanks. The system has effectively treated most of the COCs, but is still in operation to complete clean up of recalcitrant compounds.

Bioventing and Soil Vapor Extraction System, Eaker Air Force Base, Arkansas

Project Manager and Design Engineer. Completed this large-scale bioventing project under an AFCEE contract. Used the bioventing system to treat JP4 and other hydrocarbon contamination of the vadose zone soil. The treatment area included a portion of the tarmac and extended to buildings occupied by businesses that had moved to the base after closure. A soil vapor extraction system was installed to protect the nearest building from the intrusion of impacted soil gas. Installed a soil gas monitoring system to verify that the buildings were not exposed to hydrocarbons from soil gas that had migrated from the bioventing system.

Installation and Operation of an SVE System to Treat Solvent Contaminated Soils, Newark Air Force Base, Newark, Ohio

Project Engineer. Soils at a former solvent storage site at Newark Air Force Base, Newark, Ohio were found to be contaminated with a variety of solvents. Groundwater impact was also present. Designed and installed a

SVE remediation system at the site. The system was operated for a period of 1.5 years until the remediation goals were met. Allowed the system to be decommissioned and the site to be clean closed.

Natural Attenuation for Chlorinated VOC Contamination in Groundwater, Air Products, Inc.

Design Engineer. Evaluated remedial options for treating a plume of chlorinated volatile organic compounds (VOCs) which had migrated one quarter of a mile off the site of a former manufacturing facility. Evaluated and compared alternatives for dealing with the plume. Recommended a monitoring only approach to the Ohio EPA, with provisions for an active air sparging system if certain criteria of attenuation were not met over time. The agency accepted the monitored natural attenuation and it is currently being implemented.

Design of a Free Product Recovery System, Toledo Molding and Die

Project Engineer. Soils beneath an industrial facility were found to contain a large quantity of oil floating on the groundwater surface. Apparently, oil used in the hydraulic presses at the factory caused the contamination. The oil had accumulated over many years of operation. At some locations, more than three feet of floating oil was found. Designed a free product recovery system for this site using a selective adsorption recovery belt. The system separated oil from groundwater within the well and recovered oil only. Selected a belt recovery system to minimize the requirement for system oversight, because factory personnel would be primarily responsible for system operation. Obtained system closure within two years.

Design, Construction, and Operation of a Soil Vapor Extraction System to Treat Contaminated Soil, Former Auto Service Station, JC Penney, Inc.

Design Engineer. Leaks from an underground storage tank at a former auto service station had caused soil contamination in the unsaturated soils. Groundwater had not been impacted above regulatory levels. Designed, constructed, tested and placed a soil vapor extraction system in service. Used quarterly sampling to track performance and estimate when the soils had been adequately treated. Conducted soil sampling to verify the endpoint. The site obtained a No Further Action letter and the system was decommissioned.

Bioventing System for Treating Petroleum Contaminated Soils, BP Oil

Project Engineer. Evaluated a site with petroleum-contaminated soils for bioventing. Conducted an in situ respiration test to determine the feasibility of bioventing at the site and to obtain design parameters for a bioventing system. The respiration test successfully determined that bioventing was a viable option and the appropriate system design parameters could be obtained. Designed, installed and operated a bioventing system. Obtained clean closure on the site.

Treatment System for Soil and Groundwater beneath a Paint Factory, Akzo Nobel

Project Engineer. Contaminated groundwater was discovered leaking from the foundation of a building at a paint factory. The nature and extent of the contamination were determined in a multiple-phase investigation, and the pathways of groundwater flow were determined. As part of the investigation, designed and implemented an interim dewatering system. Used the dewatering system to prevent the release of contaminated water during a construction project in which a new building was connected to the impacted building. Also used the dewatering system to obtain data for the design of a permanent remediation system to treat the contamination under the building.

Review of Treatment Options for a Chlorinated VOC Plume, USEPA

Project Engineer. Provided technical guidance for USEPA on a project involving a TCE plume in groundwater. The plume extended approximately one-half mile beyond the property boundaries of the Sparton Industries Facility in Albuquerque, New Mexico. Groundwater in the region is used extensively by the City of Albuquerque as a sole source of municipal water. The project involved support for USEPA during a long litigation involving Sparton, the City, New Mexico, and the USEPA. Developed alternatives for containment of the source area and the leading edge of the plume as well as remediation of on-site contaminated soils.

Bioslurping System Design, Installation, and Operation, Ohio Department of Administrative Services

Project Engineer. Based on results of a site remedial investigation, it was determined that soil and groundwater in a buried channel deposit were impacted with a large quantity LNAPL and dissolved phase petroleum hydrocarbon. Designed a bioslurping system to control groundwater migration, remove LNAPL, and biovent residual hydrocarbon in the soil. Designed the system to meet the needs of an interim action to control

migration, while being capable of expansion to a full-scale system to remediate the site. The system began the process of oil recovery and maintained control over the LNAPL in the interim phase. Subsequently expanded the system to full scale and has operated successfully for six years. Fully recovered the oil plume and the system are currently being decommissioned.

Groundwater and Surface Water Modeling Experience

Evaluation of Large Scale Pump and Treat Remediation System, U.S. Air Force

Project Engineer/Modeler. A pump and treat remediation system had been in operation for approximately nine years at a site impacted with chlorinated organic compounds. The system operated continuously at a withdrawal rate of greater than 4,000 gallons per minute (gpm) using a total of 30 extraction and injection wells. Following treatment most of the groundwater was reinjected to the aquifer. Evaluated the system to determine if the remediation objectives could be met at a lower pumping rate with an optimized pumping schedule. Based on the results of the modeling project, it was determined that the remediation objectives could be met using a pumping rate of approximately 1,600 gallons per minute. This lower pumping rate would result in an annual savings of approximately $250,000 for the client. Modeling software used for this project included Visual MODFLOW, and MODPATH.

Evaluation of Soil Treatment Alternatives at a Solvent Recycling Facility, Granville Solvents Site

Project Engineer/Modeler. A former solvent recycling site was found to be impacting groundwater in a buried valley aquifer system. Wells for a municipal wellfield were located within one-half mile of the site. The contaminant plume was captured and remediated using a pump and treat system. A groundwater flow and contaminant transport model were used to evaluate and optimize the pump and treat system and to evaluate the level of remediation required in the soil to achieve below MCL levels of TCE, PCE, and other chlorinated compounds at a compliance zone located between the site and the wellfield. A monitoring plan for future verification of the model results was developed. Modeling software used included Visual MODFLOW, MODFLOW, MODPATH, MT3D96, and QuickFlow.

Evaluation of Landfill Underdrain System, Laidlaw

Groundwater Modeler. A proposed landfill expansion was to be placed below the actual water table of sandy silt aquifer. To be allowed to place the base of the landfill system below water table conditions, an underdrain system that dropped the water table below the proposed landfill base was required. Used a numerical groundwater flow model to aid in the design of the underdrain system and to provide a demonstration before and after construction of the effectiveness of the underdrain. Modeling software used included Visual MODFLOW, MODFLOW, and MODPATH.

Evaluation of the Effects of a Proposed Community Supply Well in the Memphis Sand Aquifer, BFI

Project Engineer/Modeler. Used an analytical and numerical model to demonstrate that a proposed community supply well (2.9 MGD) would drop the water table at a municipal solid waste landfill and form a capture zone that would include the landfill. Evaluated advective travel times from the landfill to the proposed community supply well and groundwater monitoring options. Models used: MODFLOW, DREAM, and an analytical model developed for the specific conditions of the problem.

Evaluation of Appropriate Location for Recovery Wells to Protect a Municipal Wellfield, the Ohio EPA (LOE Contract)

Groundwater Modeler. Used an analytical groundwater flow model to estimate the optimal placement for a single well to protect a municipal wellfield from VOC contamination in the groundwater. The source for the contamination had been identified in previous site investigations and aquifer properties had been established with pumping tests. Used data from the pumping tests to calibrate the analytical model. After the model had been adequately calibrated, it was used to determine the effects of placing recovery well(s) in various locations and using various pumping strategies. Based on the results of the model, selected a location for a recovery well. The well will be used for conducting a pumping test to validate the model and will likely be used as a recovery well in the final remedial design. Used QuickFlow as the model for this project.

Determination of the Zone of Capture and Remediation for a Soil Vapor Extraction System, JC Penney, Inc.

Project Engineer. Used a numerical model to estimate the time required to remediate a petroleum-contaminated site using an SVE system. Used data from a pilot test of the recovery system to calibrate the model. Then, used the model to determine the rate of exchange of pore volumes within the zone of contamination. Used the pore exchange estimates in conjunction with published vapor pressure values to estimate the rate of contaminant removal and the time required to complete the remediation. Used MODFLOW as the computer model for this project.

Evaluation of the Short-Term Maximum Productive Capacity of a Bedrock Aquifer, Envirosafe

Project Engineer/Modeler. Developed a groundwater flow model to establish the short-term productive capacity of a dolomite aquifer to be used for fire protection at a hazardous waste landfill. Used the model to determine the placement, depth, and pumping rate of wells used in the fire protection system. Model used: DREAM (analytical flow model).

Evaluation of Potential sources of Contamination for a Municipal Wellfield, The Ohio EPA (LOE Contract)

Groundwater Modeler. An analytical groundwater flow model was used to evaluate groundwater flow paths toward a municipal wellfield that was being impacted by low level VOC contamination. The model incorporated aquifer characteristics determined from a pumping test of the wellfield and used the pumping test data to calibrate the model. Determined Flowpaths and established a potential industrial source for the contamination. Used QuickFlow as the model for this project.

Evaluation of the Significance of Sand Lens in a Glacial Till, Envirosafe

Project Engineer/Modeler. Developed a groundwater flow model to evaluate flow within a sand lens imbedded between two very low permeability tills. The sand lens had been considered a significant pathway for contaminant transport by opponents of a landfill. Used the model to establish a maximum, relatively low, potential flow rate for the lens, and to demonstrate that horizontal flow through the lens was less significant than flow through the highly impermeable tills.

Evaluation of the Effect of a Public Water Supply Well on Groundwater Monitoring at a Landfill, BFI

Groundwater Modeler. Developed a groundwater flow model to evaluate the effects of a public water supply well proposed near a closed landfill. Used the model to demonstrate that the supply well could alter the flow direction at the landfill and result in changes to the upgradient and downgradient designations. Also used the model to demonstrate that placing the production well in a lower horizon would prevent any major effects to the landfill-monitoring network.

Evaluation of Recovery Well Placement for a Pump and Treat Recovery System, BFI

Project Engineer/Modeler. Used a groundwater flow model to determine optimum placement and pumping rate for a recovery well designed to prevent off-site migration of VOC groundwater contamination. Following system installation, matched the model to data obtained while the system was in operation and system capture zones were confirmed. Models used: MODFLOW, GWPATH.

Evaluation of Protective Capability of Glacial Till Units, Laidlaw

Project Engineer/Modeler. Used historical data and a numerical flow model to demonstrate the low permeability of glacial till units at a hazardous waste landfill. The long-term hydraulic conductivity of the till was determined to be less than 2 x 10-8 cm/sec. Unlike typical in situ and laboratory methods, the model was capable of demonstrating this low conductivity for the combined effects of sediments over a total area of approximately 33 acres. MODFLOW was used for this project.

Remediation System Design and Analysis, BFI

Modeler. Developed groundwater flow model at a landfill site where landfill gas had impacted groundwater with low level VOCs. The model was used to aid in establishing the flow system, to determine optimum placement of the recovery wells, and to evaluate the capture zone of the operating recovery system. Conducted two pumping tests to calibrate the model and used a third test to validate the model. Models used: MODFLOW, MODPATH.

Piketon Groundwater Flow Model

Groundwater Modeler. Aided in the development of a regional groundwater flow model for the buried valley aquifer system located in the area surrounding Piketon, Ohio. Developed the model as a part of a long-term study of the regional water resources conducted by the Department of Agricultural Engineering and the Hydrogeology Group at The Ohio State University. Models used: MODFLOW, MODPATH.

Evaluation of Flow Paths and Discharge Points for a Glacial Till Zone of Saturation, Laidlaw

Groundwater Modeler. Evaluated the potential for contamination of a bedrock aquifer beneath a proposed municipal solid waste landfill. The bedrock was separated from the proposed landfill by glacial tills with very low permeability. It was determined, based on the modeling that the bedrock aquifer could not be impacted by the landfill and that monitoring of the bedrock aquifer was not necessary. Supported model predictions by groundwater isotope dating from the tills and the bedrock aquifer. Used MODFLOW, MODPATH, and DREAM models for project.

Industrial Wastewater Treatment

Arbor Hills East Landfill Leachate Treatment, Republic Services – Northville, Michigan

Project Manager/Project Engineer. This closed landfill had been discharging leachate to the Northville sewer system under a long-term agreement. The agreement included a provision that no PCBs would be present in the leachate. When PCBs began to be detected in the leachate, the Northville Sewer Authority stopped accepting leachate from Arbor Hills East, and the landfill had to install new leach holding tanks and begin a costly hauling program for leachate disposal. The project involved evaluating pre-treatment alternatives for removal of the PCBs and working with the local Sewer District to reinstate the leachate discharge following the installation of a pre-treatment system. During initial evaluations, it was determined that the PCBs were associated with very small particulate matter in the leachate and could only be reliably removed through filtration of particles greater than approximately 0.5 microns in diameter. Evaluated and pilot tested treatment technologies capable of this type of filtration. Ultrafiltration was found to be the most cost-effective alternative for treatment of the leachate and a longer-term pilot test was completed to provide data required for the design and to ensure that the filers would retain their permeate production rates following multiple cleaning cycles. Negotiations with the Sewer Authority were completed, and a detailed design for the treatment system was developed. Construction of the treatment system is pending the completion of agreements with the current site owner. The cost savings in net present value for the landfill is estimated to be $3 MM over the next ten years of operation including all costs associated with evaluating, designing, installing, operating, and maintaining the treatment system.

Lorain I Leachate Disposal, Allied Waste – Oberlin, Ohio

Project Manager/Project Engineer. This closed landfill had been hauling leachate to a publicly owned treatment works (POTW) at a considerable distance, resulting in significant current and long-term costs for Allied Waste. A publically owned treatment works (POTW) for the City of Oberlin was located relatively close to the landfill, but was unwilling to accept the leachate due to concerns about the high ammonia concentration and the potential that the leachate might cause process upsets in the treatment plant. Evaluated the Oberlin POTW for capability to accept the leachate, laboratory treatability testing and pilot testing was completed to verify that the plant could adequately treat the leachate. Negotiations with the POTW and the City of Oberlin were undertaken to allow direct discharge to the sewer system without pretreatment. An agreement was negotiated between the landfill and the City for long-term disposal of the leachate. The design of equipment for monitoring the discharge and transporting the leachate to the nearest sewer manhole was completed and the system was installed. No process disturbances have been identified at the plant due to the addition of the leachate and the POTW has met all discharge limits. The costs associated with the evaluations, negotiations, construction, operation and maintenance to the leachate discharge were paid back in less than one year through savings in not having to haul the leachate for disposal.

Willow Creek Leachate Disposal, Allied Waste – Atwood, Ohio

Project Manager/Project Engineer. This landfill was hauling leachate a great distance to a facility willing to accept the very low level PCBs present in the leachate. Evaluated alternatives for leachate disposal for this closed landfill to reduce the overall cost for leachate disposal. On-site treatment and pre-treatment alternatives

were evaluated that would allow disposal of the leachate at a closer location, and alternative facilities closer to the landfill that could accept the leachate without pre-treatment were contacted and evaluated. Hauling the leachate to a sister landfill with a direct discharge agreement and excess capacity was also considered in the evaluation. Developed and compared feasibility and costs for each alternative, and provided a recommended approach of hauling to the sister landfill. This approach was implemented, resulting in significant cost savings for leachate disposal at this landfill.

Industrial Wastewater Treatment System Upgrade, Confidential Client – Ashtabula, Ohio

Project Manager/Project Engineer. A confidential chemical company in Ashtabula, Ohio treats groundwater, stormwater, and plant process water on-site with an aging treatment system with components installed in phases from the 1950's through 1991. The client retained Brown and Caldwell to evaluate the treatment system due high operating costs and unreliable operation. Upgrades to the system had to be completed primarily using the existing network of treatment system piping, while minimizing subsurface excavation work. Work included evaluating the existing system to determine what treatment systems were still necessary, a determination of what needed components could be re-used, and the design of a compact treatment system housed primarily in a single building. This project included extensive work with the Ohio EPA Northeast District Office (NEDO) to obtain a PTI for the upgraded treatment system. By keeping the Ohio EPA informed during the process and meeting with them to discuss, the PTI application prior to submission, the PTI was obtained within two weeks of submission. Provided Construction oversight and start-up assistance for the new system. The new system greatly reduced the use of energy and the need for operator oversight and system maintenance. The system has been in operation for approximately one year, and it is now projected that the operation and maintenance costs for the new system will be approximately one half the previous costs, with a net present value savings of approximately $1.5 million (including all costs to design and upgrade the facility).

Vertical Wetlands Treatment System for Leachate-Impacted Underdrain Water – Waste Management, American Landfill – Waynesburg, Ohio

Project Engineer. As a part of an expansion of the American Landfill, an underdrain system had to be installed beneath the liner system to prevent groundwater intrusion from a high water table. The initial intent was to discharge the underdrain water to a sedimentation pond and allow it to leave the site through an intermittent stream. However, when recovery of the underdrain water began, it was found to contain levels of ammonia and iron that were too high for surface water discharge. A vertical wetlands treatment system was designed to reliably remove the iron and ammonia to low levels. Designed the system for a projected capacity of 50,000 gallons per day (gpd) of underdrain water, with the capability of expanding the system to 100,000 as new cells requiring underdrains were added to the landfill. The system was designed, permitted, and installed in a relatively short period of time to minimize the cost of continuing to haul the underdrain water (with the site leachate) to a local POTW. Provided construction oversight and start-up assistance. The system began meeting discharge limits within one week of start-up and has consistently met discharge limits. The cost for design and installation of the system was recovered in less than a year of start-up.

Evaluation of a Leachate Connection to Local POTWs – Republic Services, Multiple Sites in Ohio, Michigan, and Kentucky

Project Manager/Project Engineer. Landfill leachate is frequently hauled to publically owned treatment works (POTWs) for disposal. In many cases, this requires long-distance hauling and high disposal costs. The option of connecting the leachate to a sewer system for direct discharge often has a favorable pay-back period, with considerable long-term savings. Evaluated this option for multiple Republic Services landfill sites located in Ohio, Michigan, and Kentucky. In some cases, bench and pilot scale testing of the leachate treatability by small local POTWs was carried out to provide evidence to the plant operators (or utility departments) that the leachate could be effectively treated by the plant. Some of the projects involved the design of sewer extensions to allow hook-up to the sewer system. Handled regulatory issues with the State Agencies for Republic and provided aid in developing agreements with the local sewer authority for the long-term treatment of the leachate. In most cases, it was determined that the direct discharge to the local sewer system provided favorable pay-back in comparison to leachate hauling.

Pretreatment of High pH Leachate – Republic Services, Niagara Falls Landfill - Niagara Falls, New York

Project Manager/Project Engineer. One of the cells at this landfill is a monofill of lime material that had been left at this site by a former owner (Union Carbide). The cell produces leachate with a very high pH that cannot be mixed with other municipal solid waste leachate without first reducing the pH (by adding HCl). This pH reduction step has been problematic for the site due to the cost of the required HCL and the operation and maintenance associated with this process. The final leachate discharged from the landfill to the local sewer system also received a relatively high surcharge due to total suspended solids (TSS). The higher TSS in the leachate was considered to be a result of the formation of particulate solids during the mixing of the very different leachate types prior to discharge. Completed a study to determine of the leachate mixing could be handled in a different manner that reduced the requirement for HCL and the level of TSS in the final leachate discharge. Evaluated leachate sources from various landfill cells in terms of flow rate/volume and water quality characteristics. Performed tests in BC's Treatability lab to determine the effects of mixing the two primary types of leachate in a controlled manner and allowing flocculation and settling to occur. Developed estimates of HCL usage under alternative scenarios and completed a preliminary design for a rapid mix chamber and settling basing. The project is currently waiting funding to allow more detailed testing to occur in support of a final design.

Ultrafiltration Treatment System for Oily Wastewater – ArvinMeritor, Inc. – Frankfort, Kentucky and Franklin Kentucky

Project Manager/Project Engineer. Wastewater containing emulsified oil is generated at these ArvinMeritor facilities both as a part of manufacturing processes and associated with plant cleaning operations. Both facilities previously hauled this wastewater to industrial wastewater treatment plants for disposal at considerable cost to the plants. Designed treatment systems consisting of membrane ultrafiltration for the plants to allow on-site treatment of the wastewater and recycling of the concentrated oil emulsion. Designed the systems to run in batch mode with minimal operator oversight. Based on the designs, an equipment vendor assembled the treatment systems on skids, and Brown and Caldwell provided installation, start-up, and training. The systems successfully met the discharge standards for the local sewer system, and provide payback periods in the range of one year.

Evaluation of POTW Upgrades to Allow Acceptance of Landfill Leachate – Republic Services, Rockwood Landfill

Project Manager/Project Engineer. Due to the high cost of hauling leachate from the Rockwood Landfill to a treatment plant, Republic Services (Republic) began working with a local sewer district, Berlin Township, to establish a direct connection for discharge of the leachate to the sewer system. The Berlin Township's POTW is a relatively small treatment plant that was already having difficulty meeting its discharge limits for ammonia. In order to accept the leachate with its relatively high ammonia concentration, upgrades were required for the POTW. The POTW had an existing consultant that had already been providing service for evaluating potential upgrades, and they preferred to continue to work with their existing consultant. Brown and Caldwell provided oversight of the work on behalf of Republic. Berlin Township selected an alternative for upgrading the POTW, but the cost for this upgrade was relatively high and the Township anticipated that Republic would pay the full cost of the upgrade. During this process, Republic decided to close the Rockwood Landfill. Given that the landfill was closing and that the cost of the selected upgrades to the plant was relatively high, the project did not prove to be cost-effective. Providing additional services to Republic to evaluate options for decreasing the volume of leachate generated by the landfill. More cost-effective methods for upgrading the POTW will also be considered to determine if a more favorable arrangement can be negotiated with Berlin Township.

Evaluation of POTW Upgrades to Allow Acceptance of Leachate – Republic Services, Lorain II Landfill – Oberlin, Ohio

Project Manager/Project Engineer. BC had previously worked with Republic Services (Allied Waste) to secure the discharge of leachate from the closed Lorain I landfill to the City of Oberlin sewer system. Given the quick payback for the Lorain I project, Republic Services was interested in having the leachate from the active Lorain II landfill connected to the sewer system and treated by the City of Oberlin's POTW. However, given the relatively small capacity of the POTW and the high ammonia loading of the leachate, it was determined that the plant could not treat the additional leachate source without upgrades. For this project, BC worked with the

POTW to evaluate low cost alternatives for upgrading the capability of the plant to treat ammonia. It was determined that changes to the plant operations and minor changes to the piping and aeration basin configuration would result in the ability to treat ammonia from the additional leachate source and result in overall better plant operation and improved methane generation from the anaerobic digesters. Completed a preliminary design for this work and the POTW and Republic Services are seeking partial funding of the project through Federal and State funding sources.

Statistics Experience

Development of Statistical Plans for Municipal Solid Waste Facilities in Ohio

Project Manager/Statistician. The background data for three county landfills in Ohio was evaluated and statistical procedures were established for evaluating their groundwater monitoring data. The plans were optimized to provide a low level of false positives (false indications of contamination) while meeting the statistical power required by the regulatory agencies. Procedures were set up to streamline and automate routine statistical analysis and reporting. The work has involved significant interaction with Ohio EPA personnel in the northwest, southwest, and southeast district offices to obtain approval of the plans and to keep p the programs in compliance. Work with these clients has continued for many years (approximately 15 years) to provide updates to the background data sets, alternative source demonstrations, and general management of the groundwater monitoring and statistical programs. The landfills have undergone minor assessments during this period, but these have been resolved favorably for the landfills.

Evaluation and Redesign of a Groundwater Monitoring Program for a RCRA Facility, Durez Corporation, Kenton, Ohio.

Project Engineer. Groundwater monitoring had been conducted in a network of wells surrounding two former surface impoundments for 14 years following closure. The monitoring program involved quarterly sampling of 26 wells and had continued since closure. The program was evaluated and it was determined that many of the monitoring wells could be removed from the program and that the monitoring frequency could be reduced from quarterly to semiannual. Considerable negotiation with the Ohio EPA regulators in the Northwest District Office was required to provide a more cost-effective approach to monitoring at this site. The sampling program is now being conducted for approximately one-third the annual cost of the program prior to the evaluation and optimization.

Alternate Source Demonstrations, Assessments, Compliance Monitoring, Various Landfills in Ohio

Statistician/Engineer. Provided multiple alternative source demonstrations (ASDs) for several municipal solid waste landfills in Ohio (for Ohio EPA northwest, southeast, and southwest district offices). Evaluated the issues associated with a given statistical exceedance and determined that the source of the exceedance was not related to landfill activities. All alternative source demonstrations submitted to date have been accepted by the Ohio EPA. In instances where an ASD could not be developed, assessments were performed. In all cases, the scope of the assessment has been minimized to reduce the overall cost while defining the issues associated with the statistical exceedance. Compliance monitoring has been applied for exceedances involving naturally occurring parameters in cases where a suitable ASD could not be developed.

Statistical Programs for Multiple Landfills in Ohio and Michigan, Republic Services.

Project Manager/Statistician. Provided support for setting up the statistical programs for groundwater monitoring at several landfills in Ohio and Michigan, and have provided oversight for the statistical and reporting programs for the landfills. Oversee and review alternative source demonstrations for the landfills and assessments, when needed. Respond to Agency comments on the groundwater programs and statistical analyses for the landfills.

Alternative Source Demonstration at a RCRA Landfill Site, Occidental Chemical, Ohio

Project Engineer/Statistician. A RCRA monitoring program had been in place at this site since the 1980's. The facility had used formaldehyde in production and the Ohio EPA had required that this parameter to be included in the monitoring program. After many years of detections of formaldehyde in the monitoring program, Occidental Chemical asked the BC project team to evaluate the formaldehyde issue and develop solutions. Through the course of evaluation, it was determined that the formaldehyde detections in the sampling program

were not from groundwater but were entering the samples from the atmosphere. Several tests were developed to definitive demonstrate this source. The Ohio EPA (northwest district) has subsequently allowed the client to treat formaldehyde as a naturally occurring parameter with an associated prediction limit. This has eliminated exceedances of formaldehyde in the sampling program and has allowed the facility to move forward toward risk-based clean closure of the former surface impoundments.

Data Management and Statistical Analysis for an Industrial Landfill in Central Ohio

Project Engineer/Statistician. Developed a database of 10 years of monthly monitoring data, including approximately 100,000 data set records. Produced graphical output to evaluate temporal and spatial trends in the data sets. Used statistical methods to establish the boundaries of leachate impact from the landfill. Evaluated statistical methods to determine the appropriate method to use for the future monitoring program, and set up a statistical analysis program to evaluate data as it was entered electronically into the database.

Study of Nitrate in Groundwater for Landfill Monitoring Program, Republic Services C&C Landfill, Marshall, Michigan

Project Engineer/Statistician. The C&C Landfill had experienced recurring exceedances of nitrate in the monitoring well network. Background water quality data were obtained from wells upgradient of the site to compare the nitrate concentration with concentrations observed at the landfill. Used the SAS statistical package to provide statistical graphics to establish that the nitrate impact was not a result of landfill activities. The Agency accepted this study as a demonstration that the nitrate found in groundwater was not a result of landfill activities.

Statistical Analysis of Water Level Data from a Pumping Test, Envirosafe, Oregon, Ohio

Project Engineer/Hydrogeologist. Conducted a pumping test in a bedrock aquifer at a landfill facility. Used one pumping well and approximately 30 monitoring wells in the test. However, many other pumping wells were active in the region surrounding the site that interfered with the pumping stress of the test well. The off-site wells were not pumped at consistent rates and flow rate and pumping time data were not available. Collected background data prior to the test and following the test, and used statistical procedures to subtract the influence of off-site wells from the influence of the tested well. Used the resulting (corrected) drawdown data to establish aquifer properties for the site.

Memberships

American Society of Agricultural Engineers

Association of Ground Water Scientists and Engineers

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Bill Foster, E.I., S.I.

Experience Summary

Bill Foster has extensive experience dealing with project management, surveying, project scheduling, project cost estimating. As a design engineer, Mr. Foster has experience in landfill design, sewer design, grading, technical report preparation, landfill gas collection and control systems (GCCS), leachate management systems, and surface water management systems. As a field engineer, he has experience in providing quality assurance (QA) services for the construction and certification of municipal solid waste facilities, sanitary landfill facilities, and construction and demolition debris facilities. As a field technician, he has experience in observing and inspecting the installation of soils, aggregates, geosynthetics, geotextiles, structural fill berms, landfill gas collection and control systems, leachate management systems, recompacted soil barriers (liner/leachate and cap systems), protective cover placement, drainage structures, and final cover placement.

Mr. Foster has been involved in many projects as a project engineer, a design engineer, a field engineer and a field technician. These projects include site selection, borrow study evaluation, wetlands delineation, cost analysis, design of leachate management systems, design of surface water management systems, design of Class I, II, and III water reservoirs, design of landfill gas collection and control systems, cap and liner stability analysis, air emission calculations, and access road development. Compost facilities and transfer station applications have also been prepared under his direction.

Assignment

CQA Monitor

Education

BS, Civil & Environmental Engineering, The Ohio State University, 2001.

Registration

Engineering Intern, (E.I.) Ohio

Surveying Intern, (S.I.) Ohio

Training

40-Hour OSHA Health & Safety Training

Troxler Nuclear Density Gauge Certified

OSHA Site Supervisor Training

CPR/First Aid

APR Training

AED Training

Experience

11 years

Joined Firm

2009

Relevant Expertise

- *Construction Quality Assurance (CQA)*
- *Project and Site Management*
- *Installation and Quality Assurance/Quality Control*
- *Repair and Maintenance*
- *Project Cost Estimating and Budget Control*
- *Permitting*
- *Compliance*
- *Planning and Development*
- *Design*

Relevant Project Experience

Countywide Recycling & Disposal Facility 2011 South Slope Relocation, Gas and Liner System CQA Services, East Sparta, Ohio

Provided engineering expertise and served as the construction quality assurance (CQA) lead for this project that included modifications to the existing south slope, the existing leachate collection system, the existing GCCS, and the existing temporary flexible membrane liner (FML). These modifications consisted of the:

- Relocation of approximately 142,000 cubic yards of waste
- Replacement of approximately 1,900 feet of toe drain
- Installation of approximately 11,000 feet of high-density polyethylene (HDPE) pipe of various diameters.
- Installation of 5 new extraction wells
- Installation of 11 replacement extraction wells
- Installation of approximately 22 acres of temporary FML

CQA activities included documenting waste relocation, leachate, GCCS, and FML installation, field testing of HDPE pipe and FML, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress and collecting data for an "as-built" construction certification report. Served as liaison between several parties including the US EPA, the Ohio EPA, the contractor, surveyor, pipe manufacturer, liner manufacturer, and the client. Prepared the construction certification report for submission and approval by the Ohio Environmental Protection Agency (Ohio EPA).

Imperial Landfill, LFG, Cell Construction, CQA Services, Republic Services, Inc., Republic Services, Findlay Township, Allegheny County, Pennsylvania

Provided engineering expertise and served as the construction quality assurance (CQA) lead for this $8 million project to address odors resulting from hydrogen sulfide generation at a landfill located adjacent to an elementary school. Major project elements included the following:

- Installation of 42 acres of 40 mil geomembrane and 16 oz geotextile
- Construction of two new sedimentation ponds
- Expansion of an existing sedimentation pond
- Construction of nearly 20,000 feet of surface water channels
- Installation of 11 surface water culverts
- Installation of nearly 60,000 feet of high-density polyethylene (HDPE) header, lateral, horizontal collector, toe drain, forcemain, and airline piping of various diameters.
- Installation of 28 new extraction wells
- Installation of 11 replacement extraction wells
- Construction of a 3.7 acre dual-lined cell

The project involved assistance in developing the design, facilitating the permitting process, overseeing the construction, and providing the construction quality assurance services. Prepared the construction certification reports for submission and approval by the Pennsylvania Department of Environmental Protection for this time critical and substantial corrective action.

Countywide Recycling & Disposal Facility 2010 Gas System CQA Services, East Sparta, Ohio

Provided engineering expertise and served as the construction quality assurance (CQA) lead for this project that included modifications to the existing GCCS. These modifications consisted of the installation of the following:

- Approximately 19,000 feet of high-density polyethylene (HDPE) header, lateral, and forcemain piping of various diameters.
- 11 new extraction wells
- 2 pump stations
- 1 lift station
- 2 force main tie-in vaults

CQA activities included documenting GCCS installation, field testing of HDPE pipe, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress and collecting data for an "as-built" construction certification report. Served as liaison between several parties including the Ohio EPA, the contractor, surveyor, pipe manufacturer, and the client. Prepared the construction certification report for submission and approval by the Ohio Environmental Protection Agency (Ohio EPA).

Countywide Recycling & Disposal Facility 2009 Gas System CQA Services, East Sparta, Ohio

Provided engineering expertise and served as the construction quality assurance (CQA) lead for this project that included modifications to the existing GCCS. These modifications consisted of the installation of the following:

- Approximately 43,000 feet of high-density polyethylene (HDPE) header, lateral, and forcemain piping of various diameters.
- 18 new extraction wells
- 26 replacement extraction wells

- 7 pump stations
- 2 force main tie-in vaults

CQA activities included documenting GCCS installation, field testing of HDPE pipe, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress and collecting data for an "as-built" construction certification report. Served as liaison between several parties including the US EPA, the Ohio EPA, the contractor, surveyor, pipe manufacturer, and the client. Prepared the construction certification report for submission and approval by the Ohio Environmental Protection Agency (Ohio EPA).

Countywide Recycling & Disposal Facility Leachate Collection System Improvements CQA Services, East Sparta, Ohio

Provided engineering expertise and served as the CQA lead for this project that incorporated improvements to the leachate collection system. These improvements consisted of the installation of the following:

- Approximately 2,200 feet of gravity drain piping.
- Approximately 14,000 feet of force main piping.
- 2 lift stations.
- 6 manholes
- A 500,000-gallon above ground storage tank.

CQA activities consisted of documenting pipe installation, field testing of the leachate pipe, coordination and review of manufacture and laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress and collecting data for an "as-built" construction certification report. Served as liaison between several parties including the US EPA, the Ohio EPA, the contractor, surveyor, concrete testing lab, leachate storage tank manufacturer, geosynthetics testing lab, and the client. Prepared the construction certification report for submission and approval by the Ohio EPA.

Countywide Recycling & Disposal Facility Isolation Break CQA Services, East Sparta, Ohio

Provided engineering expertise and served as the CQA lead for this project that included the installation of the following:

- Approximately 7,000 feet of high-density polyethylene (HDPE) header, lateral, and forcemain piping of various diameters.
- 8 new extraction wells
- 2 pump stations
- 1 force main tie-in vault
- 1 leachate sump
- Approximately 7.80 acres of Flexible Membrane Liner (FML)

CQA activities included documenting GCCSand FML installation, field testing of HDPE pipe and FML, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress and collecting data for an "as-built" construction certification report. Served as liaison between several parties including the US EPA, the Ohio EPA, the contractor, surveyor, pipe manufacturer, FML manufacturer, and the client. Prepared the construction certification report for submission and approval by the United States Environmental Protection Agency (USEPA).

Countywide Recycling & Disposal Facility 2009 Temporary FML CQA Services, Stark County, Ohio

Provided engineering expertise and served as the CQA lead for this project which included the installation of approximately 22.4 acres of FML

CQA activities included documenting FML installation, field testing of FML, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation

of the construction progress and collecting data for an "as-built" construction certification report. Served as liaison between several parties including the US EPA, the Ohio EPA, the contractor, surveyor, FML manufacturer, soils testing lab, geosynthetics testing lab, and the client. Prepared the construction certification report for submission and approval by the USEPA.

Lorain County II Landfill Gas System CQA Services, Oberlin, Ohio

Provided engineering expertise and served as the CQA lead for this project that included the following:

- Replacement of approximately 800 linear feet of existing 12-inch diameter SDR-17 HDPE header pipe along the north slope of the Landfill with new 12-inch diameter SDR-17 HDPE header pipe.
- Installation of new 6-inch diameter SDR-17 HDPE jumper lines for EW-47, EW-48, EW-56, and EW-62R2.
- Installation of new 4-inch diameter SDR-17 HDPE vacuum lines to three existing side slope risers.
- Enhancements (new 48-inch diameter HDPE sump top and 4-inch diameter HDPE vacuum pipeline) to the northern sump of the southwest leachate sumps.
- Replacement of existing 2-inch diameter wellheads with new 3-inch diameter wellheads on five landfill gas extraction wells.

CQA activities included documenting GCCS installation, field testing of HDPE pipe, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress and collecting data for an "as-built" construction certification report. Served as liaison between several parties including the contractor, surveyor, pipe manufacturer, and the client. Prepared the construction certification report for submission and approval by the Ohio EPA.

Wyandot County Landfill Gas System CQA Services, Carey, Ohio

Provided engineering expertise and served as the CQA lead for this project that included the installation of approximately 2,956 linear feet of high-density polyethylene (HDPE) header, lateral, and forcemain piping of various diameters to connect the re-drilled extraction wells, new flare station, condensate sump, and convert the two existing extraction wells for combination wellheads.

CQA activities included documenting GCCS installation, field testing of HDPE pipe, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress and collecting data for an "as-built" construction certification report. Served as liaison between several parties including the contractor, surveyor, pipe manufacturer, and the client. Prepared the construction certification report for submission and approval by the Ohio EPA.

Design, Permitting, and Construction Quality Assurance of a Resource Conservation and Recovery Act (RCRA) Hazardous Waste Landfill, Eastern Ohio

Managed the permitting and design for the remediation of an existing RCRA hazardous waste landfill in eastern Ohio. Permitting included the preparation and subsequent approval of the Interim Measures Work Plan for submittal to the USEPA Region 5 as part of a Consent Decree. The landfill remedial design included replacement of leachate storage tanks, incorporation of a new final cover system to completely encompass the existing landfill footprint, construction of a flood protection levee, and remediation of the perimeter surface drainage system. Provided CQA for the construction of the new final cover system including geosynthetic components installation. Prepared the construction certification report for submission and approval by the USEPA.

Coshocton County Landfill, Coshocton, Ohio

Served as project engineer and CQA lead on a project that included excavation of cell, placement of engineered subgrade, structural fill, recompacted soil liner, geosynthetic clay liner, 60 mil HDPE geomembrane, geotextile, HDPE pipe, and protective layer. QA activities included documenting liner installation, field sampling and testing, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress, and collecting data for an "as-built" construction certification report. The work was performed at an accelerated pace to meet the client's needs. To minimize and ease the regulatory review process, worked closely with the

site owner and the Ohio EPA district engineers through the preparation of this alteration. Served as liaison between several parties including the contractor, surveyor, soils testing lab, geosynthetics testing lab, and client. Prepared construction certification report for submission to the Ohio EPA.

Gallia County Landfill, Gallia County, Ohio

Provided engineering expertise and served as the CQA lead for this project which included leachate management system (leachate collection and storage system, lift station, and force main), surface water management system (sedimentation basin, culverts, and channels), and a final cover system (recompacted soil barrier, intermediate cover, linear low-density polyethylene (LLDPE) geomembrane, geonet, geotextile and vegetative layer). CQA activities included documenting liner installation, field sampling and testing, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress and collecting data for an "as-built" construction certification report. Served as liaison between several parties including the contractor, surveyor, soils testing lab, geosynthetics testing lab, and client. Prepared the construction certification report for submission and approval by the Ohio EPA. Also prepared the annual operational report for submission and approval by the Ohio EPA.

Franklin County Sanitary Landfill, Franklin County, Ohio

As Project Engineer, is involved in all contracts providing professional services at the Franklin County Landfill, either for the landfill operator or the Solid Waste Authority of Central Ohio (SWACO). Highly knowledgeable with the landfill and both the current landfill operations management and the SWACO landfill management personnel. Prepared the annual operational report for submission and approval by the Ohio EPA. Developed an excellent working relationship with the Ohio EPA Central District engineers and general staff having regulatory jurisdiction over the site.

H. Hafner & Sons, Inc., Construction and Demolition Debris Facility, Cincinnati, Ohio

Project included excavation of cell, placement of engineered subgrade, structural fill, recompacted soil liner, HDPE pipe, protective layer, drainage channels, sedimentation basins, and leachate management system. Services include preparing required air emission and storm water discharge permit applications for this facility located along the Little Miami River (State Designated Scenic River), including a Storm Water Pollution Prevention Plan (SWPPP) to control site runoff. Had designed a leachate management system, a surface water management system, and overall site grading. Evaluated the floodway line and 100-year flood impact of the Little Miami River adjacent to this site using HEC modeling. The firm has worked closely with the local health department to demonstrate facility expansion plans and flood control practices in this environmentally sensitive area. The firm has prepared various site expansion plans to compare available airspace in relation to final site grade and coordinated topographic mapping of the site. The firm has assisted the owner in phasing the landfill development in such a manner to minimize financial assurance requirements. Prepared the annual license application reports for submission and approval by the Ohio EPA.

D-K Enterprises, Construction and Demolition Debris Facility, Wood County, Ohio

Re-designed surface water management system (drainage channels, stilling basins, and sedimentation basins), and overall site grading. Prepared air emission and storm water discharge permits, a SWPPP, a preliminary site layout. Prepared a SWPPP to control site runoff. Provided design assistance in site access road paving, site entry layout, operational manifests, and transportation logs to allow the site operator to better track incoming loads. Coordinated the acquisition of topographic mapping and property line surveys. Also prepared numerous annual license application reports for submission and approval by the Ohio EPA.

Gene Hazen & Sons, Construction and Demolition Debris Facility, Zanesville, Ohio

Provided project engineering, project management, and oversight of this project from designing the final cap to the closure construction certification report. The project was under legal action from the Ohio's Attorney General's Office. The Ohio EPA closely regulated this project and considered many different closure options in detail. Developed an excellent working relationship with the Ohio EPA Southeast District engineers and general staff, as well as the staff of the Ohio Attorney General's Office, having regulatory jurisdiction over the site. Prepared the construction certification report for submittal and approval by the Ohio EPA.

Design, Permitting, and Construction of a Hazardous Waste Tipping Floor, The Environmental Quality Company, Wayne Disposal, Inc., Belleville, Michigan

Provided engineering expertise for the redesign, of a hazardous waste tipping floor, to minimize Polychlorinated Biphenyls being tracked out on the truck tires. Provided support in the preparation and management of the contract documents, technical specifications, and construction drawings including QA/QC of the final bid documents. Provided engineering guidance and construction quality assurance during the construction of the tipping floor.

Design, Permitting, and Construction of a Solid Waste Transfer/Recycling Station, Rumpke Waste, Inc., Ironton, Ohio

Provided engineering expertise for the design, permitting, and construction including construction quality assurance of a solid waste transfer/recycling station for a major solid waste company in southeast Ohio. The facility permit was obtained through the Ohio EPA Southeast District Office in accordance with the Ohio Administrative Code rules and regulations pertaining to transfer stations. Provided support in the preparation and management of the contract documents, technical specifications, and construction drawings including QA/QC of the final bid documents. Provided part-time construction quality assurance (CQA) during the construction of the facility.

North Star Golf Community Development, Delaware County, Ohio

Served as the project engineer providing expertise in surface water management, sediment control, and erosion control practices. Designed and modeled a channel to handle the off-site flow for up to a 100-year storm. Designed and modeled an irrigation impoundment to receive the 100-year storm without any discharge. Provided site grading and site underground utility layout guidance. Developed an excellent working relationship with the Ohio EPA Central District engineers and general staff and worked very closely with them throughout this project. Served as liaison between several parties including the contractor, surveyor, soils testing lab, and client.

The Ohio State University Experimental Wetlands, Franklin County, Ohio

Project included redesigning the surface water management of facility to better meet the client's needs. This project required more regulated inflow and the outflow of a 6.0 acres wetland area and the ability to possibly control, if so desired. An outlet channel and outlet structure, as well as a pump to control the inflow were all components of the design.

Long Term Control Plan, City of Columbus, Ohio

Served as a sampling crew team leader for this project. His crew is responsible for collecting samples from sewer overflows and regulators throughout the City's sewer system during wet weather events. Member of the consultant team led by Malcolm Pirnie, Inc., conducting these studies for the City of Columbus to develop a long-term plan to control and eliminate sewer overflows.

Nathan A. Givens, E.I.

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Nathan A. Givens, E.I.

Experience Summary

Mr. Givens recently obtained his civil engineering degree after more than 14 years of experience in the construction industry. His experience includes construction of surface and subsurface drainage systems, wetlands, stormwater detention basins, underground utilities and roadways. Since joining Brown and Caldwell, Mr. Givens has been involved with Landfill Gas Collection and Control System (GCCS) design and Construction Quality Assurance (CQA), geosynthetics CQA, remediation, and groundwater monitoring projects. He brings exceptional attention to detail, proven understanding and is driven to provide quality services.

Assignment

CQA Monitor

Education

B.S., Civil Engineering, Ohio University, 2009

Registration

Engineer Intern, Ohio

Experience

16 years

Joined Firm

2010

Training

- *HAZWOPER Eight-hour Refresher*
- *Bloodborne Pathogens Exposure Control*
- *First Aid*
- *Hazard Communications*
- *40-Hour Hazardous Waste Operations Safety Training*

Relevant Expertise

- *Construction Quality Assurance*
- *Field Testing*
- *Soil and Groundwater Sampling*
- *Landfill Gas Design*

Fremont Raw Water Reservoir CQA, City of Fremont, Fremont, Ohio

CQA Field Monitor. Performed compaction testing of structural fill and observed and documented installation of 94 acres of geocomposite clay liner (GCL), 40-mil linear low-density polyethylene (LLDPE) geomembrane, and geotextile.

Imperial Landfill New Cell Construction CQA, Republic Services, Inc., Imperial, Pennsylvania

Engineer. Observed construction of a 3.8-acre, dual-lined solid waste disposal cell. Provided written and photographic documentation of installation methods, as well as equipment and materials onsite. Prepared daily work summary reports for client.

Imperial Landfill Temporary Geomembrane Cap CQA, Republic Services, Inc., Imperial, Pennsylvania

Engineer. Observed installation of 40 acres of geotextile and 40-mile high-density polyethylene (HDPE) geomembrane, surface water channels, surface water culverts and sedimentation basins. Provided written and photographic documentation of installation methods, as well as equipment and materials onsite. Prepared daily work summary reports for client.

Grenada Sludge Lagoon Closure CQA, ArvinMeritor, Inc., Grenada, Mississippi

CQA Field Monitor. Observed and documented the installation of the vegetative soil cover component of the final cover system for the closure of a former sludge lagoon. Provided direction to the contractor for expansion of the onsite soil borrow area.

Bobmeyer Landfill Publicly Owned Treatment Works (POTW) Connection, Republic Services, Inc., Fairfield, Ohio

Alternative Delivery Field Engineer. Worked with the City of Fairfield and the City of Hamilton to meet both the client's needs and each municipality's needs. Observed and documented construction of a new leachate force main connection to the City of Hamilton, Ohio POTW. This project involved installing a force main under an active railroad line and roadway. Worked with contractors to adapt design to unforeseen circumstances during construction.

Cherokee Run Landfill Gas Collection and Control System (GCCS) CQA, Republic Services, Inc., Bellefontaine, Ohio

Engineer. Observed installation of landfill gas extraction wells, GCCS piping, and leachate forcemain at a municipal waste landfill over multiple phases. Provided written and photographic documentation of installation methods, as well as equipment and materials onsite. Prepared daily work summary reports for client.

Imperial Landfill Gas Collection and Control System CQA, Republic Services, Inc., Imperial, Pennsylvania

Engineer. Observed installation of landfill gas extraction wells, GCCS piping, and leachate forcemain at a municipal waste landfill over multiple phases. Provided written and photographic documentation of installation methods, as well as equipment and materials onsite. Prepared daily work summary reports for client.

Lorain II Landfill Gas Collection and Control System CQA, Republic Services, Inc., Oberlin, Ohio

Engineer. Observed installation of landfill gas extraction wells, GCCS piping, and leachate forcemain at a municipal waste landfill over multiple phases. Provided written and photographic documentation of installation methods, as well as equipment and materials onsite. Prepared daily work summary reports for client.

ArvinMeritor Groundwater Sampling, ArvinMeritor, Inc., Grenada, Mississippi

Engineer. Performed the semi-annual groundwater monitoring at the site. Samples were obtained following Mississippi Department of Environmental Quality (DEQ) and USEPA sampling protocols.

Preble County Landfill Groundwater Sampling, Preble County, Eaton, Ohio

Engineer. Performed the semi-annual groundwater monitoring at the site. Samples are obtained following Ohio EPA and USEPA sampling protocols.

Site Closure Activities—Historical Document Review, Confidential Client, Ohio

Engineer. Reviewed more than 20 years of historical documents related to closure activities for the site. Attributed the client provided documents by document type, date, author and subject making them easily retrievable for future use. Entered historical analytical data into spreadsheets for trending purposes.

Julie McGowan

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Julie J. McGowan

Experience Summary

Julie McGowan has ten years experience providing technical field support on solid waste and environmental investigation and construction projects, including construction quality assurance (CQA) oversight of earthwork contractor's geosynthetic installation contractors and drilling contractors. Her experience also includes environmental sampling, field testing, and health and safety monitoring. Her responsibilities include quality assurance monitoring and testing during the installation of geosynthetic and clay liners at landfill sites. Ms. McGowan has provided soil component monitoring including moisture density testing of low permeability soil and preparation of subgrade for geosynthetic installation. She has conducted geosynthetic quality assurance monitoring for various materials including geosynthetic clay liners (GCL), geomembrane, geonet, geotextile and geocomposite. Monitoring and testing are performed to fulfill and document compliance with project requirements including destructive testing for trial welds and field seams, panel placement logs, documentation of air test and vacuum tests, and project record (as-built) drawings. Her experience includes air and vacuum testing seams, material deployment, and wedge or extrusion testing. She has conducted air monitoring of explosive gases and leachate temperatures. She also supports reporting efforts including preparation of QA/QC certification reports, documenting cover integrity in daily reports, and entry of information into databases.

Assignment

CQA Field Monitor

Education

Polaris Career Center, 2007

Meadowbrook High School, 2000

Registration/Certification

OSHA Construction Safety, 10-Hour

HAZWOPER, 40-Hour trained per 29 CFR 1910.120

Troxler Nuclear Density Gauge Certified

First Aid and CPR

Experience

10 years

Joined Firm

2009

Relevant Expertise

- *Construction Quality Assurance (CQA) Oversight*
- *Solid Waste*
- *Environmental Investigation*

Landfill Cell and Leachate Pond CQA, Aleris Recycling, Inc., Morgantown, KY

CQA Technician. Observed construction of a 10-acre, double composite lined industrial waste disposal cell. Cell components included a 36-inch recompacted soil liner, 80-mil textured high-density polyethylene (HDPE) geomembrane, double-sided geocomposite, 80-mil textured HDPE geomembrane, double-sided geocomposite and protective cover. Cell also has a leachate detection and collection system. Observed construction of a 1-acre leachate pond which consisted of a 6-inch recompacted soil liner and a 60-mil textured HDPE geomembrane. Provided soil testing for compaction and moisture utilizing a Troxler Nuclear Density Gauge. Also, provided written and photographic documentation of installation methods, as well as equipment and materials onsite. Prepared daily work summary reports for client.

Liner and Earthwork CQA Services, City of Fremont, Fremont, OH

Lead Field CQA Monitor. Managed the field CQA for the installation of a 96 acre liner system for a raw water reservoir in Fremont, Ohio. The liner system included, in ascending order, Bentomat 200R geosynthetic clay liner (GCL), 40-mil smooth linear low density polyethylene (LLDPE) geomembrane, 10 oz./sy. nonwoven geotextile, and 18-inches of protective soil on the reservoir floor and Bentomat DN GCL, 40-mil textured LLDPE geomembrane, 10 oz./sy. nonwoven geotextile, 12-inches of sand material, 4-inch bedding stone, and 24-inch dumped rock riprap on the reservoir slopes. Provided direction to the field CQA inspectors and spotters who were onsite full-time throughout the duration of the liner installation activities. Performed field density/moisture testing for the liner system subgrade, anchor trench backfill, and replacement of the reservoir embankment.

Countywide Recycling & Disposal Facility 2011 South Slope Relocation, Gas and Liner System CQA Services, East Sparta, Ohio

CQA Technician for this project that included modifications to the existing south slope, the existing leachate collection system, the existing GCCS, and the existing temporary flexible membrane liner (FML). These modifications consisted of the relocation of approximately 142,000 cubic yards of waste, replacement of approximately 1,900 feet of toe drain, installation of

approximately 11,000 feet of high-density polyethylene (HDPE) pipe of various diameters, installation of 5 new extraction wells and 11 replacement extraction wells, and installation of approximately 22 acres of temporary FML

CQA activities included documenting waste relocation, leachate, GCCS, and FML installation, field testing of HDPE pipe and FML, coordination and review of laboratory testing, interpretation of specifications, documentation of all construction activities, documentation of the construction progress and collecting data for an "as-built" construction certification report.

Countywide Recycling & Disposal Facility Cell Construction CQA Services, East Sparta, OH

CQA Technician responsible for the monitoring of daily landfill construction activities for a constant term, providing soil testing for compaction and moisture utilizing a Troxler Nuclear Density Gauge, providing daily documentation for three Cell construction projects (Cells 8B, 8C, and 16). Cell components include a 36-inch recompacted soil liner, geosynthetic clay liner, 60-mil textured high-density polyethylene (HDPE) geomembrane, double-sided geocomposite, and protective cover. Cell also has a leachate collection system. Responsibilities also include working in accordance with project specifications and permit guidelines. Monitored construction of landfill gas and leachate collection system as well as gas line road crossing, toe drains and other ancillary features on-site.

Also performed monthly monitoring of landfill gas on all probes and punch bars for the entire site, as well as explosive gas monitoring in all buildings where Sierra monitors were not available. Provided CQA on the Area N Geosynthetics section of the temporary capping (seven anchors). Provided CQA oversight on 30,000 feett of underground piping on 39 anchors of the landfill. Utilized a GX-2001 gas meter for all activities.

Imperial Landfill Cell Construction CQA, Republic Services, Inc., Imperial, PA

CQA Technician. Observed construction of a 3.8-acre, double composite lined solid waste disposal cell. Provided written and photographic documentation of installation methods, as well as equipment and materials onsite. Prepared daily work summary reports for client.

Lewis Landfill Cap CQA Services, Mahoning County, OH

CQA Technician responsible for on-site field monitoring to ensure that the final cover system maintenance activities were constructed in accordance with the design plans and technical specifications for the Lewis Landfill (Closed). Responsibilities included the monitoring of daily landfill construction activities including placement of the TENSAR geogrid material, structural fill, and low permeability soil material, and vegetation. Performed compaction testing of the structural fill and moisture/density testing of the low permeability soil material utilizing a Troxler Nuclear Density Gauge. Prepared daily documentation including field notes, CQA forms, and photographs. Worked on the Construction Certification Report for submission to the Ohio EPA.

County Land Development Landfill Closure CQA Services, Salem, OH

CQA Technician responsible for on-site field monitoring to ensure that the new final cover system was constructed in accordance with the design plans and technical specifications for the County Land Development (CLD) Landfill Closure Area 4. Responsibilities included the monitoring of daily landfill construction activities including placement of the re-compacted soil barrier (RSB) material, vegetative/protective cover material, landfill gas system pipeline laterals, and storm water controls. Performed compaction and moisture testing utilizing a Troxler Nuclear Density Gauge. Prepared daily documentation including field notes, CQA forms, and photographs. Worked on the Final Closure/Construction Certification Report for submission to the Ohio EPA.

Imperial Landfill Temporary Geomembrane Cap CQA, Republic Services, Inc., Imperial, PA

CQA Technician. Observed installation of 40 acres of geotextile and 40-mile high-density polyethylene (HDPE) geomembrane, surface water channels, surface water culverts and sedimentation basins. Provided written and photographic documentation of installation methods, as well as equipment and materials onsite. Prepared daily work summary reports for client.

Liner Installation Quality Control, Various Sites, Nationally

Quality Control Technician. Provided quality control for a national liner installation company that installed 10 million square feet of geosynthetics annually. Types of geosynthetics installed included Smooth and Textured HDPE and LLDPE, PVC, Polypropylene, and XR5. Responsible for documenting all quantitative and qualitative

testing of the geosynthetics including panel layouts, seam logs, air testing, destructive testing, repair logs and vacuum box testing.

Former AZC Site Remedial Investigation, Slovan, PA

Environmental Technician responsible for overseeing and documenting drilling activities, including monitoring well installations, down hole packer testing and down hole geophysical logging. Additional responsibilities include well development, groundwater sampling, surface water sampling and flow measurements, and sediment sampling.

Old Mill Superfund Site Monitored Natural Attenuation (MNA) Pilot Study, Rock Creek, OH

Environmental Technician responsible for sampling monitoring wells and hydrogen release compound-advanced (HRCA) application trenches to evaluate the effectiveness of MNA during the MNA Pilot Study. In addition to collecting groundwater samples for laboratory analysis, also uses field test kits to analyze the groundwater samples for a suite of bioparameters, including iron, manganese, chloride, nitrate and carbon dioxide.

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Amy Minner

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Amy E. Minner

Experience Summary

Amy Minner is a project engineer with a focus on solid waste. Recently joining Brown and Caldwell, Amy brings valuable experience from having worked in a co-op learning environment where she performed construction quality assurance (CQA) at a landfill for about a year where a variety of remediation and cell construction activities took place. Amy also brings experience performing nuclear density tests for landfill cell and AST construction, soil testing, and collaboration with client and EPA representatives. In addition, Amy has worked previously for the engineering department of a Public Works facility, gaining a working knowledge of the Department's responsibilities and functions within a municipality.

Assignment

CQA Monitor

Education

B.S. Environmental Engineering, Michigan Technological University, 2010

Registration/Certification

- *HAZWOPER Eight-hour Refresher*
- *C4 HAZWOPER Superviser*
- *Nuclear Gauge Safety (Troxler)*
- *HAZMAT (Troxler),(as per U.S.DOT & IATA)*
- *First Aid/CPR*
- *10-Hour Construction Safety*
- *40-Hour Hazardous Waste Operations Safety Training*

Experience

1 Year

Joined Firm

2010

Relevant Expertise

- *Construction Quality Assurance*
- *Groundwater Sampling*
- *Leachate Sampling*
- *Soil Sampling*
- *Methane Surface Scan*

Select Project Experience

Gas Extraction Wells Dewatering System (600 Series), Taunton Sanitary Landfill, Waste Management of Massachusetts, Taunton, MA

Project Engineer. Provided construction quality assurance for the installation of air and forcemain as part of a landfill gas extraction wells dewatering system. Services included field documentation and record keeping, engineering assistance and overview.

Stage 3 Final Cover, Crapo Hill Sanitary Landfill, Greater New Bedford Regional Refuse Management District, Dartmouth, MA

Project Engineer. Providing field construction quality assurance services for the construction of the Stage 3 Final Cover at the Crapo Hill Landfill. Services included field documentation and record keeping, engineering assistance, overview, and taking soil samples from the vegetative subsoil.

Phase VI Final Cover, Carver-Marion-Wareham Landfill, Covanta Energy, Carver, MA

Project Engineer. Provided construction quality assurance for the installation of Phase VI Final Cover, including field documentation and record keeping, engineering assistance and overview.

Middleborough Sanitary Landfill, Waste Management of Massachusetts, Middleborough, MA

Project Engineer. Provided construction quality assurance for the Phase II drainage layer installation. Conducted methane surface scans of the landfill and prepared drawings of the site showing the results of the scan.

Crapo Hill Sanitary Landfill, Greater New Bedford Regional Refuse Management District, Dartmouth, MA

Project Engineer. Managed and conducted leachate sampling (bi-monthly, quarterly). Assisted in the preparation of environmental monitoring reports. Provided construction quality assurance for the installation of vertical gas extraction wells.

Middleborough Sanitary Landfill, Waste Management of Massachusetts, Middleborough, MA

Project Engineer. Provided construction quality assurance for the Phase II drainage layer installation. Conducted methane surface scans and prepared drawings of the landfill site showing the results of the scan.

E.L. Harvey Westborough Facility, E.L. Harvey & Sons, Westborough, Massachusetts

Project Engineer. Conducted surface water and groundwater sampling at two former landfills on the property. Assisted in the preparation of environmental monitoring reports.

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Appendix D: Project Record Drawings

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Phase I Remedial Action

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PROJECT RECORD DRAWINGS

PHASE I REMEDIAL ACTION
FORD ROAD LANDFILL
LORAIN COUNTY, ELYRIA, OHIO

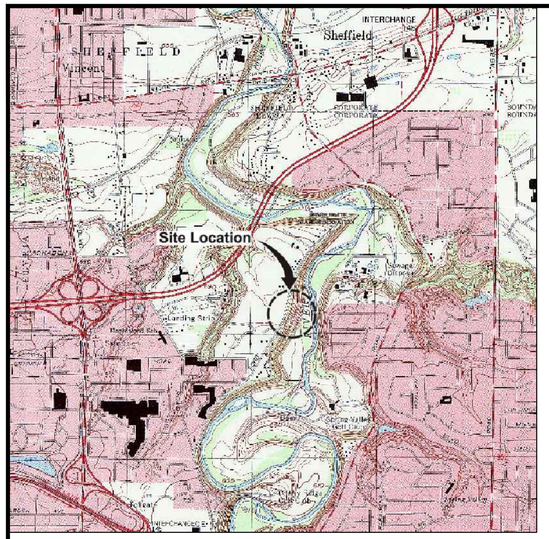
PREPARED FOR THE FORD ROAD LANDFILL SETTLING PARTIES

APRIL 2013

PREPARED BY

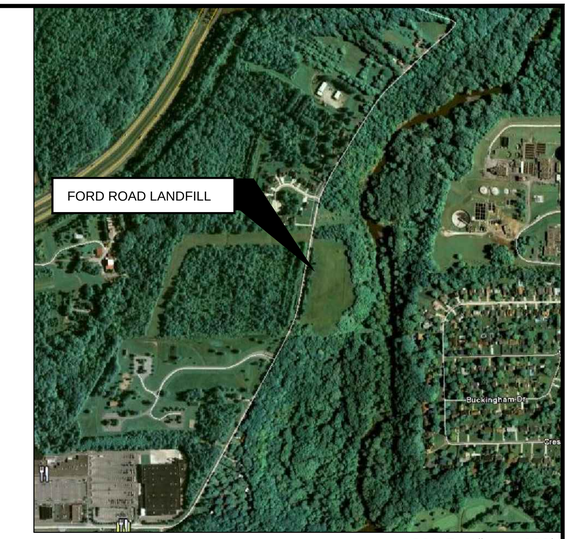
Brown AND Caldwell

COLUMBUS, OHIO



SOURCE: USGS SCALE: 1 IN. = 2000 FT.

LOCATION MAP



SOURCE: GOOGLE MAPS SCALE: 1" = 1200'

VICINITY MAP

DRAWING INDEX

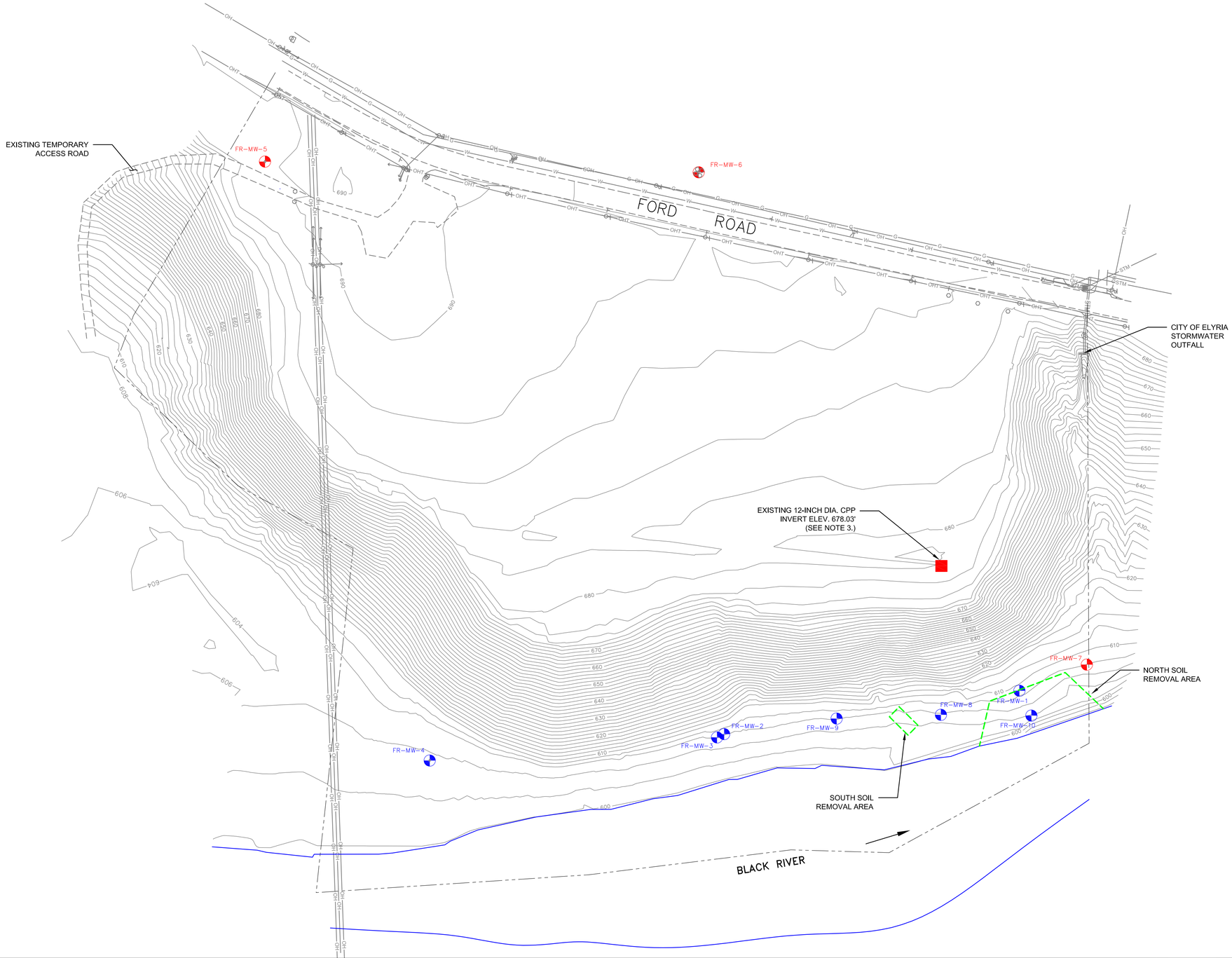
DRAWING	TITLE
RD-1	PHASE I: PRE-CONSTRUCTION SITE PLAN
RD-2	PHASE I: TOP OF WASTE - UPPER LANDFILL SURFACE
RD-3	PHASE I: FINAL COVER CROSS SECTIONS
RD-4	PHASE I: EROSION AND SEDIMENTATION CONTROL - PLAN VIEW
RD-5	PHASE I: POST- CONSTRUCTION EROSION AND SEDIMENTATION CONTROL - DETAILS
RD-6	PHASE I: EROSION AND SEDIMENTATION CONTROL - DETAILS
RD-7	PHASE I: SEDIMENTATION BASIN AND CHANNEL - SECTIONS
RD-8	PHASE I: SEDIMENTATION BASIN - DETAILS
RD-9	PHASE I: ROAD CROSS SECTIONS AND DETAILS
RD-10	PHASE I: CONSTRUCTION - STEP 1
RD-11	PHASE I: CONSTRUCTION - STEP 2 - SOUTH SOIL REMOVAL AREA
RD-12	PHASE I: SLURRY WALL AND SAND BAGS
RD-13	PHASE I: CONSTRUCTION - STEP 3 - NORTH SOIL REMOVAL AREA
RD-14	PHASE I: DESIGN / FIELD SURVEY - PLAN VIEW
RD-14A	PHASE I: POST-CONSTRUCTION PLAN VIEW
RD-15	PHASE I: NORTH CORNER REMEDIATON - SOIL REPLACEMENT AND BANK STABILIZATION

STATE OF OHIO
RICHARD A. ISAAC
E-57074
REGISTERED
PROFESSIONAL ENGINEER

I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED ENGINEER UNDER THE LAWS OF THE STATE OF OHIO.

RICHARD A. ISAAC, PE

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_COVER_SHEET.DWG 4/30/2013 4:02 PM Isaac, Richard



LEGEND:

- EXISTING GROUND CONTOURS
- 680 — EXISTING GROUND INDEX CONTOURS
- PROPERTY LINE
- OH — OVERHEAD POWER LINES
- G — GAS LINE
- OHT — OVERHEAD TELEPHONE LINE
- W — WATER LINE
- STM — STORM LINE
- RIVER EDGE (APPROXIMATE)
- SOIL REMOVAL AREA
- FR-MW-5 — EXISTING GROUNDWATER MONITORING WELLS - PROTECTED BY CONTRACTOR
- FR-MW-1 — ABANDONED GROUNDWATER MONITORING WELLS
- EXISTING 12-INCH DIA. CPP

SURVEY CONTROL POINTS

POINT NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
BM-1	2638.44	6679.79	672.62	SOUTH END OF HEADWALL
BM-2	2210.83	4391.64	692.15	NE CORNER OF CONCRETE PAD
BM-3	2471.77	5484.02	691.85	5 FEET EAST OF ENTRANCE SIGN
BM-4	4443.95	6301.26	682.64	3 FEET EAST OF ENTRANCE SIGN

SURVEY CONTROL POINTS ARE 5/8" DIAMETER x 30" LONG IRON BARS WITH PLASTIC CAPS STAMPED BAIR GOODIE SET ON MAY 13, 2010 AND MAY 14, 2010 BY BAIR GOODIE AND ASSOCIATES, INC. OF NEW PHILADELPHIA, OHIO.

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE WAS PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010.
2. WATER EDGE IS APPROXIMATE.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

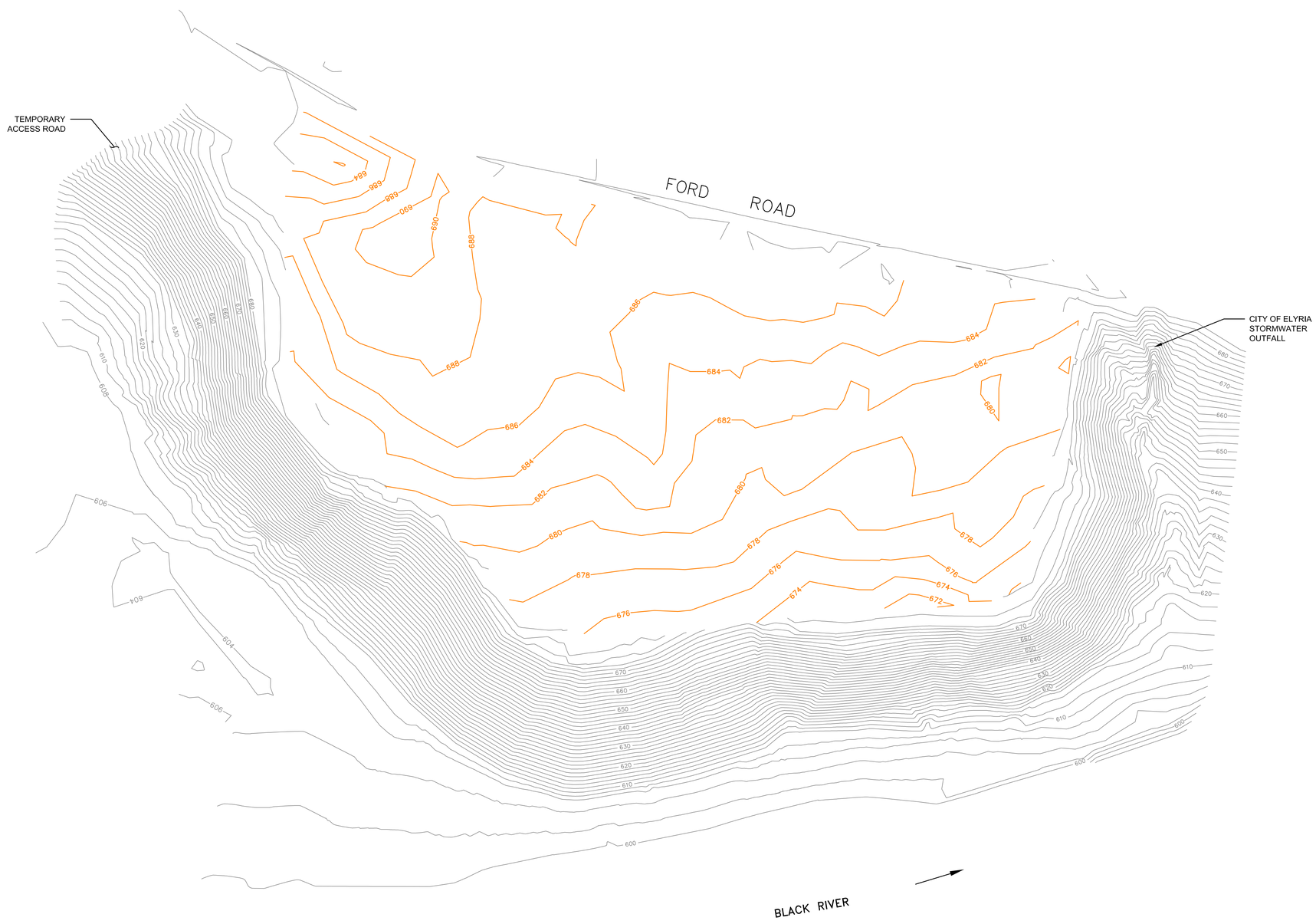
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: PRE-CONSTRUCTION SITE PLAN

FILENAME: FR_P1_RD-1.DWG
BC PROJECT NUMBER: 137355
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-1

P:\FORD ROAD\CONSTRUCTION\FIELD COA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-1.DWG March 27, 2013

March 27, 2013



LEGEND:

- EXISTING GROUND CONTOURS
- 680 EXISTING GROUND INDEX CONTOURS
- PROPERTY LINE
- OH OVERHEAD POWER LINES
- G GAS LINE
- OHT OVERHEAD TELEPHONE LINE
- W WATER LINE
- STM STORM LINE
- RIVER EDGE (APPROXIMATE)
- 680 TOP OF WASTE CONTOUR

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE WAS PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010.
2. WATER EDGE IS APPROXIMATE.
3. WASTE CONTOUR SURFACE GENERATED BASED ON CAP THICKNESS BORINGS.
4. THIS DRAWING PROVIDED FOR INFORMATIONAL PURPOSES; THE INTENT IS TO NOT DISTURB THE IN PLACE WASTE UNLESS ABSOLUTELY NECESSARY AND ONLY UNDER THE DIRECTION OF ENGINEER.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

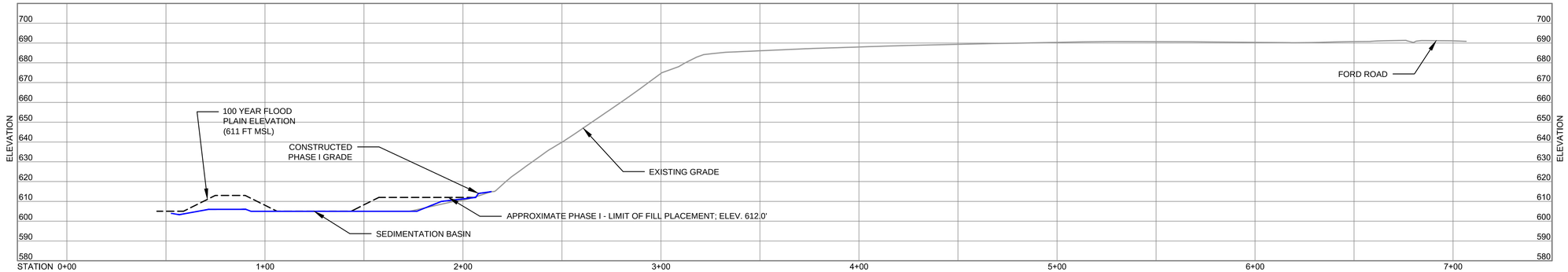
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: TOP OF WASTE
UPPER LANDFILL SURFACE

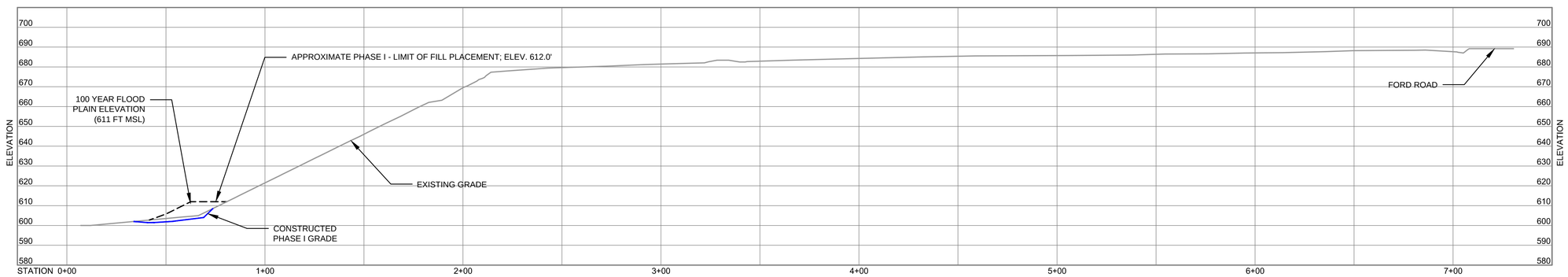
FILENAME FR_P1_RD-2.DWG
BC PROJECT NUMBER 137355
CLIENT PROJECT NUMBER
DRAWING NUMBER RD-2

P:\FORD ROAD\CONSTRUCTION\FIELD COA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-2.DWG March 27, 2013

March 27, 2013



SECTION A / RD-14



SECTION B / RD-14

SECTION C / RD-14

0 30' 60'
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: FINAL COVER
CROSS SECTIONS

FILENAME FR_P1_RD-3.DWG
BC PROJECT NUMBER 137355
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-3

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April 1, 2013

SOUTH ACCESS ROAD (PARTIALLY CONSTRUCTED)

3 / RD-9

EMERGENCY SPILLWAY (NOT CONSTRUCTED)

RIP-RAP OUTLET APRON (NOT CONSTRUCTED)

PRINCIPLE SPILLWAY (NOT CONSTRUCTED)

STEEP SLOPE EROSION PROTECTION (NOT CONSTRUCTED)

SEDIMENTATION BASIN (NOT CONSTRUCTED)

SOUTH ACCESS ROAD (NOT CONSTRUCTED)

A / RD-3

CONTRACTOR STAGING AREA

APPROXIMATE LOCATION OF UPPER SURFACE MATERIAL STAGING AREA (REFER TO DRAWING RD-14 FOR ACTUAL LOCATION)

FORD ROAD

LOCATION OF BAKER TANKS AND ONSITE WATER TREATMENT SYSTEM

CITY OF ELYRIA STORMWATER OUTFALL

TEMPORARY DRAINAGE CHANNEL TO SEDIMENTATION BASIN (NOT CONSTRUCTED)

15' WIDE TEMPORARY CONSTRUCTION ACCESS ROAD

STEEP SLOPE EROSION PROTECTION WITH GREEN ARMOR™ 7020 (NOT CONSTRUCTED)

B / RD-3

2 / RD-9

C / RD-3

BLACK RIVER

LEGEND:

- EXISTING GROUND CONTOURS
- EXISTING GROUND INDEX CONTOURS
- FINAL GRADE CONTOURS
- FINAL GRADE INDEX CONTOURS
- PERMANENT SEEDING - RAINWATER AND LAND DEVELOPMENT, THIRD EDITION 2006
- GREEN ARMOR (TM) 7020 WITH FLEXTERRA (R) HP-FGM (TM)
- FLEXTERRA (R) HP-FGM (TM)
- LIMITS OF SILT FENCE
- PROPERTY LINE
- OVERHEAD POWER LINES
- GAS LINE
- OVERHEAD TELEPHONE LINE
- WATER LINE
- STORM LINE
- RIVER EDGE (APPROXIMATE)

NOTES:

1. THE STEEP SLOPE EROSION PROTECTION WAS NOT USED AS PART OF THE PHASE I REMEDIAL ACTION IMPLEMENTATION.
2. THE PHASE I DISTURBED AREA WAS VEGETATED USING THE PERMANENT SEED MIX.

0 60' 120'

GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: EROSION AND SEDIMENTATION CONTROLS
PLAN VIEW

FILENAME: FR_P1_RD-4.DWG
BC PROJECT NUMBER: 137355
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-4

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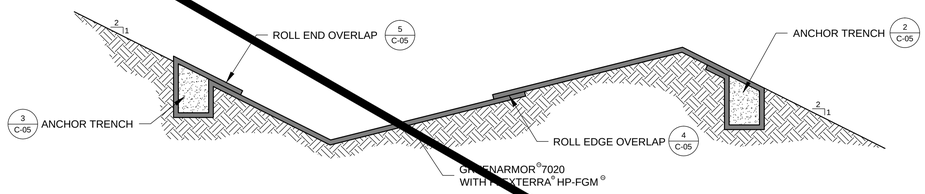
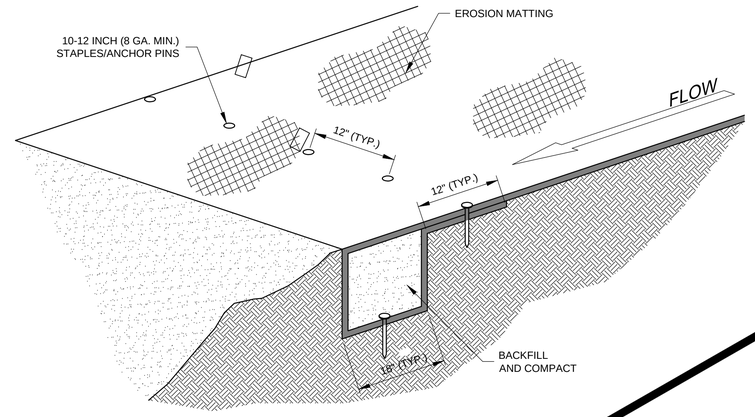
April 1, 2013



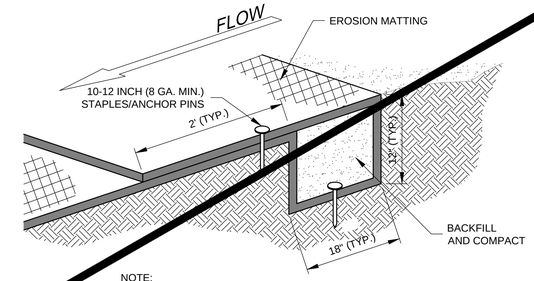
1
C-05
STORM WATER DIVERSION CHANNEL SECTION
NOT TO SCALE



NOTE:

1. ANCHOR TRENCH USED FOR THE INITIAL DOWNSTREAM ROLL.

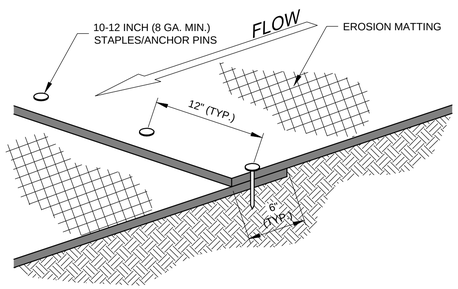
2
C-05
ANCHOR TRENCH
NOT TO SCALE



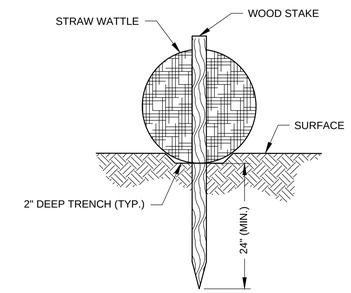
NOTE:

1. ANCHOR TRENCH USED FOR THE TERMINAL UPSTREAM ROLL.

3
C-05
ANCHOR TRENCH
NOT TO SCALE



4
C-05
ROLL EDGE OVERLAP
NOT TO SCALE

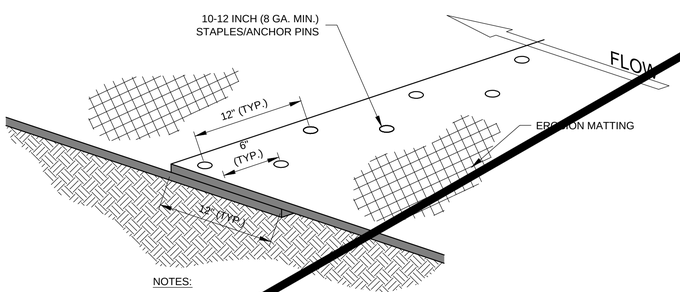


NOTES:

1. ENDS OF WATTLES SHALL BE TURNED SLIGHTLY UP.

2. STAKES ARE 1 1/8" WIDE x 1 1/8" THICK x 30" LONG. STAKES SHALL NOT EXTEND ABOVE THE STRAW WATTLE MORE THAN 2" (SEE DETAIL 8 ON SHEET C-05).

7
C-05
STRAW WATTLE
NOT TO SCALE



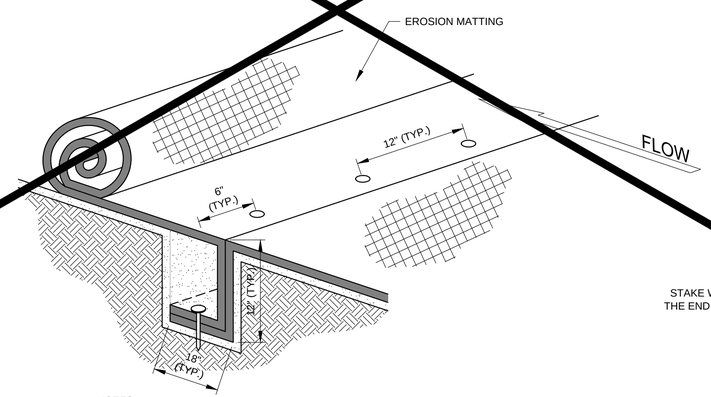
NOTES:

1. UNROLL MAT IN THE UPSTREAM DIRECTION BEGINNING FROM THE CHANNEL OUTLET AND PROGRESSING UPSTREAM TO THE CHANNEL INLET.

2. INSTALL STAPLES OR ANCHOR PINS AT 3 TO 5 FOOT INTERVALS ACROSS ROLL FROM THE ROLL END OVERLAP.

3. INSTALL INTERMITTENT CHECK (SEE DETAIL 6 ON SHEET C-05) SLOTS AT 25 TO 30 FOOT INTERVALS PERPENDICULAR TO FLOW.

5
C-05
ROLL END OVERLAP
NOT TO SCALE



NOTES:

1. INTERMITTENT CHECK SLOTS INSTALLED AT 25-30 FOOT INTERVALS PERPENDICULAR TO FLOW.

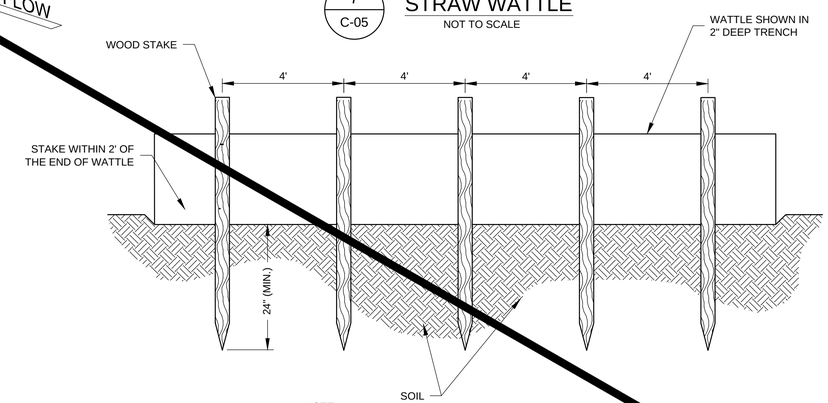
2. FOLD AND SECURE MAT ROLLS SNUGLY INTO INTERMITTENT CHECK SLOTS.

3. LAY MAT IN THE BOTTOM AND FOLD BACK AGAINST ITSELF.

4. ANCHOR THROUGH BOTH LAYERS OF MAT AT 1-FOOT INTERVALS THEN BACKFILL AND COMPACT SOIL.

5. CONTINUE ROLLING MAT UPSTREAM TO THE NEXT INTERMITTENT CHECK SLOTS OR TERMINAL ANCHOR TRENCH.

6
C-05
INTERMITTENT CHECK SLOTS
NOT TO SCALE



NOTE:

1. STRAW WATTLES ARE OPTIONAL FOR PHASE I CONSTRUCTION; HOWEVER, CONTRACTOR MAY USE FOR EROSION/SEDIMENT CONTROL, AS APPLICABLE.

8
C-05
STRAW WATTLE STAKING PATTERN
NOT TO SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: NG
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

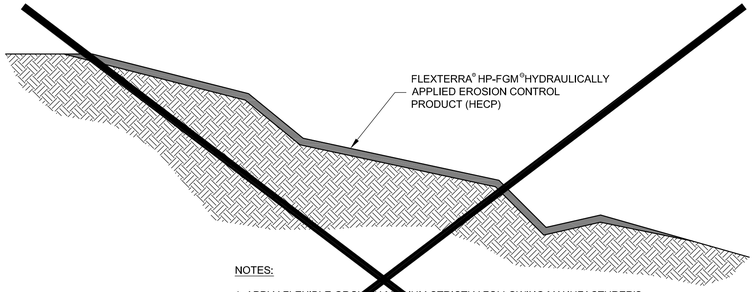
NOTE: CONSTRUCTED AS PART OF THE PHASE II REMEDIAL ACTION IMPLEMENTATION.

FORD ROAD LANDFILL
ELYRIA, OHIO
PROJECT RECORD DRAWINGS
PHASE I: POST - CONSTRUCTION
EROSION AND SEDIMENTATION CONTROL
DETAILS

FILENAME
FR_P1_RD-5.DWG
BC PROJECT NUMBER
137355
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-5

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-5.DWG April 2, 2013

April 2, 2013



NOTES:

1. APPLY FLEXIBLE GROWTH MEDIUM STRICTLY FOLLOWING MANUFACTURER'S INSTRUCTIONS, WITH ON-SITE INSPECTION BY MANUFACTURER'S REPRESENTATIVE.

2. "TRACK-WALK" SURFACE OF TOPSOIL WITH A CLEATED, TRACK-MOUNTED TRACTOR PRODUCING TRACK INDENTATIONS PARALLEL TO THE SLOPE UP THE SURFACE OF THE SLOPE BEFORE APPLYING THE FLEXIBLE GROWTH MEDIUM.

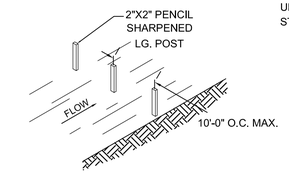
3. APPLY FLEXIBLE GROWTH MEDIUM FROM OPPOSING DIRECTION TO THE TOPSOIL SURFACE.

1 / C-06

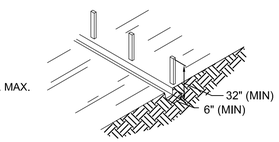
STEEP SLOPE EROSION PROTECTION

NOT TO SCALE

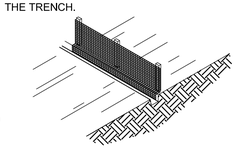
1.) SET THE STAKES.



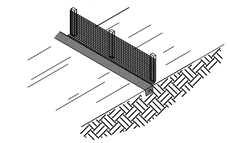
2.) EXCAVATE A 6"X6" TRENCH UPSLOPE ALONG THE LINE STAKES.



3.) STAPLE FILTER MATERIAL TO STAKES AND EXTEND IT INTO THE TRENCH.



4.) BACKFILL AND COMPACT THE EXCAVATED SOIL.



SILT FENCE. THIS SEDIMENT BARRIER UTILIZES STANDARD STRENGTH SYNTHETIC FILTER FABRICS. IT IS DESIGNED FOR SITUATIONS IN WHICH ONLY SHEET OR OVERLAND FLOWS ARE EXPECTED. THE HEIGHT OF A SILT FENCE SHALL NOT EXCEED 16 INCHES (HIGHER FENCES MAY IMPOUND VOLUMES OF WATER SUFFICIENT TO CAUSE FAILURE TO THE STRUCTURE).

THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID THE USE OF JOINTS. WHEN JOINTS ARE NECESSARY FILTER CLOTH SHALL BE SPLICED TOGETHER ONLY AT A SUPPORT POST WITH A MINIMUM 6-INCH OVERLAP AND SECURELY SEALED.

POSTS SHALL BE SPACED A MAXIMUM OF 10 FEET APART AT THE BARRIER LOCATON AND DRIVEN SECURELY INTO THE GROUND (MINIMUM OF 6 INCHES).

A TRENCH SHALL BE EXCAVATED APPROXIMATELY 6 INCHES WIDE AND 6 INCHES DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE AND 8 INCHES OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 16 INCHES ABOVE THE ORIGINAL GROUND SURFACE. FILTER FABRIC SHALL NOT BE STAPLED TO EXISTING TREES.

SILT FENCES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFUL PURPOSE BUT NOT BEFORE THE UPSLOPE AREA HAS BEEN PERMANENTLY STABILIZED.

MAINTENANCE

SILT FENCES AND FILTER BARRIERS SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.

SHOULD THE FABRIC ON A SILT FENCE OR FILTER BARRIER DECOMPOSE OR BECOME INEFFECTIVE PRIOR TO THE END OF THE EXPECTED USABLE LIFE AND THE BARRIER IS STILL NECESSARY, THE FABRIC SHALL BE REPLACED PROMPTLY.

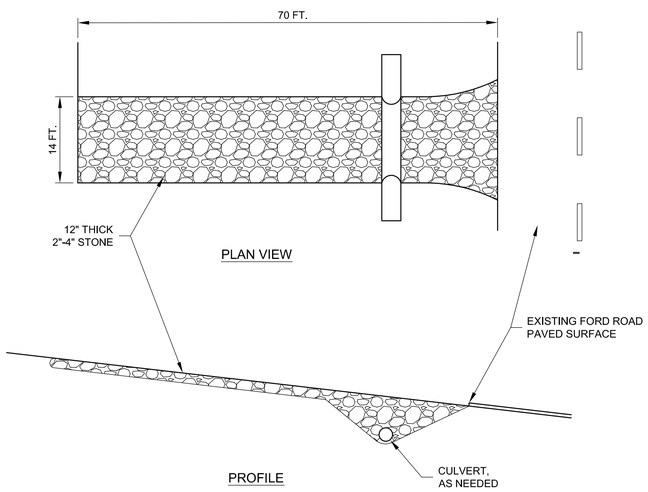
SEDIMENT DEPOSITS SHALL BE REMOVED AFTER EACH STORM EVENT. THEY MUST BE REMOVED WHEN DEPOSITS REACH APPROXIMATELY ONE HALF OF THE HEIGHT OF THE BARRIER.

ANY SEDIMENT DEPOSITS REMAINING IN PLACE AFTER THE SILT FENCE OR FILTER BARRIER IS NO LONGER REQUIRED SHALL BE DRESSED TO CONFORM WITH THE EXISTING GRADE AND SHALL BE PREPARED AND SEEDED.

3 / RD-6

TEMPORARY CONSTRUCTION SILT FENCE

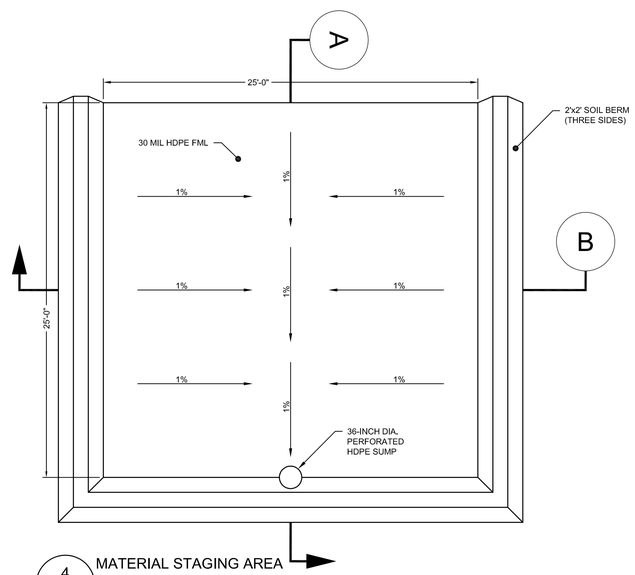
NOT TO SCALE



2 / RD-6

CONSTRUCTION ENTRANCE

NOT TO SCALE

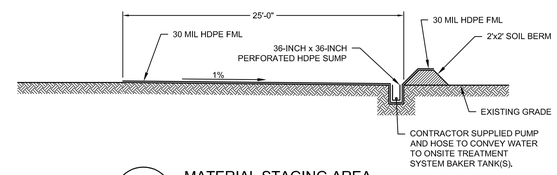


4 / RD-6

MATERIAL STAGING AREA

PLAN

SCALE: NTS

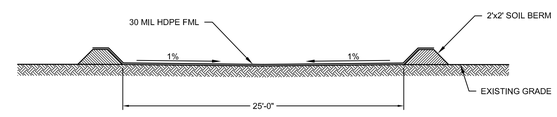


A

MATERIAL STAGING AREA

SECTION

SCALE: NTS



B

MATERIAL STAGING AREA

SECTION

SCALE: NTS

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: EROSION AND SEDIMENTATION CONTROLS
DETAILS

FILENAME
FR_P1_RD-6.DWG

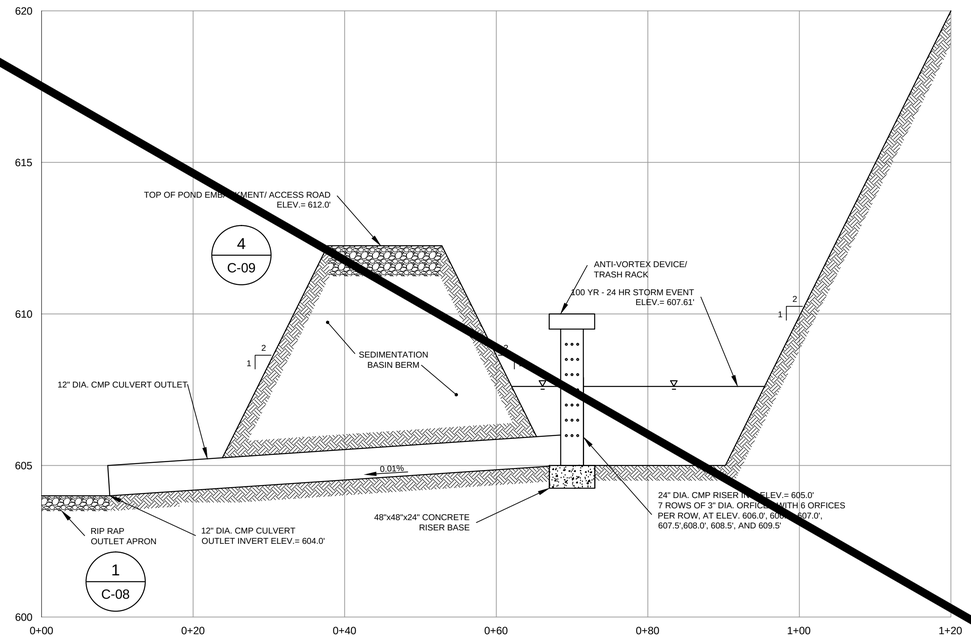
BC PROJECT NUMBER
137355

CLIENT PROJECT NUMBER

DRAWING NUMBER
RD-6

P:\FORD ROAD\CONSTRUCTION\FIELD COA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-6.DWG March 27, 2013

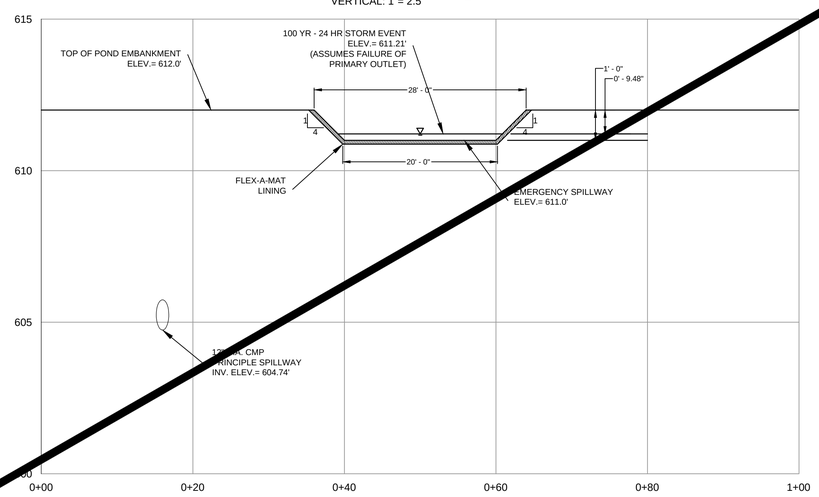
March 27, 2013



PRINCIPLE SPILLWAY

SECTION A / C-07

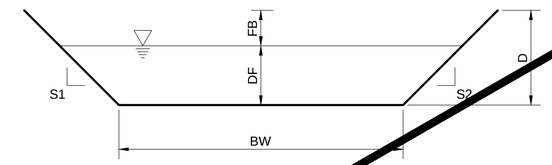
HORIZONTAL: 1"= 10'
VERTICAL: 1"= 2.5'



EMERGENCY SPILLWAY

SECTION B / C-07

HORIZONTAL: 1"= 10'
VERTICAL: 1"= 2.5'



TYPICAL DIVERSION/DOWNCHUTE

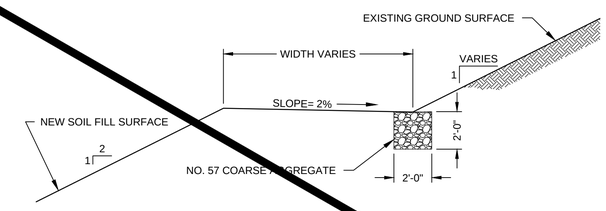
SECTION C / C-07

NTS

NOTES:

D	DEPTH (FT)
BW	BOTTOM WIDTH (FT)
S1 OR S2	SIDE SLOPE (FT/FT)
DF	DEPTH OF FLOW (FT)
FB	FREEBOARD (FT)

DIVERSION/ DOWNCHUTE ID	ROUGHNESS COEFFICIENT	CHANNEL SLOPE (ft/ft)	DISCHARGE (cfs)	D (feet)	BW (feet)	S1 (ft/ft) (H:V)	S2 (ft/ft) (H:V)	DF (feet)	FB (feet)
Downchute									
Bottom	0.050	0.50	62.04	2.00	10.00	3.00	3.00	0.96	1.04



TYPICAL CONVEYANCE DITCH

SECTION D / C-07

NTS

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

NOTE: CONSTRUCTED AS PART OF THE PHASE II REMEDIAL ACTION IMPLEMENTATION.

FORD ROAD LANDFILL
ELYRIA, OHIO

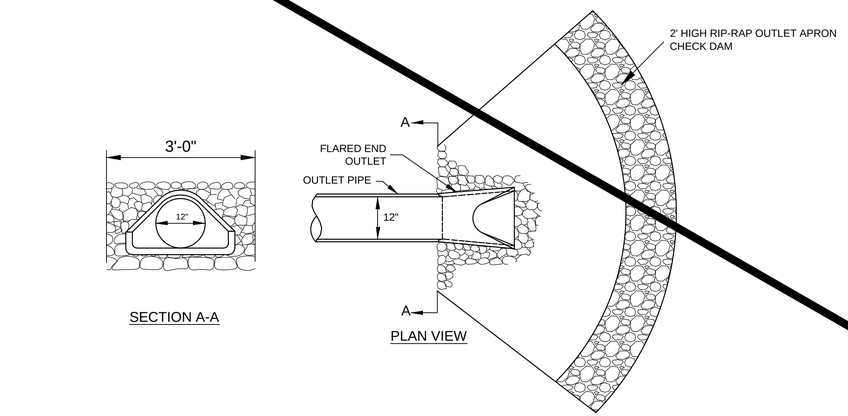
PROJECT RECORD DRAWINGS
PHASE I: SEDIMENTATION BASIN
AND CHANNEL
CROSS SECTIONS

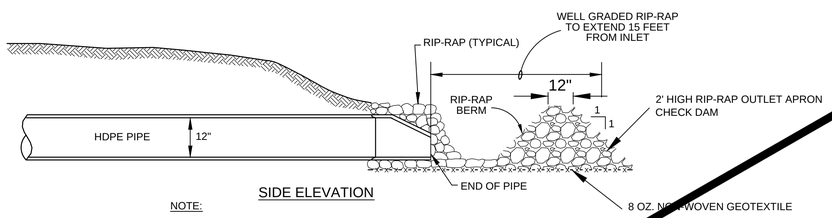
FILENAME
FR_P1_RD-7.DWG
BC PROJECT NUMBER
137355
CLIENT PROJECT NUMBER

DRAWING NUMBER
RD-7

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-7.DWG April 1, 2013

April 1, 2013





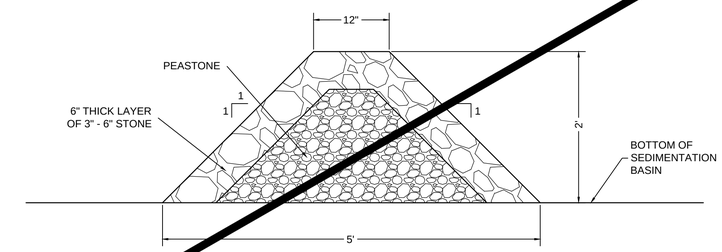
SIDE ELEVATION

NOTE:

RIP-RAP SHALL BE WELL GRADED FROM A MINIMUM SIZE OF 6" TO A MAXIMUM SIZE OF 12".

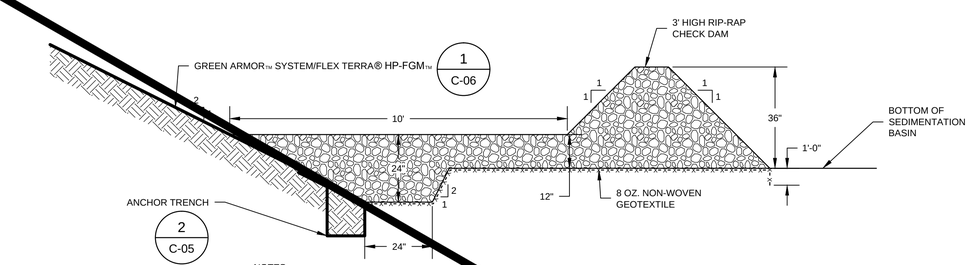
1 / C-08 RIP-RAP OUTLET APRON

NOT TO SCALE



2 / C-08 2' HIGH CHECK DAM

SCALE: 1"= 1'



NOTES:

1. RIP-RAP USED AT BASE OF LET-DOWN CHANNEL SHALL CONSIST OF WELL GRADED RIP-RAP, CONSISTING OF A MAXIMUM STONE SIZE OF 18-INCHES, WITHIN THE FOLLOWING LIMITS:

STONE SIZE	% OF MASS
18" OR OVER	0
10"-18"	30-50
6"-10"	30 - 50
4" - 6"	20 - 30
2" - 4"	10-20
LESS THAN 2"	0 - 10

3 / C-08 DOWNCHUTE CHANNEL OUTLET

SCALE: 1"= 2'

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

NOTE: CONSTRUCTED AS PART OF THE PHASE II REMEDIAL ACTION IMPLEMENTATION.

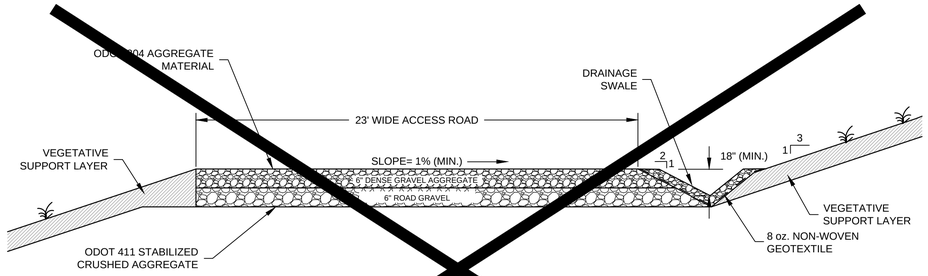
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: SEDIMENTATION BASIN DETAILS

FILENAME: FR_P1_RD-8.DWG
BC PROJECT NUMBER: 137355
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-8

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-8.DWG April 1, 2013

April 1, 2013

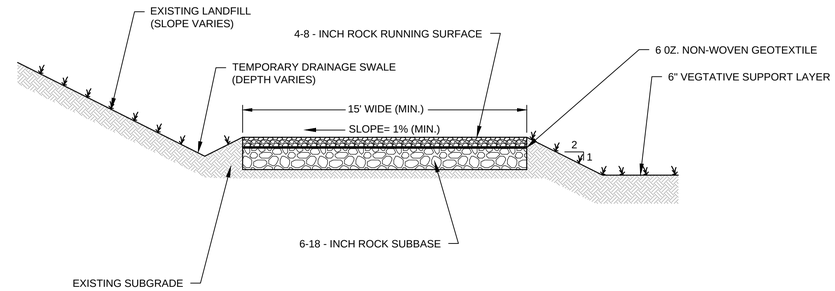


NOTE:

THE RIP-RAP LINING FOR THE ACCESS ROAD SWALE SHALL BE A MINIMUM OF 6-INCHES THICK.

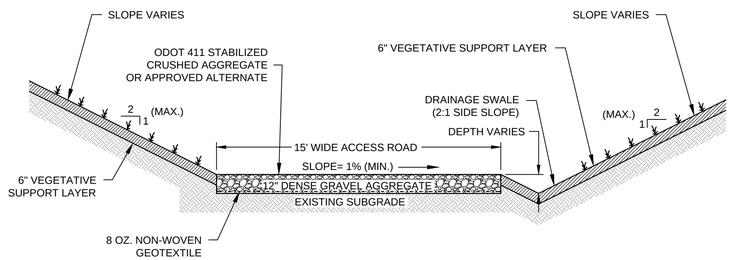
1 / C-09 ON-LANDFILL ACCESS ROAD

SCALE: 1"=4'



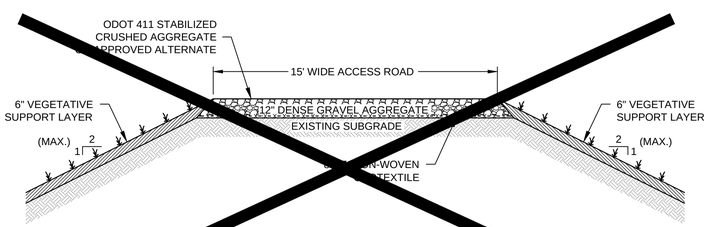
2 / RD-9 TEMPORARY CONSTRUCTION ROAD

SCALE: 1"=4'



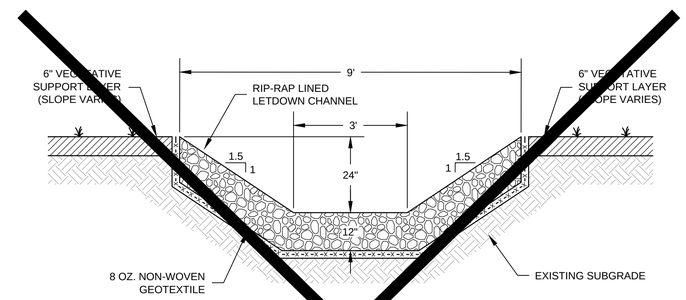
3 / RD-9 SOUTH ACCESS ROAD - PARTIALLY CONSTRUCTED

SCALE: 1"=4'



4 / C-09 SOUTH ACCESS ROAD BELOW FLOOD PLAIN

SCALE: 1"=4'



NOTES:

1. RIP-RAP USED IN LET-DOWN CHANNEL SHALL CONSIST OF WELL GRADED RIP-RAP, CONSISTING OF A D50 OF 6-INCHES A MAXIMUM STONE SIZE OF 10-INCHES, WITH THE FOLLOWING LIMITS:

STONE SIZE	% OF MASS
6"-10"	30 - 50
4" - 6"	20 - 30
2" - 4"	10-20
LESS THAN 2"	0 - 10

5 / C-09 FORD ROAD CULVERT OUTLET CHANNEL

SCALE: 1" = 2'

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

NOTE: ONLY THE SOUTH ACCESS ROAD AND TEMPORARY CONSTRUCTION ROAD WERE CONSTRUCTED AS PART OF THE PHASE I REMEDIAL ACTION IMPLEMENTATION.

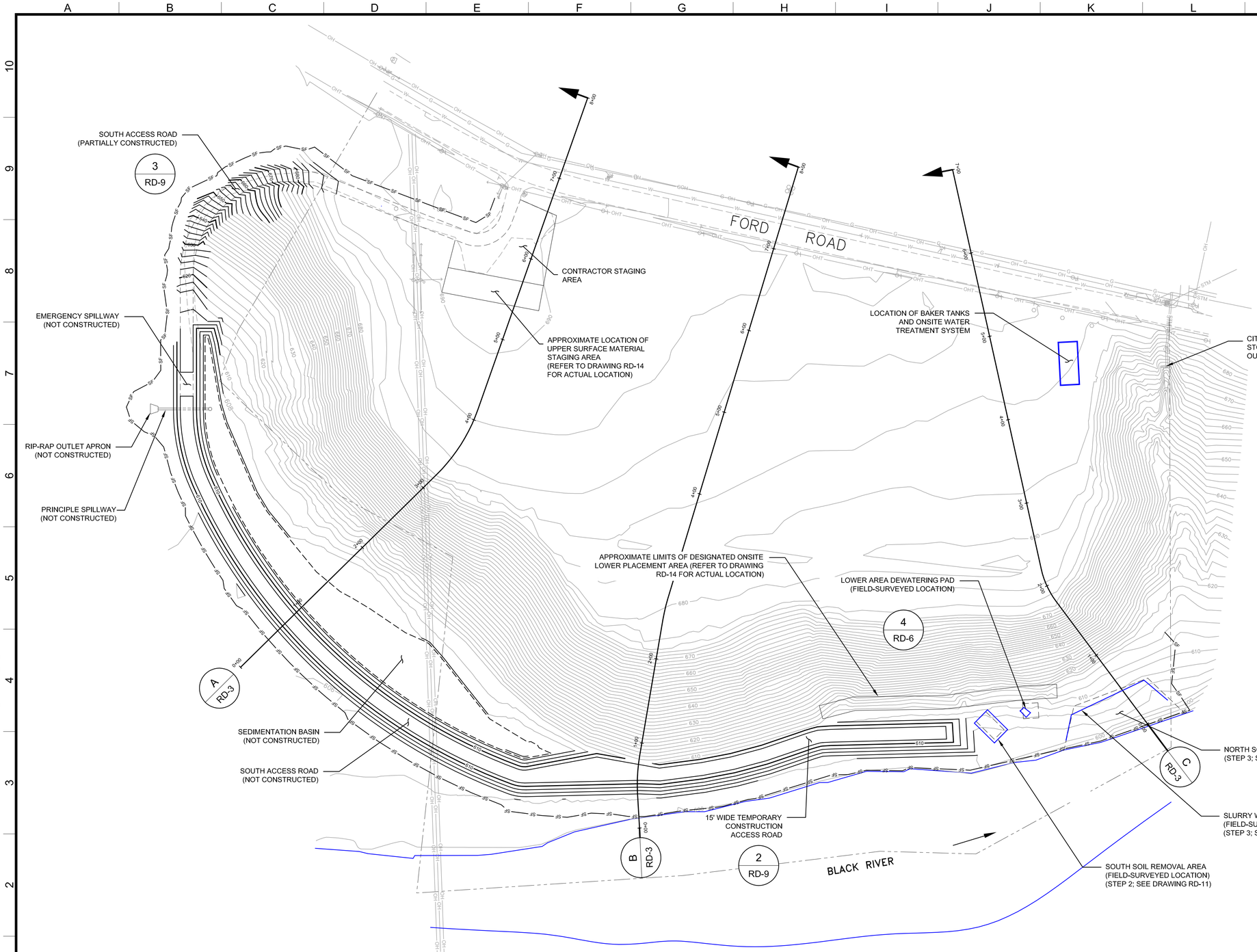
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: ROAD CROSS SECTIONS AND DETAILS

FILENAME: FR_P1_RD-9.DWG
BC PROJECT NUMBER: 137355
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-9

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-9.DWG April 30, 2013

April 30, 2013



LEGEND:

- EXISTING GROUND CONTOURS
- EXISTING GROUND INDEX CONTOURS (680)
- FINAL GRADE CONTOURS
- FINAL GRADE INDEX CONTOURS (670)
- PROPERTY LINE
- OVERHEAD POWER LINES (OH)
- GAS LINE (G)
- OVERHEAD TELEPHONE LINE (OHT)
- WATER LINE (W)
- STORM LINE (STM)
- RIVER EDGE (APPROXIMATE)
- SOIL REMOVAL AREA
- LIMITS OF SILT FENCE (SF)
- 15' ACCESS ROAD

NOTES:

1. CONTRACTOR CONSTRUCTED THE TEMPORARY CONSTRUCTION ACCESS ROAD TO PROVIDE ACCESS TO THE SOIL REMOVAL AREAS.
2. CONTRACTOR INSTALLED AND SET UP THE ONSITE WATER TREATMENT SYSTEM BEFORE INITIATING WORK ON THE NORTH AND SOUTH SOIL REMOVAL AREAS.
3. CONTRACTOR INSTALLED AND SET UP THE MATERIAL STAGING AREA BEFORE INITIATING SOIL EXCAVATION OF THE NORTH AND SOUTH SOIL REMOVAL AREAS.
4. CONTRACTOR CLEARED AND REMOVED TREES FROM WITHIN THE LIMITS OF CLEARING/SILT FENCE LINE ONLY.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

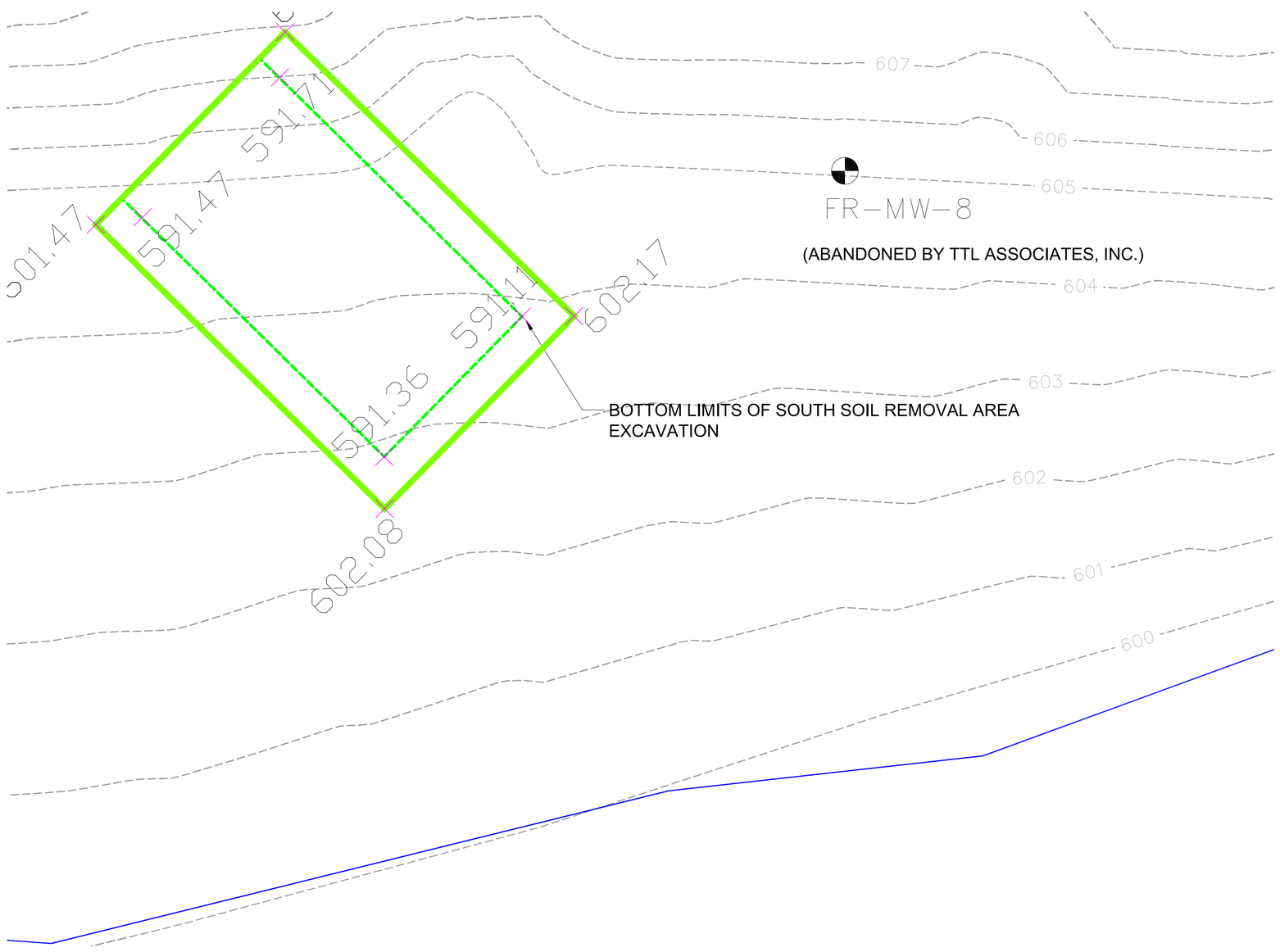
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: CONSTRUCTION
STEP 1

FILENAME: FR_P1_RD-10.DWG
BC PROJECT NUMBER: 137355
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-10

P:\FORD ROAD\CONSTRUCTION\FIELD COA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-10.DWG March 25, 2013

March 25, 2013



LEGEND:

FR-MW-2	MONITORING WELL
	PROPERTY LINE
	RIVER EDGE (APPROXIMATE)
	EXISTING GROUND SURFACE CONTOUR
× 591.36	FIELD-LOCATED TOP OF BEDROCK
	APPROXIMATE SOIL REMOVAL AREA LIMITS
	ACTUAL SOIL REMOVAL AREA LIMITS

0 5 10
GRAPHIC SCALE

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE WAS PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010.
2. WATER EDGE IS APPROXIMATE OUTSIDE THE SITE PROPERTY LINE.

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

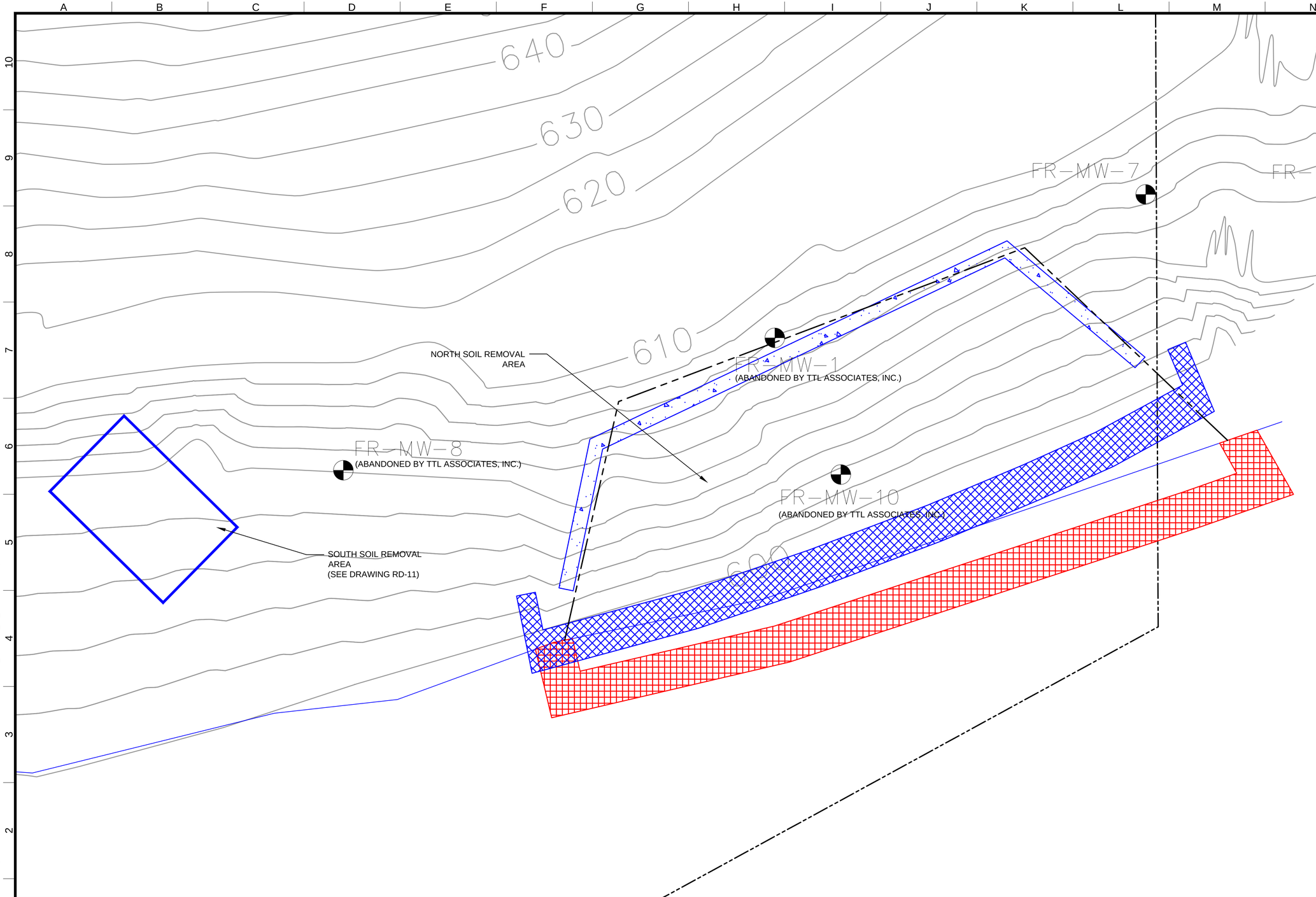
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: CONSTRUCTION
STEP 2
SOUTH SOIL REMOVAL AREA

FILENAME
FR_P1_RD-11.DWG
BC PROJECT NUMBER
137355
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-11

P:\FORD ROAD\CONSTRUCTION\FIELD CO\A\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-11.DWG March 27, 2013

March 27, 2013



LEGEND:

- MONITORING WELL
- EXISTING GROUND SURFACE CONTOUR
- PROPERTY LINE
- RIVER EDGE (APPROXIMATE)
- PROPOSED SLURRY WALL
- FIELD-LOCATED SLURRY WALL
- PROPOSED SAND BAG WALL
- FIELD-CONSTRUCTED SAND BAG WALL

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE WAS PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010.
2. WATER EDGE IS APPROXIMATE OUTSIDE THE SITE PROPERTY LINE.

0 10 20
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

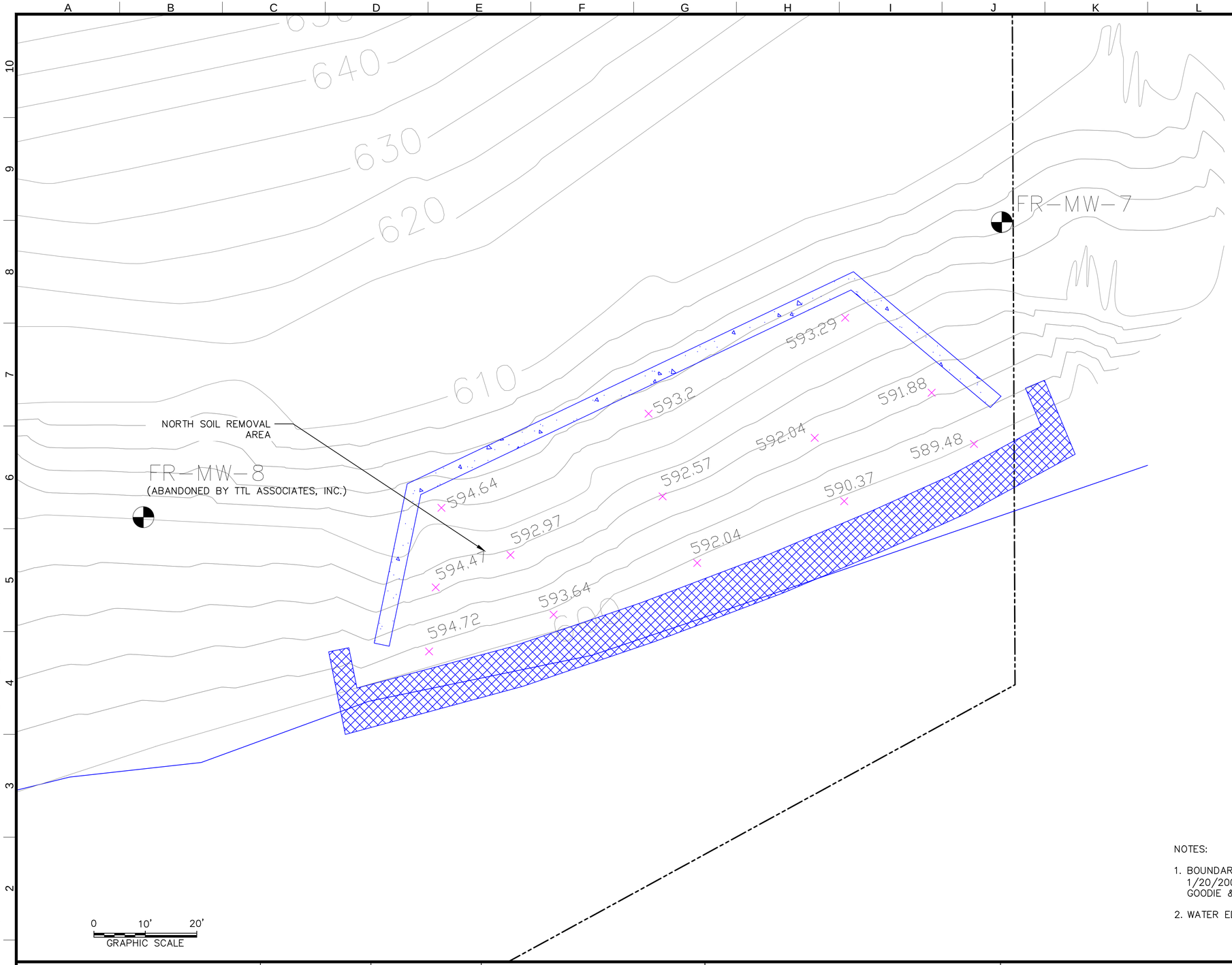
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: SLURRY WALL AND SAND BAGS

FILENAME: FR_P1_RD-12.DWG
BC PROJECT NUMBER: 137355
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-12

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-12.DWG April 1, 2013

April 1, 2013



LEGEND:

FR-MW-2	MONITORING WELL
	PROPERTY LINE
	RIVER EDGE (APPROXIMATE)
	EXISTING GROUND SURFACE CONTOUR
× 591.88	FIELD-LOCATED TOP OF BEDROCK
	SLURRY WALL
	SAND BAG WALL

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE WAS PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010.
2. WATER EDGE IS APPROXIMATE OUTSIDE THE SITE PROPERTY LINE.

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

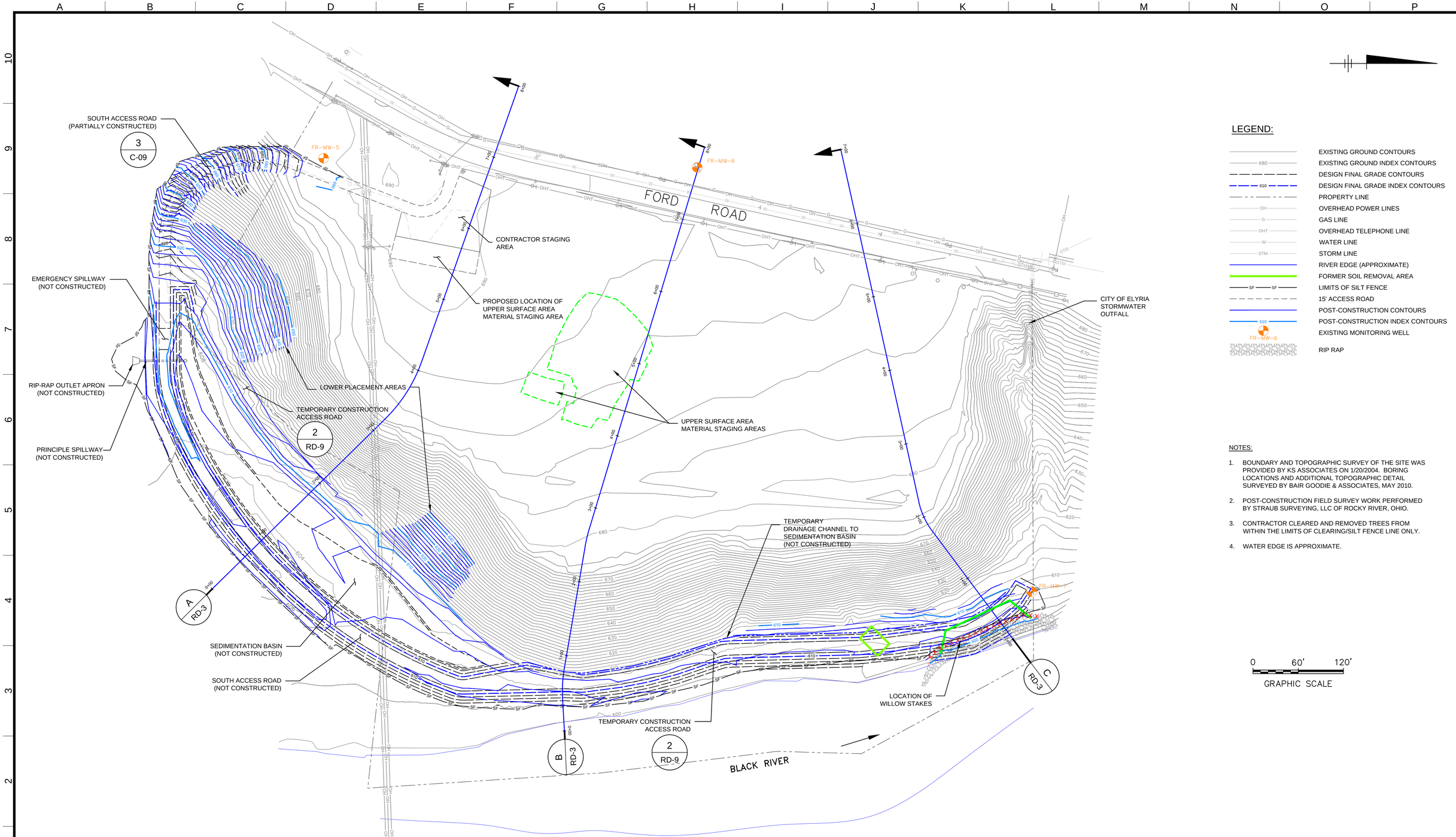
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: CONSTRUCTION
STEP 3
NORTH SOIL REMOVAL AREA

FILENAME FR_P1_RD-13.DWG
BC PROJECT NUMBER 137355
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-13

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-13.DWG April 1, 2013

April 1, 2013



LEGEND:

- EXISTING GROUND CONTOURS
- 680 EXISTING GROUND INDEX CONTOURS
- DESIGN FINAL GRADE CONTOURS
- 610 DESIGN FINAL GRADE INDEX CONTOURS
- PROPERTY LINE
- OH OVERHEAD POWER LINES
- G GAS LINE
- OHT OVERHEAD TELEPHONE LINE
- W WATER LINE
- STM STORM LINE
- RIVER EDGE (APPROXIMATE)
- FORMER SOIL REMOVAL AREA
- SF LIMITS OF SILT FENCE
- 15' ACCESS ROAD
- POST-CONSTRUCTION CONTOURS
- 610 POST-CONSTRUCTION INDEX CONTOURS
- FR-MW-6 EXISTING MONITORING WELL
- RIP RAP

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE WAS PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010.
2. POST-CONSTRUCTION FIELD SURVEY WORK PERFORMED BY STRAUB SURVEYING, LLC OF ROCKY RIVER, OHIO.
3. CONTRACTOR CLEARED AND REMOVED TREES FROM WITHIN THE LIMITS OF CLEARING/SILT FENCE LINE ONLY.
4. WATER EDGE IS APPROXIMATE.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER
APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

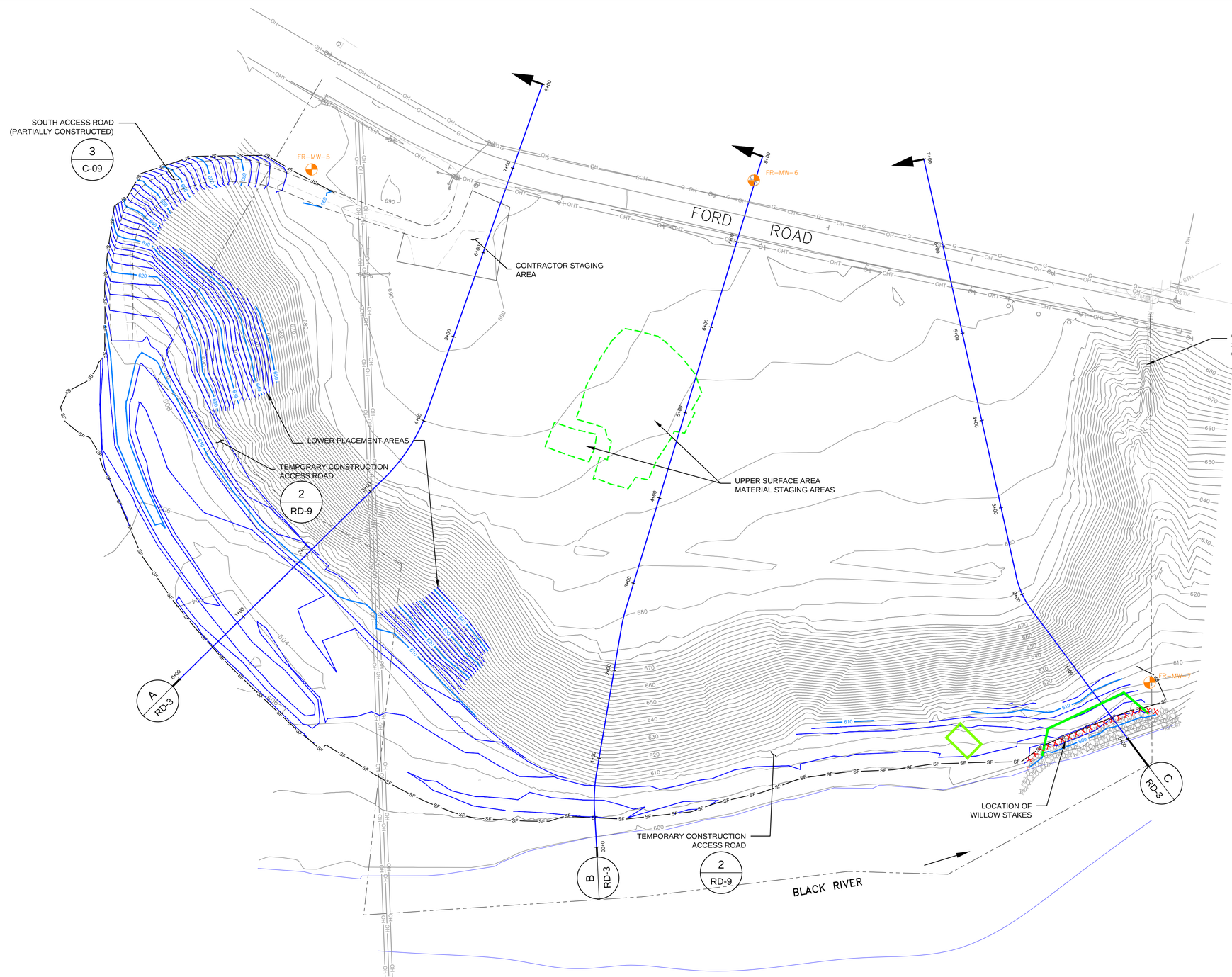
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: DESIGN / FIELD SURVEY
PLAN VIEW

FILENAME
FR_P1_RD-14.DWG
BC PROJECT NUMBER
137355
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-14

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-14.DWG April 2, 2013

April 2, 2013



LEGEND:

- EXISTING GROUND CONTOURS
- EXISTING GROUND INDEX CONTOURS
- PROPERTY LINE
- OVERHEAD POWER LINES
- GAS LINE
- OVERHEAD TELEPHONE LINE
- WATER LINE
- STORM LINE
- RIVER EDGE (APPROXIMATE)
- FORMER SOIL REMOVAL AREA
- LIMITS OF SILT FENCE
- ACCESS ROAD
- POST-CONSTRUCTION CONTOURS
- POST-CONSTRUCTION INDEX CONTOURS
- EXISTING MONITORING WELL
- RIP RAP

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE WAS PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010.
2. POST-CONSTRUCTION FIELD SURVEY WORK PERFORMED BY STRAUB SURVEYING, LLC OF ROCKY RIVER, OHIO.
3. CONTRACTOR CLEARED AND REMOVED TREES FROM WITHIN THE LIMITS OF CLEARING/SILT FENCE LINE ONLY.
4. WATER EDGE IS APPROXIMATE.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

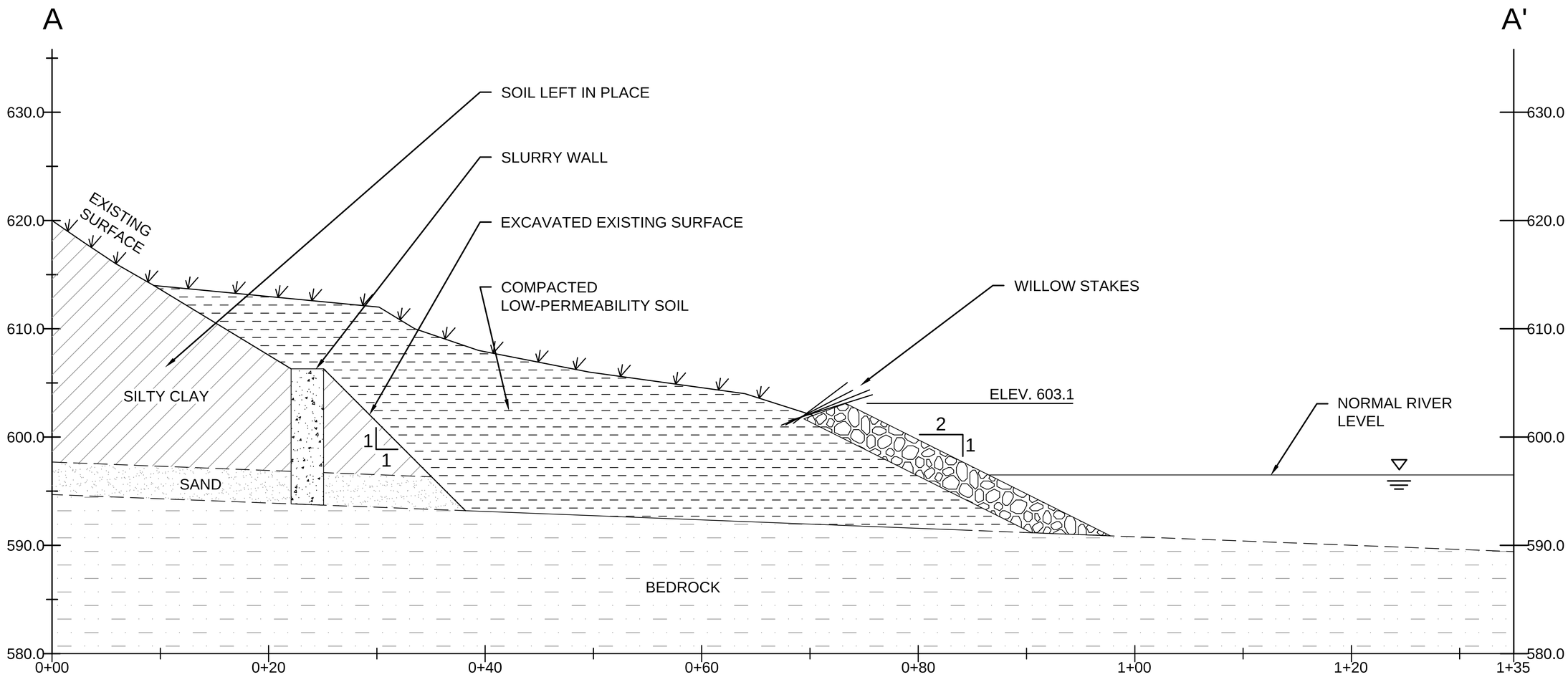
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS PHASE I: POST-CONSTRUCTION PLAN VIEW

FILENAME: FR_P1_RD-14A.DWG
BC PROJECT NUMBER: 137355
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-14A

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P1_FINAL\FR_P1_RD-14A.DWG April 2, 2013

April 2, 2013



Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED: RA
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE I: NORTH CORNER REMEDIATION - SOIL REPLACEMENT AND BANK STABILIZATION

FILENAME
FR_P1_RD-15.DWG
BC PROJECT NUMBER
137355
CLIENT PROJECT NUMBER
FIGURE NUMBER
RD-15

April 1, 2013

Apr 01, 2013 - 11:43am
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risaac

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Appendix D: Project Record Drawings

Phase II Remedial Action

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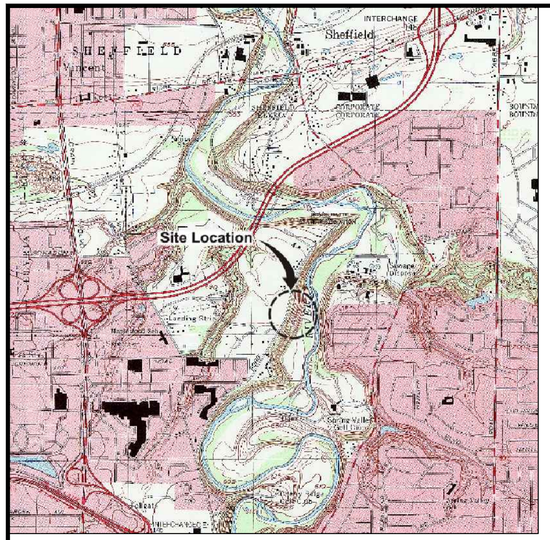
PROJECT RECORD DRAWINGS

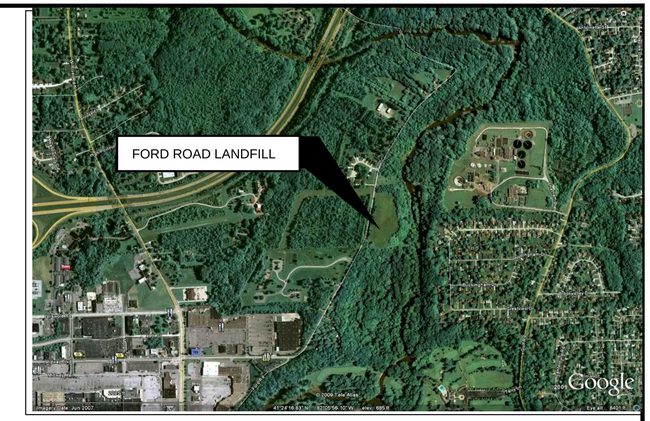
PHASE II REMEDIAL ACTION
FORD ROAD LANDFILL
LORAIN COUNTY, ELYRIA, OHIO

PREPARED FOR THE FORD ROAD LANDFILL SETTLING PARTIES



SOURCE: USGS SCALE: 1 IN. = 2000 FT.

LOCATION MAP



SOURCE: GOOGLE MAPS SCALE: 1" = 1200'

VICINITY MAP

APRIL 2013

PREPARED BY

Brown AND Caldwell

COLUMBUS, OHIO

DRAWING INDEX

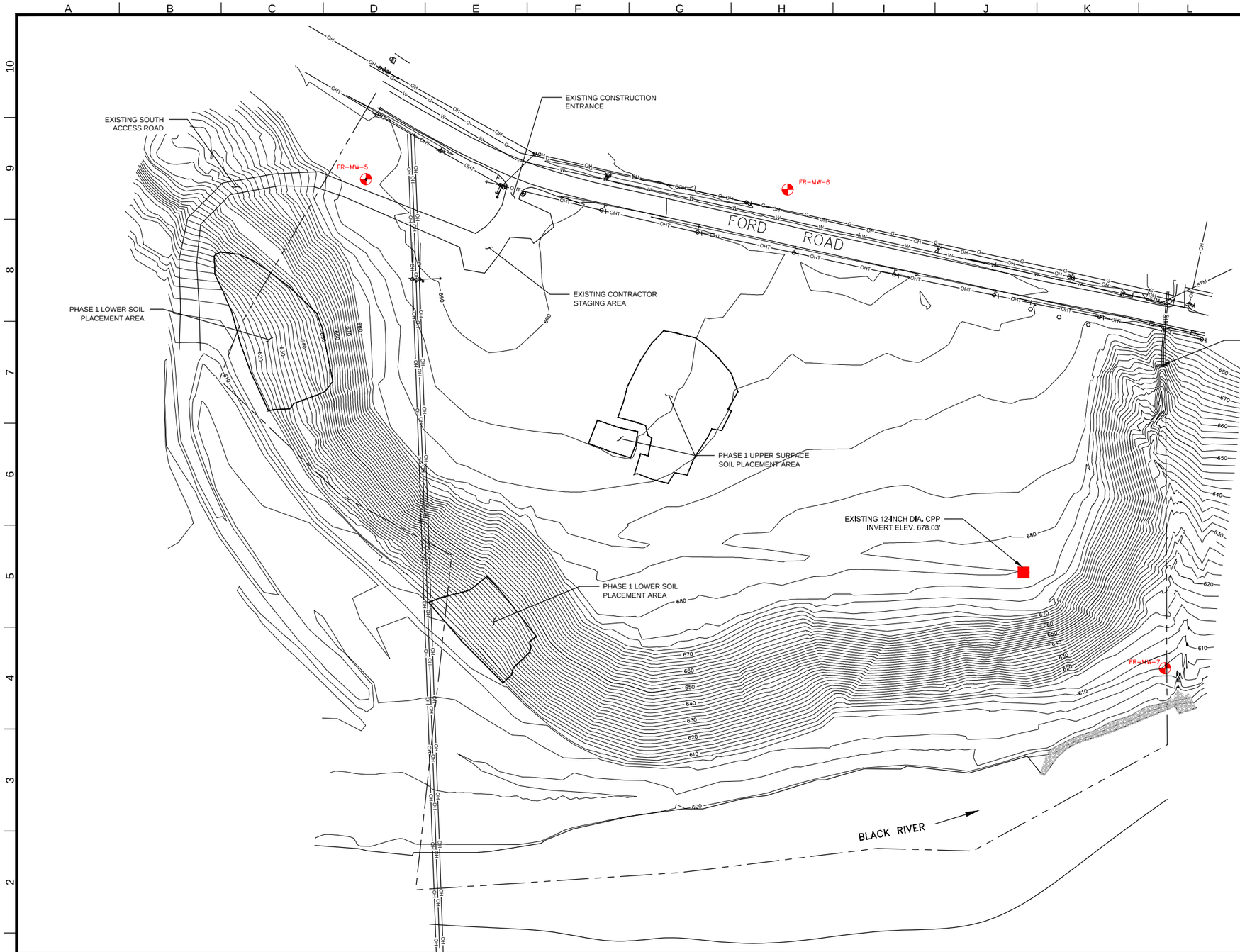
DRAWING	TITLE
RD-1	PHASE II: PRE-CONSTRUCTION SITE PLAN
RD-2	PHASE II: TOP OF WASTE - UPPER LANDFILL SURFACE
RD-3	PHASE II: FINAL COVER CROSS SECTIONS
RD-4	PHASE II: EROSION AND SEDIMENTATION CONTROL - PLAN VIEW
RD-5	PHASE II: EROSION AND SEDIMENTATION CONTROL - DETAILS
RD-6	PHASE II: EROSION AND SEDIMENTATION CONTROL - DETAILS
RD-7	PHASE II: SEDIMENTATION BASIN AND CHANNEL - SECTIONS
RD-8	PHASE II: SEDIMENTATION BASIN - DETAILS
RD-9	PHASE II: ROAD SECTIONS AND DETAILS
RD-10	PHASE II: DESIGN/FIELD SURVEY PLAN PLAN
RD-10A	PHASE II: POST-CONSTRUCTION PLAN VIEW
RD-11	PHASE II: SEEP DRAIN PLAN AND DETAILS
RD-12	PHASE II: SEEP DRAIN - SOUTH PROFILE
RD-13	PHASE II: SEEP DRAIN - NORTH PROFILE
RD-14	PHASE II: UPPER SURFACE AREA - FINAL COVER SYSTEM CAP THICKNESS

STATE OF OHIO
RICHARD A. ISAAC
E-57074
REGISTERED
PROFESSIONAL ENGINEER

I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED ENGINEER UNDER THE LAWS OF THE STATE OF OHIO.

RICHARD A. ISAAC, PE

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P2 FINAL\FR_P2_COVER SHEET.DWG 4/30/2013 4:00 PM Isaac, Richard



LEGEND:

- EXISTING GROUND CONTOURS
- EXISTING GROUND INDEX CONTOURS
- PROPERTY LINE
- OVERHEAD POWER LINES
- GAS LINE
- OVERHEAD TELEPHONE LINE
- WATER LINE
- STORM LINE
- RIVER EDGE (APPROXIMATE)
- FR-MW-5 — EXISTING GROUNDWATER MONITORING WELLS - PROTECTED BY CONTRACTOR
- EXISTING 12-INCH DIA. CPP
- EXISTING RIPRAP

SURVEY CONTROL POINTS

POINT NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
BM-1	2638.44	6678.79	672.62	SOUTH END OF HEADWALL
BM-2	2210.83	4391.64	692.15	NE CORNER OF CONCRETE PAD
BM-3	2471.77	5484.02	691.85	5 FEET EAST OF ENTRANCE SIGN
BM-4	4443.95	6301.26	682.64	3 FEET EAST OF ENTRANCE SIGN

SURVEY CONTROL POINTS ARE ¾" DIAMETER x 30" LONG IRON BARS WITH PLASTIC CAPS STAMPED BAIR GOODIE SET ON MAY 13, 2010 AND MAY 14, 2010 BY BAIR GOODIE AND ASSOCIATES, INC. OF NEW PHILADELPHIA, OHIO.

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010, AND STRAUB SURVEYING, LLC, FEBRUARY 2012.
2. WATER EDGE IS APPROXIMATE.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER
APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: NG
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: PRE-CONSTRUCTION
PLAN VIEW

FILENAME FR_P2_RD-1.DWG
BC PROJECT NUMBER 142889
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-1

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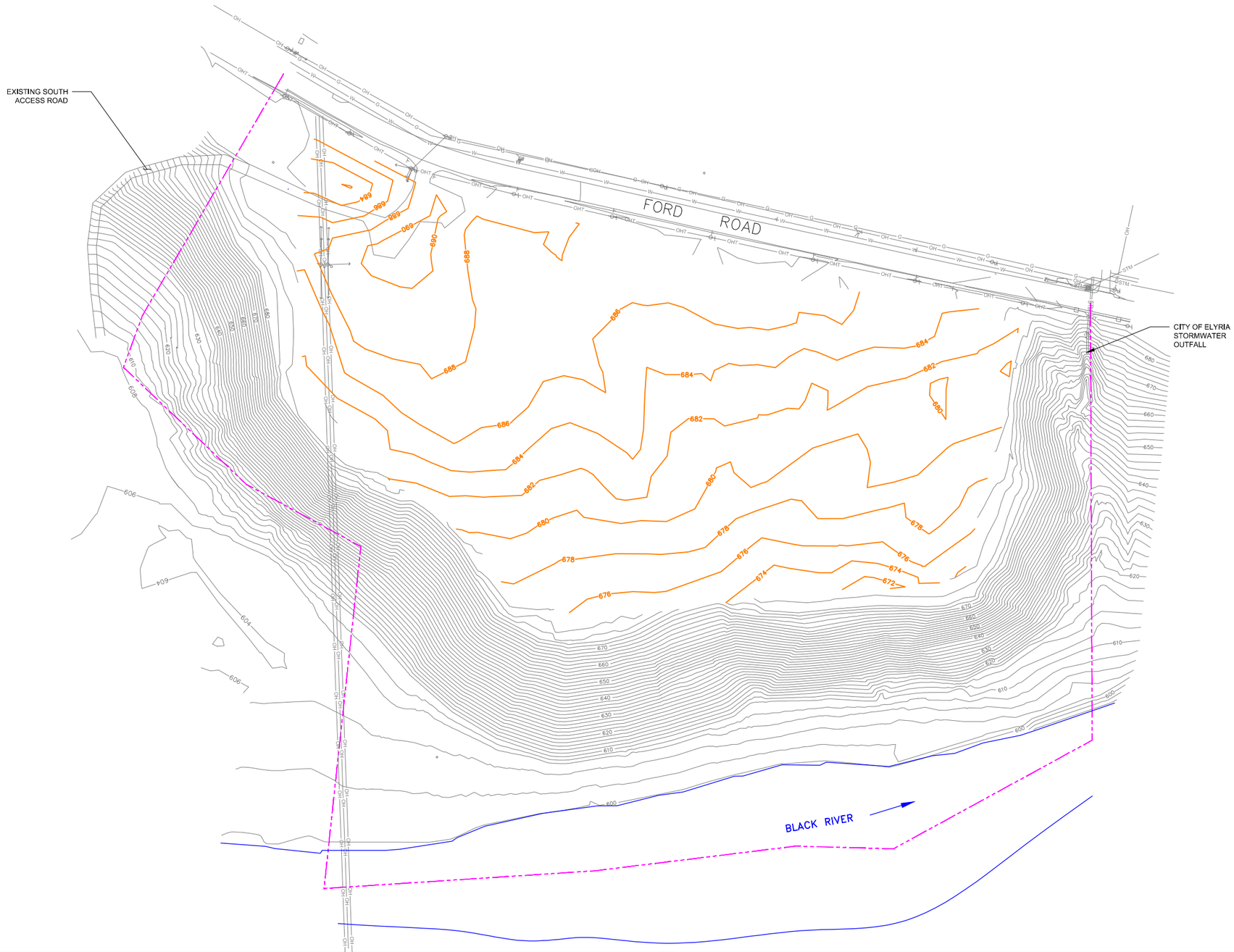
April 2, 2013



LEGEND:

- EXISTING GROUND CONTOUR
- 680 EXISTING GROUND INDEX CONTOUR
- 680 EXISTING TOP OF WASTE CONTOUR
- PROPERTY LINE
- OH OVERHEAD POWER LINE
- G GAS LINE
- OHT OVERHEAD TELEPHONE LINE
- W WATER LINE
- STM STORM LINE
- RIVER EDGE

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE WAS PROVIDED BY KS ASSOCIATES ON 1/20/2004. ADDITIONAL TOPOGRAPHIC DETAIL PROVIDED BY BAIR GOODIE & ASSOCIATES ON 05/13/2010..
2. RIVER EDGE IS APPROXIMATE.
3. WASTE CONTOUR SURFACE GENERATED BASED ON CAP THICKNESS BORINGS.

0 60' 120'

GRAPHIC SCALE

Brown AND Caldwell

COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS

EXISTING TOP OF WASTE
UPPER SURFACE AREA

FILENAME FR_P2_RD-2.DWG
BC PROJECT NUMBER 142889
CLIENT PROJECT NUMBER
DRAWING NUMBER RD-2

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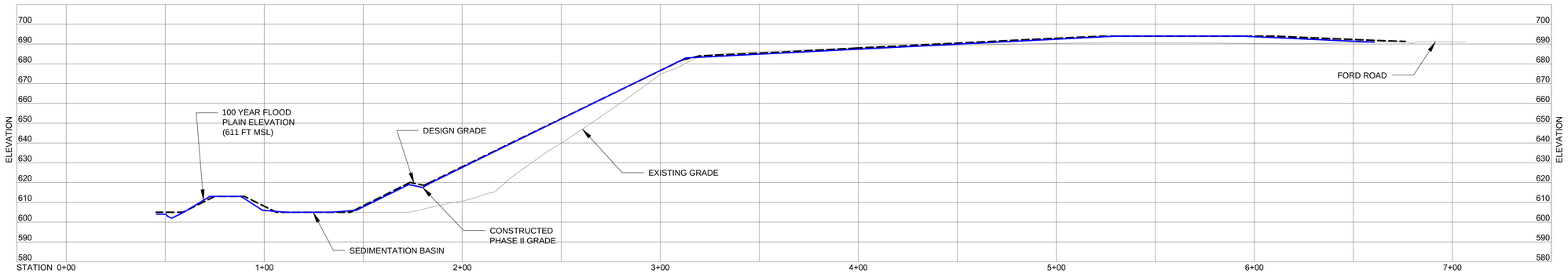
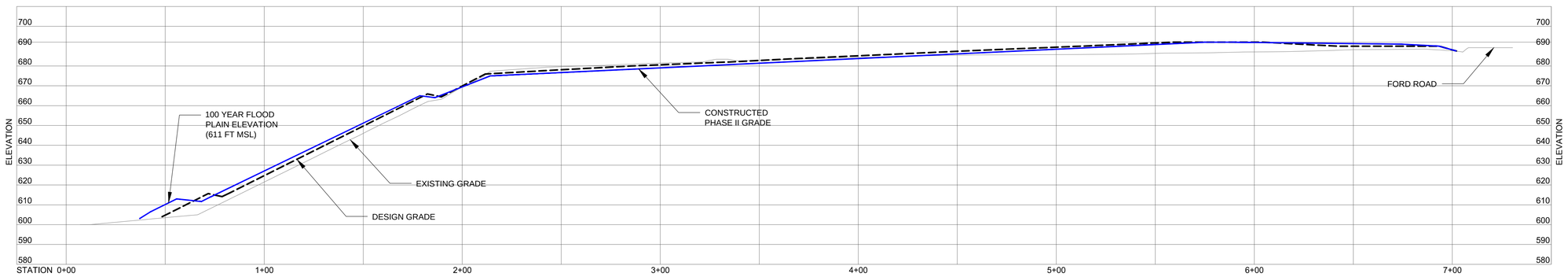
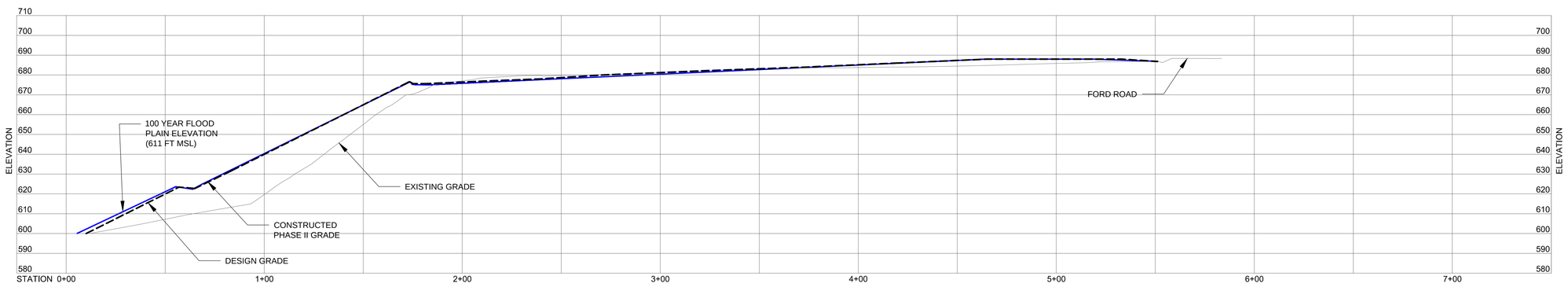
April 2, 2013



SECTION A / RD-3



SECTION B / RD-3



SECTION C / RD-3

0 30' 60'
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: FINAL COVER
CROSS SECTIONS

FILENAME
FR_P2_RD-3.DWG
BC PROJECT NUMBER
142889
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-3

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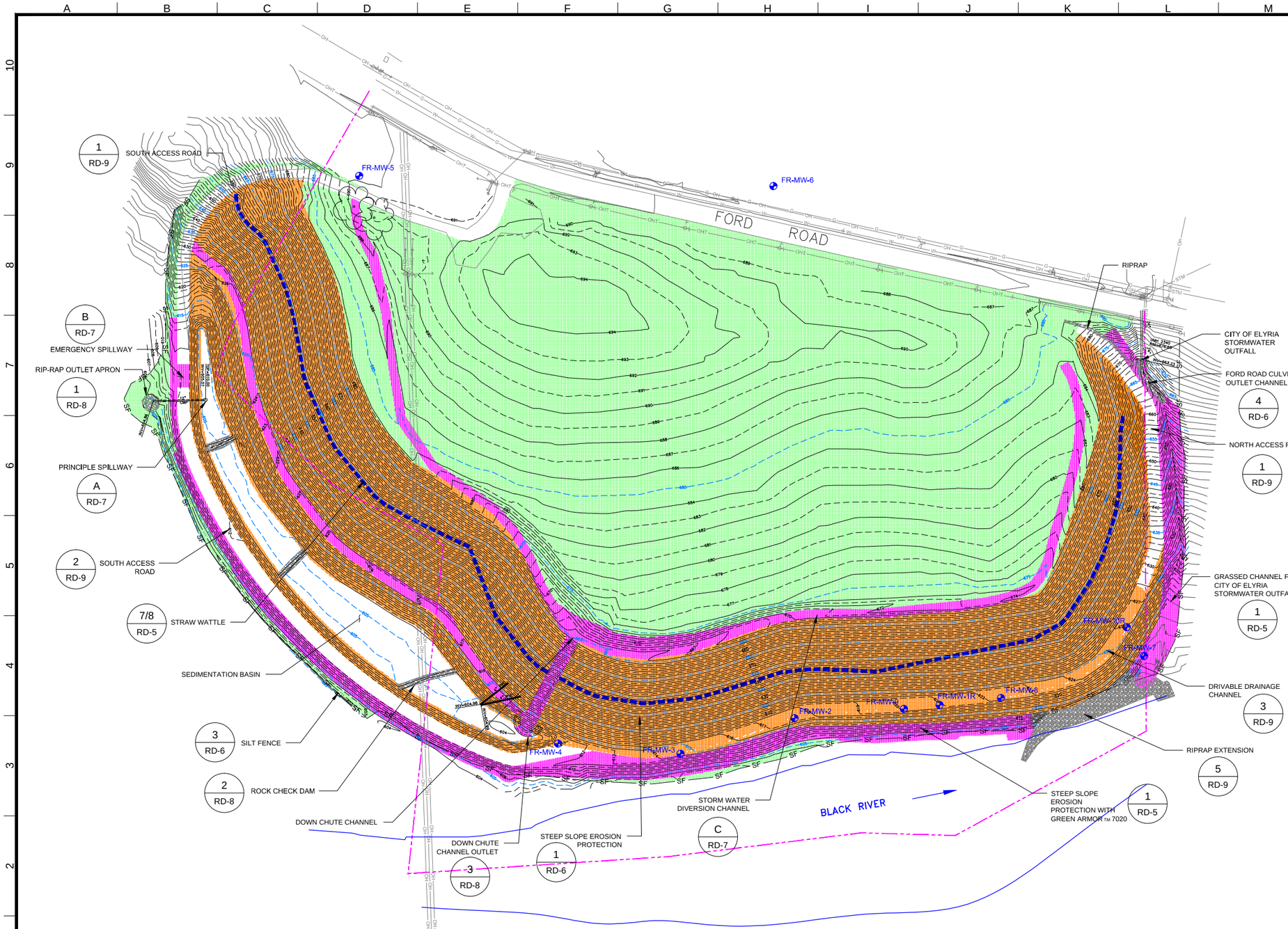
April 3, 2013



LEGEND:

- EXISTING GROUND CONTOUR
- FINAL GRADE INDEX CONTOUR
- FINAL GRADE INTERMEDIATE CONTOUR
- PERMANENT SEEDING - RAINWATER AND LAND DEVELOPMENT, THIRD EDITION 2006
- GREEN ARMOR (TM) 7020 WITH FLEXTERRA (R) HP-FGM (TM)
- FLEXTERRA (R) HP-FGM (TM)
- STRAW WATTLE
- SILT FENCE
- PROPERTY LINE
- OVERHEAD POWER LINE
- GAS LINE
- TELEPHONE LINE
- WATER LINE
- STORM LINE
- RIVER EDGE
- RIP RAP
- FR-MW-8 FINAL MONITORING WELL LOCATION

NOTES:

1. BOUNDARY AND EXISTING TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 1/20/2004.
2. TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 10/19/2012.
3. NEW GROUNDWATER MONITORING WELL LOCATIONS (FR-MW-1R, FR-MW-2, FR-MW-3, FR-MW-4, FR-MW-8, FR-MW-9, AND FR-MW-10R) PROVIDED BY BAIR GOODIE & ASSOCIATES, ON 10/11/2012.
4. RIVER EDGE IS APPROXIMATE.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER
APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS

EROSION AND SEDIMENTATION CONTROL-PLAN VIEW

FILENAME FR_P2_RD-4.DWG
BC PROJECT NUMBER 142889
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-4

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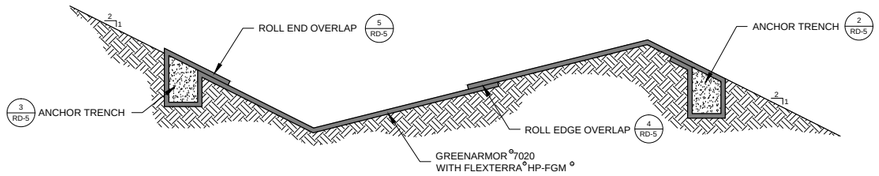
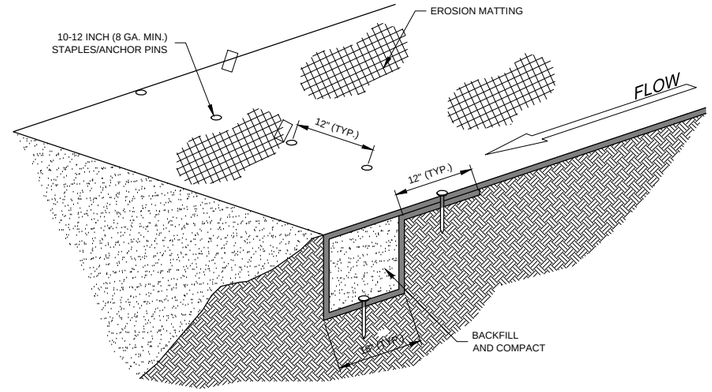
April 3, 2013



1 RD-5 STORM WATER DIVERSION CHANNEL SECTION

NOT TO SCALE

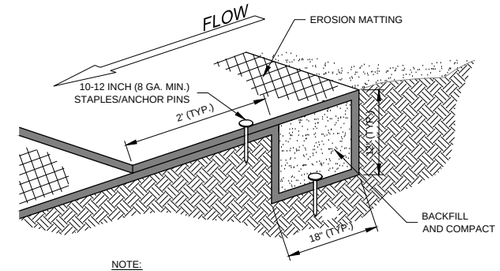


NOTE:

1. ANCHOR TRENCH USED FOR THE INITIAL DOWNSTREAM ROLL.

2 RD-5 ANCHOR TRENCH

NOT TO SCALE

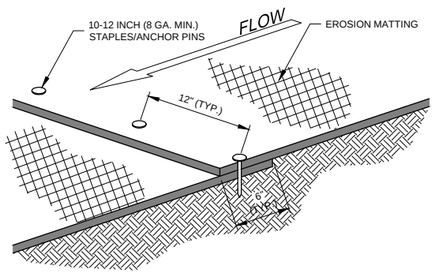


NOTE:

1. ANCHOR TRENCH USED FOR THE TERMINAL UPSTREAM ROLL.

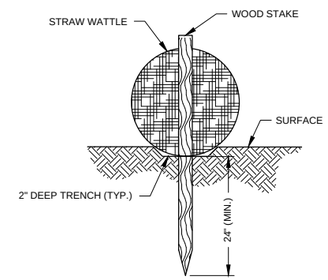
3 RD-5 ANCHOR TRENCH

NOT TO SCALE



4 RD-5 ROLL EDGE OVERLAP

NOT TO SCALE

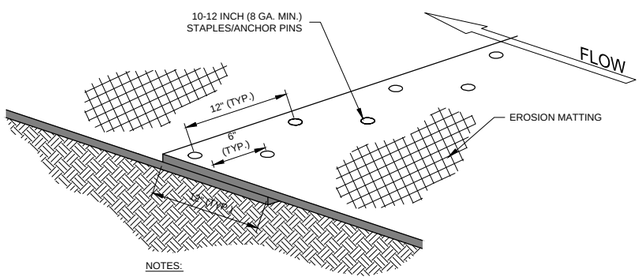


NOTES:

1. ENDS OF WATTLES TURNED SLIGHTLY UP.
2. STAKES ARE 1 ½" WIDE x 1 ½" THICK x 30" LONG. STAKES DO NOT EXTEND ABOVE THE STRAW WATTLE MORE THAN 2".

7 RD-5 STRAW WATTLE

NOT TO SCALE

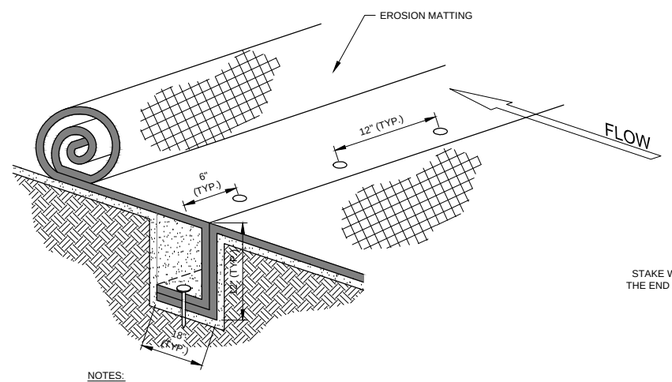


NOTES:

1. UNROLLED MAT IN THE UPSTREAM DIRECTION BEGINNING FROM THE CHANNEL OUTLET AND PROGRESSED UPSTREAM TO THE CHANNEL INLET.
2. INSTALLED STAPLES OR ANCHOR PINS AT 3 TO 5 FOOT INTERVALS ACROSS ROLL FROM THE ROLL END OVERLAP.
3. INSTALLED INTERMITTENT CHECK (SEE DETAIL 6 ON SHEET XX) SLOTS AT 25 TO 30 FOOT INTERVALS PERPENDICULAR TO FLOW.

5 RD-5 ROLL END OVERLAP

NOT TO SCALE

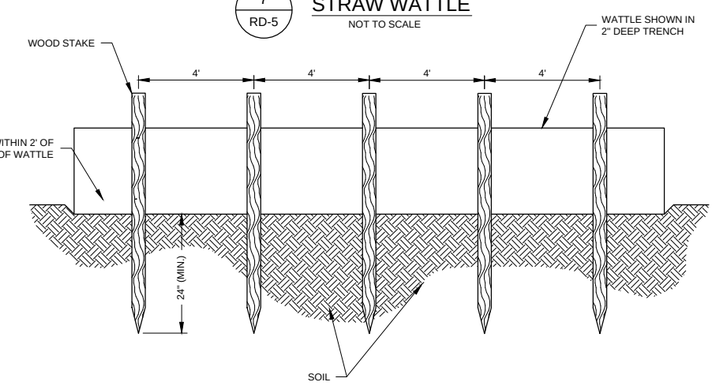


NOTES:

1. INTERMITTENT CHECK SLOTS INSTALLED AT 25-30 FOOT INTERVALS PERPENDICULAR TO FLOW.
2. FOLDED AND SECURED MAT ROLLS SNUGLY INTO INTERMITTENT CHECK SLOTS.
3. LAYED MAT IN THE BOTTOM AND FOLDED BACK AGAINST ITSELF.
4. ANCHOR THROUGH BOTH LAYERS OF MAT AT 1-FOOT INTERVALS THEN BACKFILLED AND COMPACTED SOIL.
5. CONTINUED ROLLING MAT UPSTREAM TO THE NEXT INTERMITTENT CHECK SLOTS OR TERMINAL ANCHOR TRENCH.

6 RD-5 INTERMITTENT CHECK SLOTS

NOT TO SCALE



8 RD-5 STRAW WATTLE STAKING PATTERN

NOT TO SCALE

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL, ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: POST-CONSTRUCTION
EROSION AND SEDIMENTATION
CONTROL DETAILS

FILENAME
FR_P2_RD-5.DWG
BC PROJECT NUMBER
142889
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-5

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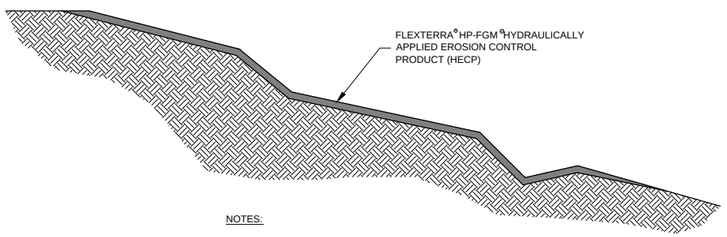
03/04/2012



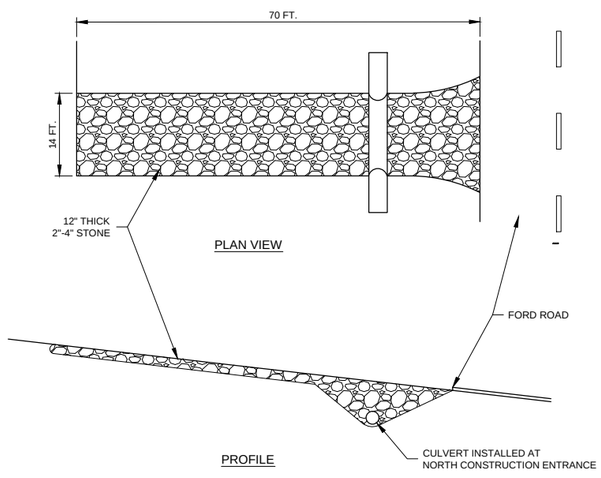
NOTES:

1. APPLIED FLEXIBLE GROWTH MEDIUM STRICTLY FOLLOWING MANUFACTURER'S INSTRUCTIONS, WITH ON-SITE INSPECTION BY MANUFACTURER'S REPRESENTATIVE.
2. "TRACK-WALKED" SURFACE OF TOPSOIL WITH A CLEATED, TRACK-MOUNTED TRACTOR PRODUCING TRACK INDENTATIONS PARALLEL TO THE SLOPE UP THE SURFACE OF THE SLOPE BEFORE APPLYING THE FLEXIBLE GROWTH MEDIUM.
3. APPLIED FLEXIBLE GROWTH MEDIUM FROM OPPOSING DIRECTION TO THE TOPSOIL SURFACE.

1 / RD-6

STEEP SLOPE EROSION PROTECTION

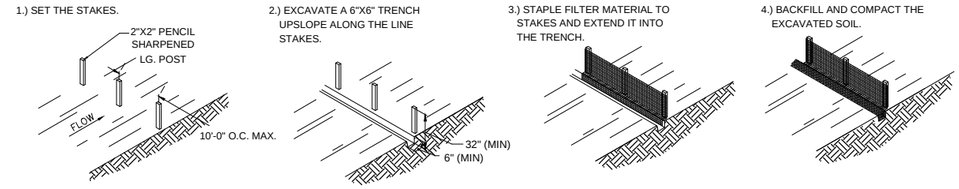
NOT TO SCALE



2 / RD-6

CONSTRUCTION ENTRANCE

NOT TO SCALE



SILT FENCE. THIS SEDIMENT BARRIER UTILIZES STANDARD STRENGTH SYNTHETIC FILTER FABRICS. IT IS DESIGNED FOR SITUATIONS IN WHICH ONLY SHEET OR OVERLAND FLOWS ARE EXPECTED. THE HEIGHT OF A SILT FENCE SHALL NOT EXCEED 16 INCHES (HIGHER FENCES MAY IMPOUND VOLUMES OF WATER SUFFICIENT TO CAUSE FAILURE TO THE STRUCTURE).

THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID THE USE OF JOINTS. WHEN JOINTS ARE NECESSARY FILTER CLOTH SHALL BE SPLICED TOGETHER ONLY AT A SUPPORT POST WITH A MINIMUM 6-INCH OVERLAP AND SECURELY SEALED.

POSTS SHALL BE SPACED A MAXIMUM OF 10 FEET APART AT THE BARRIER LOCATON AND DRIVEN SECURELY INTO THE GROUND (MINIMUM OF 6 INCHES).

A TRENCH SHALL BE EXCAVATED APPROXIMATELY 6 INCHES WIDE AND 6 INCHES DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE AND 8 INCHES OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 16 INCHES ABOVE THE ORIGINAL GROUND SURFACE. FILTER FABRIC SHALL NOT BE STAPLED TO EXISTING TREES.

SILT FENCES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFUL PURPOSE BUT NOT BEFORE THE UPSLOPE AREA HAS BEEN PERMANENTLY STABILIZED.

MAINTENANCE

SILT FENCES AND FILTER BARRIERS SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.

SHOULD THE FABRIC ON A SILT FENCE OR FILTER BARRIER DECOMPOSE OR BECOME INEFFECTIVE PRIOR TO THE END OF THE EXPECTED USABLE LIFE AND THE BARRIER IS STILL NECESSARY, THE FABRIC SHALL BE REPLACED PROMPTLY.

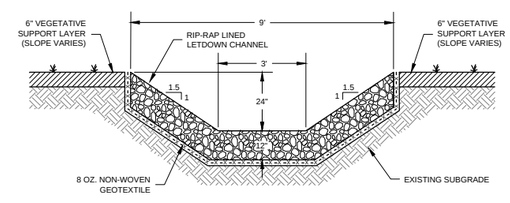
SEDIMENT DEPOSITS SHALL BE REMOVED AFTER EACH STORM EVENT. THEY MUST BE REMOVED WHEN DEPOSITS REACH APPROXIMATELY ONE HALF OF THE HEIGHT OF THE BARRIER.

ANY SEDIMENT DEPOSITS REMAINING IN PLACE AFTER THE SILT FENCE OR FILTER BARRIER IS NO LONGER REQUIRED SHALL BE DRESSED TO CONFORM WITH THE EXISTING GRADE AND SHALL BE PREPARED AND SEEDED.

3 / RD-6

TEMPORARY CONSTRUCTION SILT FENCE

NOT TO SCALE



NOTES:

1. RIP-RAP USED IN LET-DOWN CHANNEL CONSISTS OF WELL GRADED RIP-RAP: D50 OF 6-INCHES, A MAXIMUM STONE SIZE OF 10-INCHES, WITHIN THE FOLLOWING LIMITS:

STONE SIZE	% OF MASS
6"-10"	30 - 50
4" - 6"	20 - 30
2" - 4"	10-20
LESS THAN 2"	0 - 10

4 / RD-6

FORD ROAD CULVERT OUTLET CHANNEL

SCALE: 1" = 2'

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

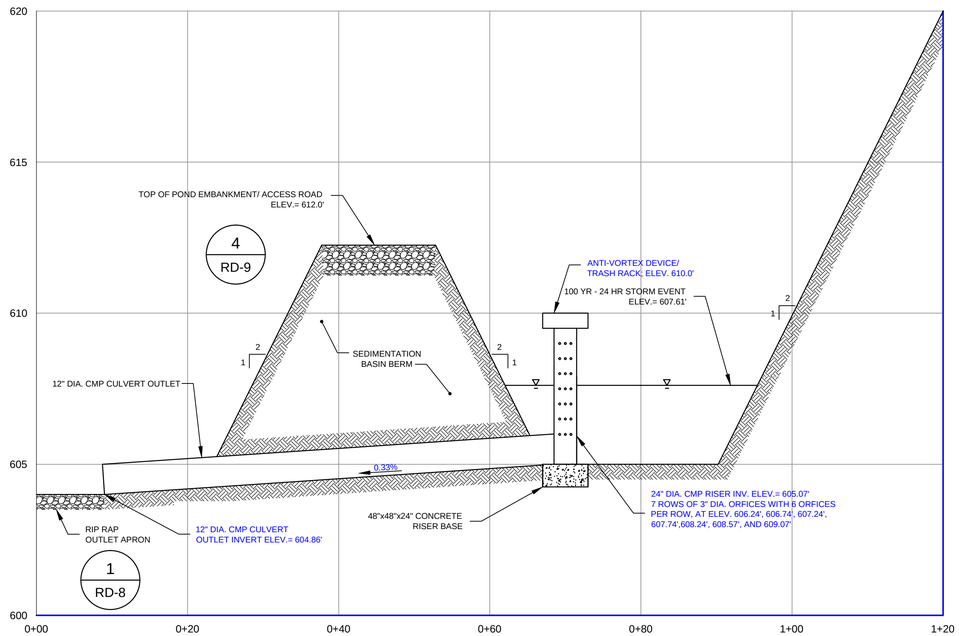
FORD ROAD LANDFILL, ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: EROSION AND SEDIMENTATION CONTROL DETAILS

FILENAME: FR_P2_RD-6.DWG
BC PROJECT NUMBER: 142889
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-6

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P2 FINAL\FR_P2_RD-6.DWG April 2, 2013

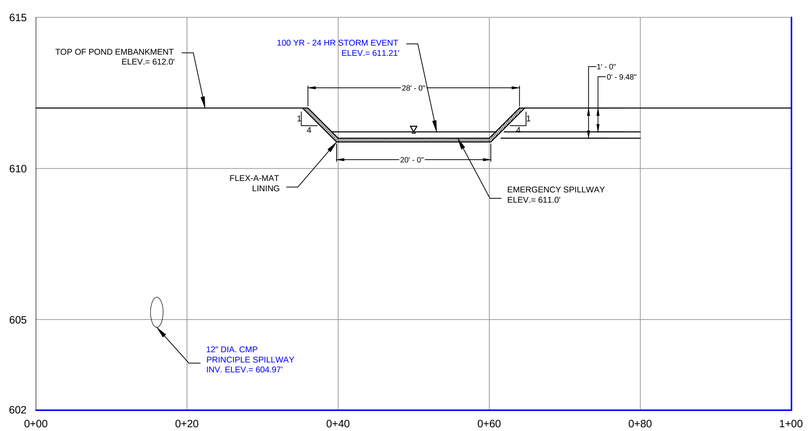
03/04/2012



PRINCIPLE SPILLWAY

SECTION A / RD-7

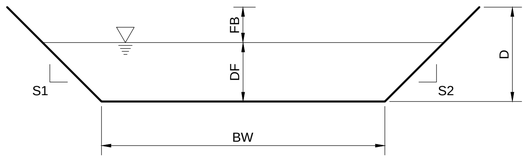
HORIZONTAL: 1"= 10'
VERTICAL: 1"= 2.5'



EMERGENCY SPILLWAY

SECTION B / RD-7

HORIZONTAL: 1"= 10'
VERTICAL: 1"= 2.5'



TYPICAL DIVERSION/DOWNSCHUTE

SECTION C / RD-7

NTS

NOTES:

D	DEPTH (FT)
BW	BOTTOM WIDTH (FT)
S1 OR S2	SIDE SLOPE (FT/FT)
DF	DEPTH OF FLOW (FT)
FB	FREEBOARD (FT)

DIVERSION/ DOWNCHUTE ID	ROUGHNESS COEFFICIENT	CHANNEL SLOPE (ft/ft)	DISCHARGE (cfs)	D (feet)	BW (feet)	S1 (ft/ft) (H:V)	S2 (ft/ft) (H:V)	DF (feet)	FB (feet)
Upper Surface									
C1	0.050	0.020	1.42	1.50	0.00	2.00	4.70	0.51	0.99
C2	0.050	0.040	7.26	1.50	0.00	2.00	4.70	0.94	0.56
C3	0.050	0.010	16.49	1.50	0.00	2.00	4.70	1.28	0.22
C6	0.050	0.020	20.80	1.50	0.00	2.00	4.70	1.39	0.11
C4	0.050	0.020	25.29	2.00	0.00	2.00	4.70	1.50	0.50
C5	0.050	0.020	29.26	2.00	0.00	2.00	4.70	1.58	0.42
C8	0.050	0.020	2.91	1.50	0.00	2.00	4.70	0.70	0.80
C7-1	0.050	0.090	11.52	1.50	0.00	2.00	4.70	0.86	0.64
C7-2	0.050	0.050	11.44	1.50	0.00	2.00	4.70	0.86	0.64
Steep Slope									
C12	0.050	0.030	2.26	1.50	0.00	2.00	0.13	1.02	0.48
C11	0.050	0.020	3.57	1.50	0.00	2.00	0.13	1.22	0.28
C13	0.050	0.020	5.98	2.00	0.00	2.00	0.17	1.46	0.54
C14	0.050	0.020	7.66	2.00	0.00	2.00	0.17	1.60	0.40
C15	0.050	0.020	10.21	2.00	0.00	2.00	0.17	1.78	0.22
C16	0.050	0.030	11.81	2.00	0.00	2.00	0.17	1.88	0.12
C22	0.050	0.040	1.17	1.50	0.00	2.00	4.70	0.47	1.03
C21	0.050	0.020	2.84	1.50	0.00	2.00	4.70	0.66	0.84
C20	0.050	0.020	4.59	1.50	0.00	2.00	4.70	0.79	0.71
C19	0.050	0.020	6.49	1.50	0.00	2.00	4.70	0.90	0.60
C18	0.050	0.020	8.09	1.50	0.00	2.00	4.70	0.98	0.52
C17	0.050	0.080	9.48	1.50	0.00	2.00	4.70	1.04	0.46
Downchute									
Top	0.050	0.44	40.62	2.00	10.00	3.00	3.00	0.74	1.26
Bottom	0.050	0.44	62.04	2.00	10.00	3.00	3.00	0.96	1.04

NOTES: Numbers shown in "blue" represent final field survey.

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: RI
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

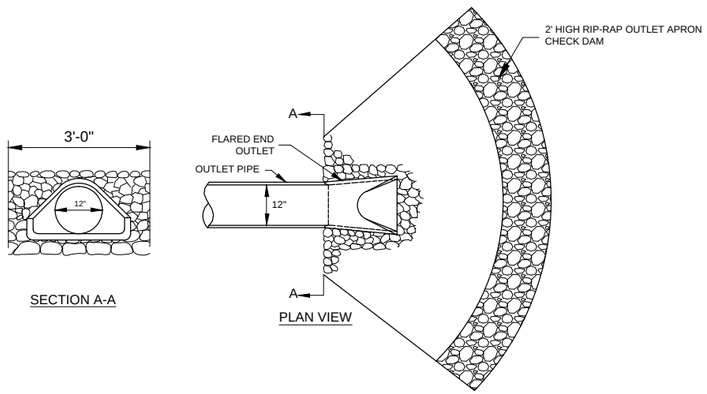
FORD ROAD LANDFILL, ELYRIA, OHIO

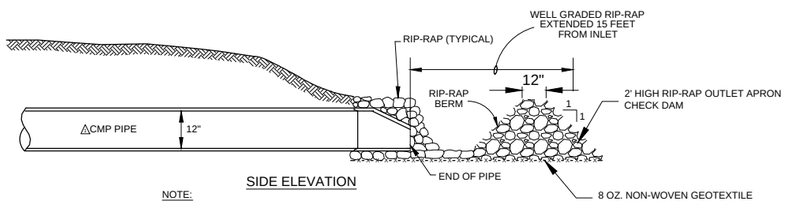
PROJECT RECORD DRAWINGS
PHASE II: SEDIMENTATION BASIN
AND CHANNEL SECTIONS

FILENAME
RD-7.DWG
BC PROJECT NUMBER
142889
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-7

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P2 FINAL\FR_P2_RD-7.DWG April 30, 2013

03/04/2012





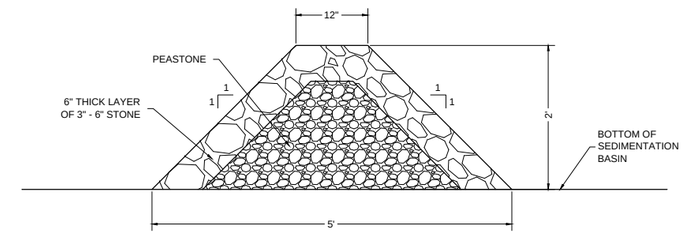
SIDE ELEVATION

NOTE:

1. RIP-RAP: WELL GRADED FROM A MINIMUM SIZE OF 6" TO A MAXIMUM SIZE OF 12".

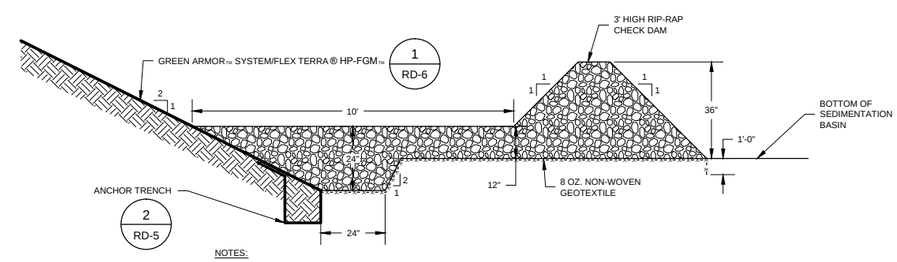
1 / RD-8 RIP-RAP OUTLET APRON

NOT TO SCALE



2 / RD-8 2' HIGH CHECK DAM

SCALE: 1"= 1'



NOTES:

1. RIP-RAP USED AT BASE OF LET-DOWN CHANNEL CONSISTS OF WELL GRADED RIP-RAP: A MAXIMUM STONE SIZE OF 18-INCHES, WITHIN THE FOLLOWING LIMITS:

STONE SIZE	% OF MASS
18" OR OVER	0
10"-18"	30-50
6"-10"	30 - 50
4" - 6"	20 - 30
2" - 4"	10-20
LESS THAN 2"	0 - 10

3 / RD-8 DOWNCHUTE CHANNEL OUTLET

SCALE: 1"= 2'

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.
	△	CHANGED HDPE TO CMP	RAI	03-22-12	RAI

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: SEDIMENTATION BASIN DETAILS

FILENAME: FR_P2_RD-8.DWG
BC PROJECT NUMBER: 142889
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-8

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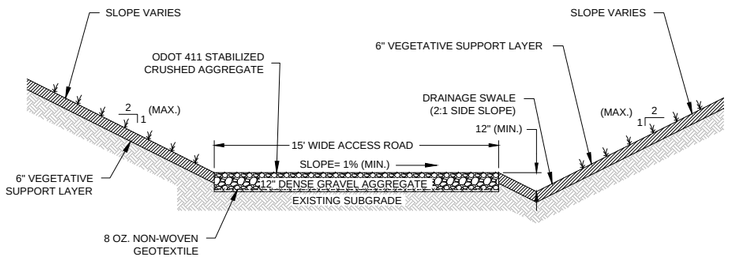
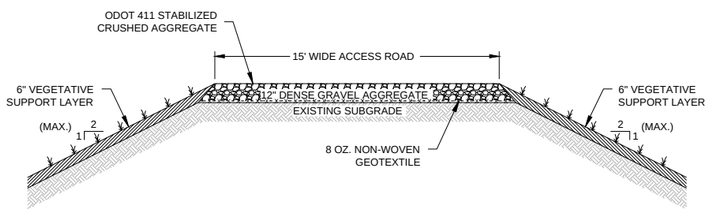
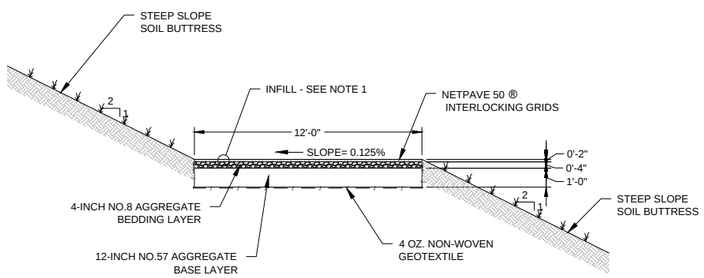
03/04/2012



1 / RD-9 NORTH/SOUTH ACCESS ROAD
NOT TO SCALE

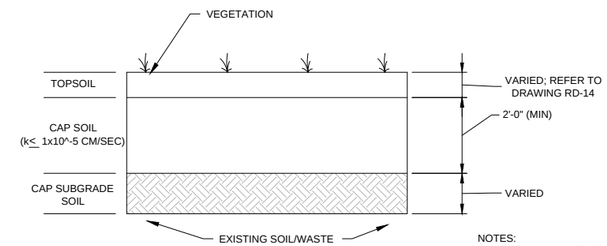


2 / RD-9 SOUTH ACCESS ROAD/SEDIMENTATION BASIN BERM
NOT TO SCALE



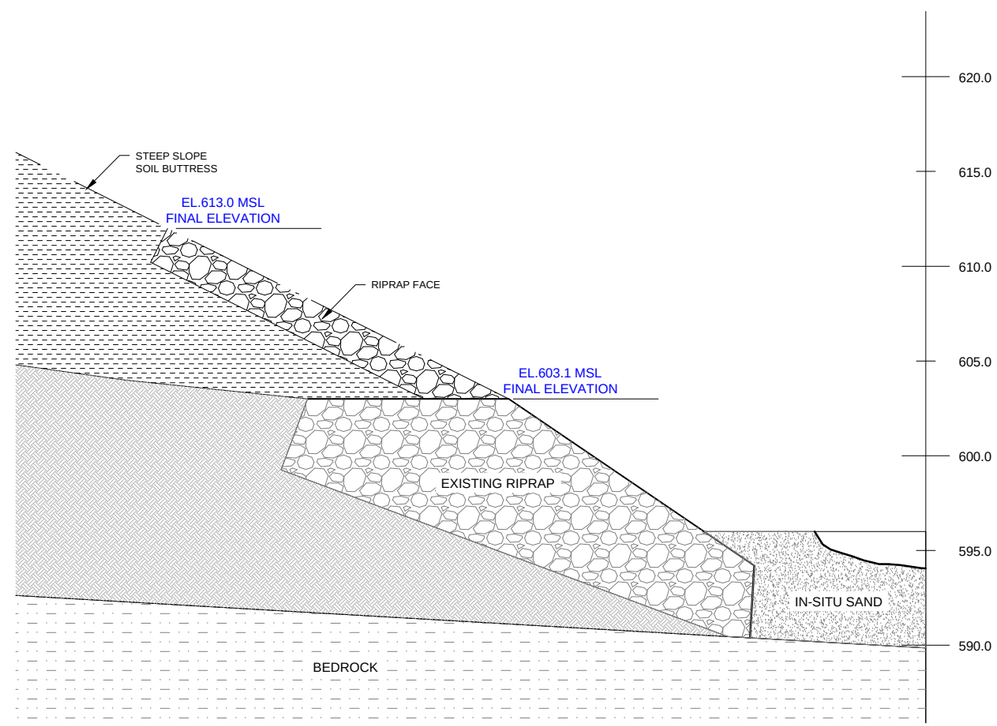
NOTES:
1. NETPAVE ® INTERLOCKING GRIDS INFILL INCLUDED 1.5-INCHES OF TOPSOIL WITH FLEXTERRA® HP-FGM™ FLEXIBLE GROWTH MEDIUM AND STEEP SLOPE MIX SEED

3 / RD-9 DRIVABLE DRAINAGE CHANNEL
NOT TO SCALE



NOTES:
1. TOPSOIL WAS EVENLY DISTRIBUTED ACROSS THE SURFACE OF THE FINAL COVER SYSTEM CAP SOIL FROM THE ONSITE TOPSOIL STOCKPILE WITH ADDITIONAL TOPSOIL OBTAINED FROM THE GROBE FRUIT FARM BORROW SOURCE.

4 / RD-9 FINAL COVER CAP SYSTEM DETAIL
NOT TO SCALE



5 / RD-9 RIPRAP EXTENSION DETAIL
NOT TO SCALE

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER
APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

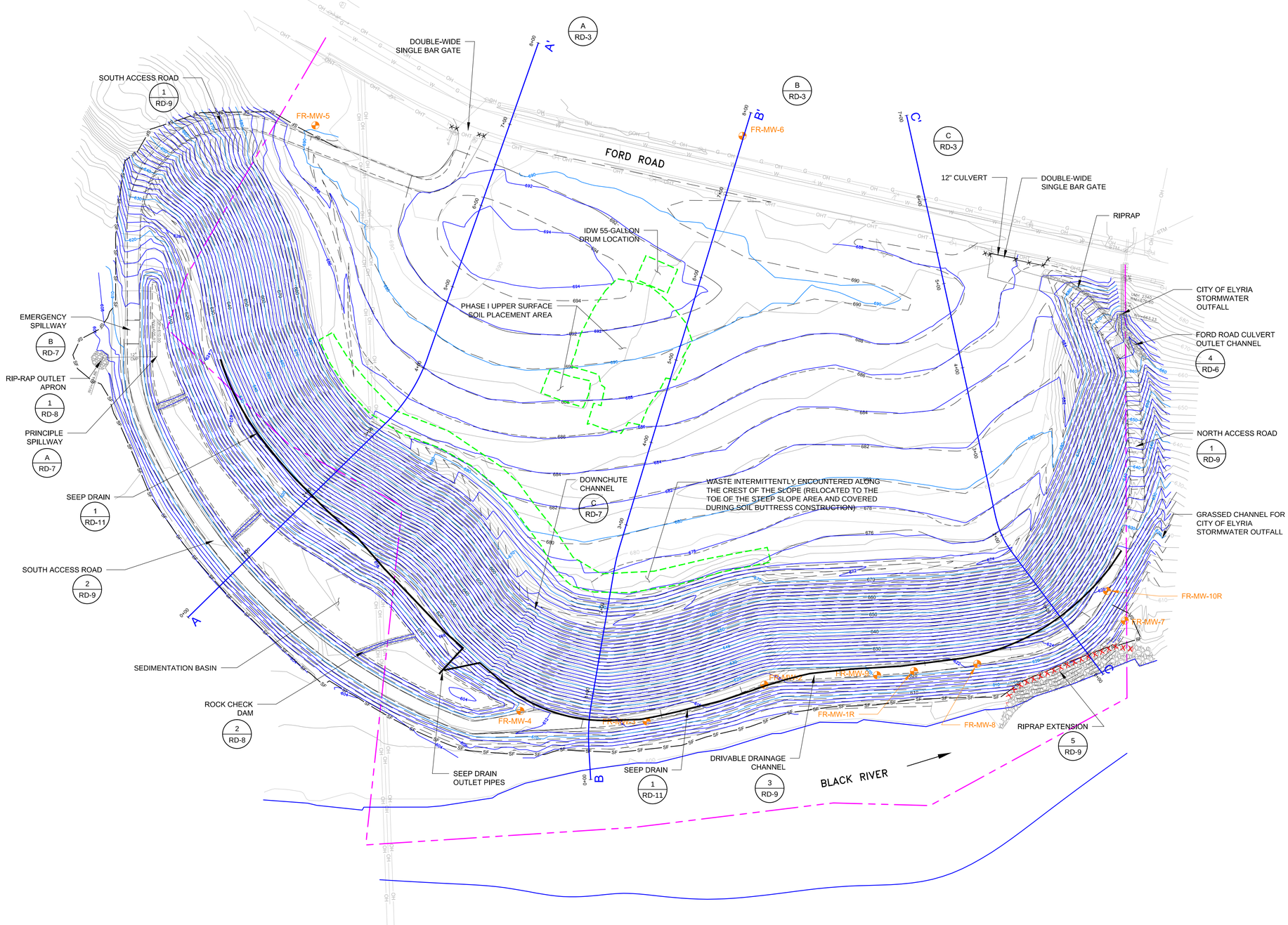
REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: ROAD SECTIONS AND DETAILS

FILENAME: FR_P2_RD-9.DWG
BC PROJECT NUMBER: 142889
CLIENT PROJECT NUMBER:
DRAWING NUMBER: RD-9

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P2 FINAL\FR_P2_RD-9.DWG April 30, 2013
April 30, 2013



LEGEND:

	EXISTING GROUND CONTOURS
680	EXISTING GROUND INDEX CONTOURS
670	DESIGN FINAL GRADE INDEX CONTOURS
682	DESIGN FINAL GRADE CONTOURS
	PROPERTY LINE
OH	OVERHEAD POWER LINE
G	GAS LINE
OHT	TELEPHONE LINE
W	WATER LINE
STM	STORM LINE
	RIVER EDGE (APPROXIMATE)
SF	LIMITS OF SILT FENCE
	POST-CONSTRUCTION CONTOURS
610	POST-CONSTRUCTION INDEX CONTOURS
	RIP RAP
FR-MW-8	FINAL MONITORING WELL LOCATION

NOTES:

1. BOUNDARY AND EXISTING TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010.
2. TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 10/19/2012.
3. NEW GROUNDWATER MONITORING WELL LOCATIONS (FR-MW-1R, FR-MW-2, FR-MW-3, FR-MW-4, FR-MW-8, FR-MW-9, AND FR-MW-10R) PROVIDED BY BAIR GOODIE & ASSOCIATES, ON 10/11/2012.
4. CONTRACTOR CLEARED AND REMOVED TREES FROM WITHIN THE LIMITS OF CLEARING / SILT FENCE LINE ONLY.
5. RIVER EDGE IS APPROXIMATE.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER
APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: DESIGN/FIELD SURVEY
PLAN VIEW

FILENAME: FR_P2_RD-10.DWG
BC PROJECT NUMBER: 142889
CLIENT PROJECT NUMBER
FIGURE NUMBER: RD-10

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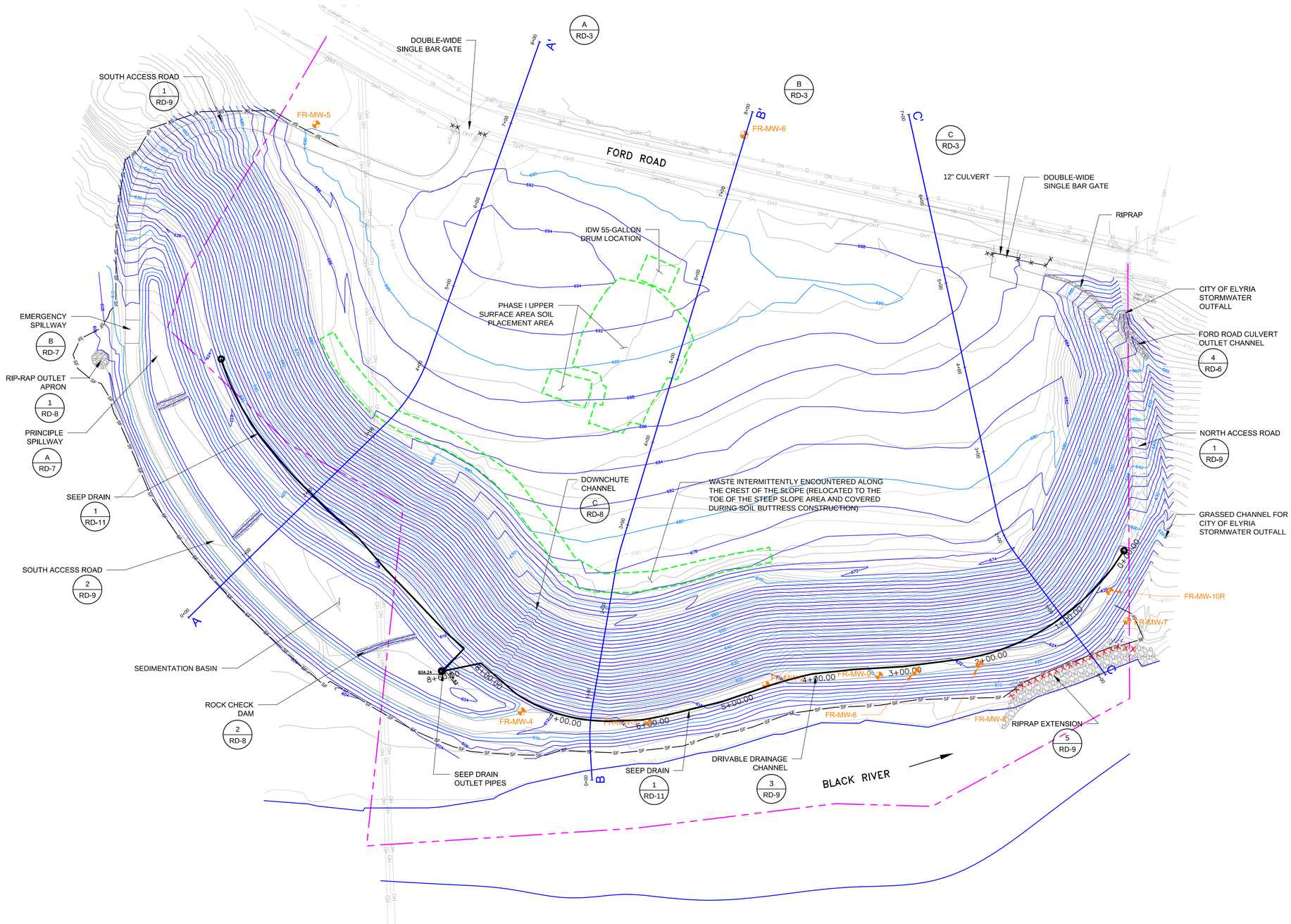
April 5, 2013



LEGEND:

- EXISTING GROUND CONTOURS
- 680 — EXISTING GROUND INDEX CONTOURS
- POST-CONSTRUCTION CONTOURS
- 610 — POST-CONSTRUCTION INDEX CONTOURS
- PROPERTY LINE
- OVERHEAD POWER LINE
- GAS LINE
- TELEPHONE LINE
- WATER LINE
- STORM LINE
- RIVER EDGE (APPROXIMATE)
- SF — SF — LIMITS OF SILT FENCE
- RIP RAP
- FR-MW-8 — FINAL MONITORING WELL LOCATION

NOTES:

1. BOUNDARY AND EXISTING TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010.
2. TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 10/19/2012.
3. NEW GROUNDWATER MONITORING WELL LOCATIONS (FR-MW-1R, FR-MW-2, FR-MW-3, FR-MW-4, FR-MW-8, FR-MW-9, AND FR-MW-10R) PROVIDED BY BAIR GOODIE & ASSOCIATES, ON 10/11/2012.
4. CONTRACTOR CLEARED AND REMOVED TREES FROM WITHIN THE LIMITS OF CLEARING / SILT FENCE LINE ONLY.
5. RIVER EDGE IS APPROXIMATE.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI / NG
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS					
ZONE	REV.	DESCRIPTION	BY	DATE	APP.

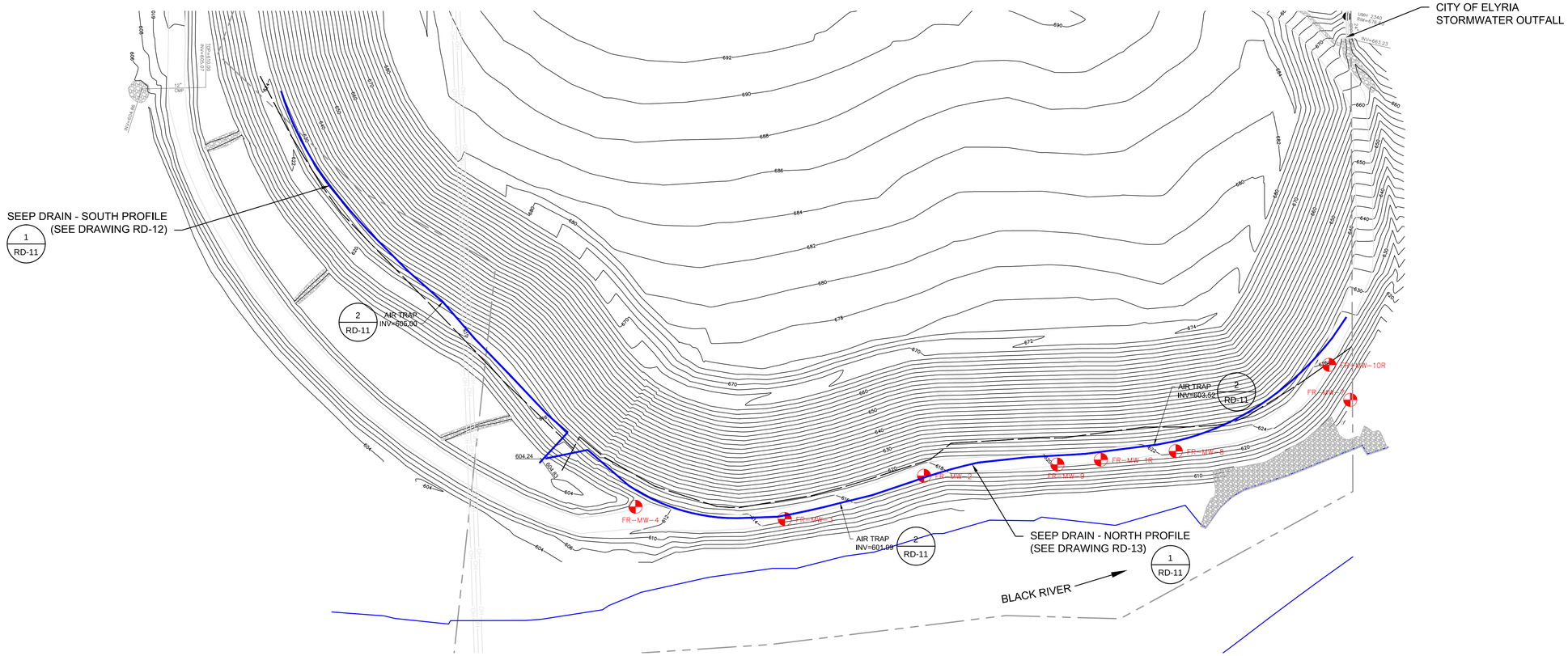
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS PHASE II: POST-CONSTRUCTION PLAN VIEW

FILENAME: FR_P2_RD-10A.DWG
BC PROJECT NUMBER: 142889
CLIENT PROJECT NUMBER:
FIGURE NUMBER: RD-10A

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P2 FINAL\FR_P2_RD-10A.DWG April 5, 2013

April 5, 2013



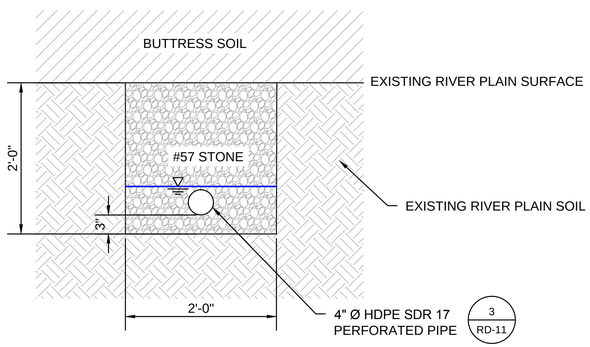
LEGEND:

- EXISTING GROUND CONTOURS
- 680 — EXISTING GROUND INDEX CONTOURS
- PROPERTY LINE
- OH — OVERHEAD POWER LINES
- G — GAS LINE
- OHT — OVERHEAD TELEPHONE LINE
- W — WATER LINE
- STM — STORM LINE
- RIVER EDGE (APPROXIMATE)
- SEEP DRAIN ALIGNMENT (DESIGN)
- SEEP DRAIN ALIGNMENT (FIELD SURVEY)
- FR-MW-5 — EXISTING GROUNDWATER MONITORING WELL TO REMAIN - PROTECTED BY CONTRACTOR
- EXISTING RIPRAP

NOTES:

1. BOUNDARY AND TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 1/20/2004. BORING LOCATIONS AND ADDITIONAL TOPOGRAPHIC DETAIL SURVEYED BY BAIR GOODIE & ASSOCIATES, MAY 2010, AND STRAUB SURVEYING, LLC, FEBRUARY 2012.
2. WATER EDGE IS APPROXIMATE.

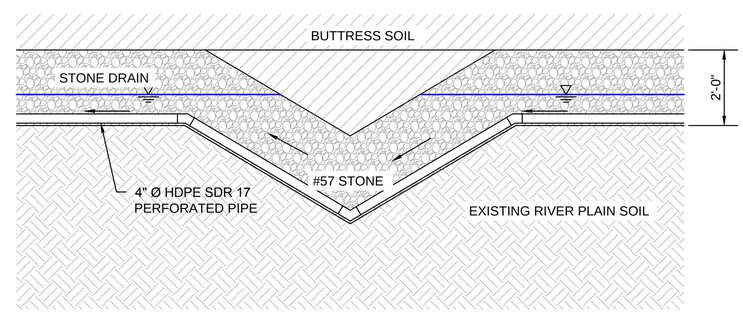
0 60' 120'
GRAPHIC SCALE



SEEP DRAIN SECTION

DETAIL 1 / RD-11

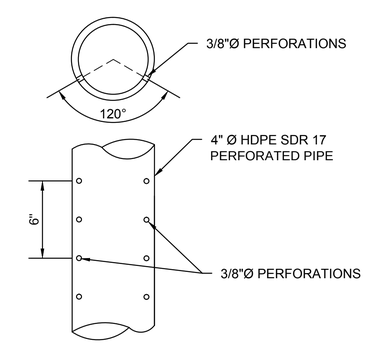
NOT TO SCALE



AIR TRAP IN SEEP DRAIN

DETAIL 2 / RD-11

NOT TO SCALE



SEEP DRAIN PIPE PERFORATIONS

DETAIL 3 / RD-11

NOT TO SCALE

Brown AND Caldwell

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: SEEP DRAIN PLAN
AND DETAILS

FILENAME
FR_P2_RD-11.DWG
BC PROJECT NUMBER
142889
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-11

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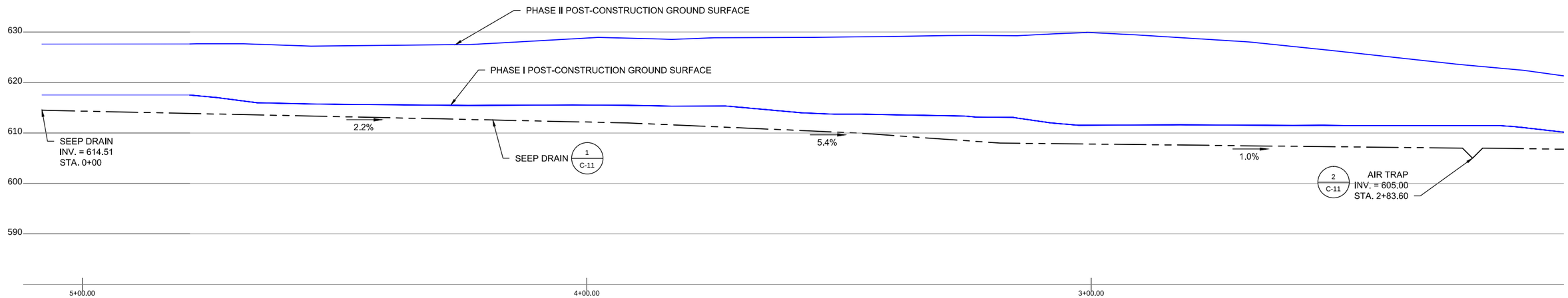
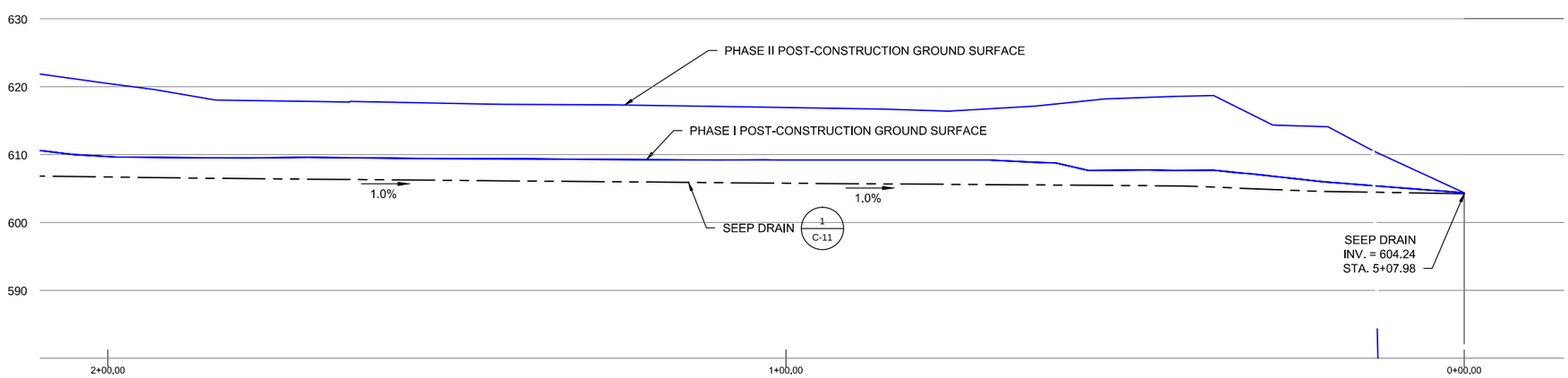
April 5, 2013





0 10' 20'
GRAPHIC SCALE

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER

APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

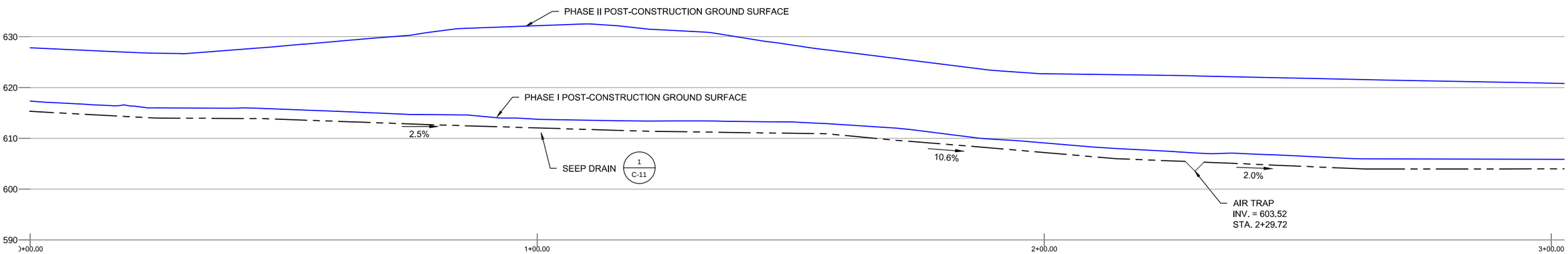
FORD ROAD LANDFILL
ELYRIA, OHIO

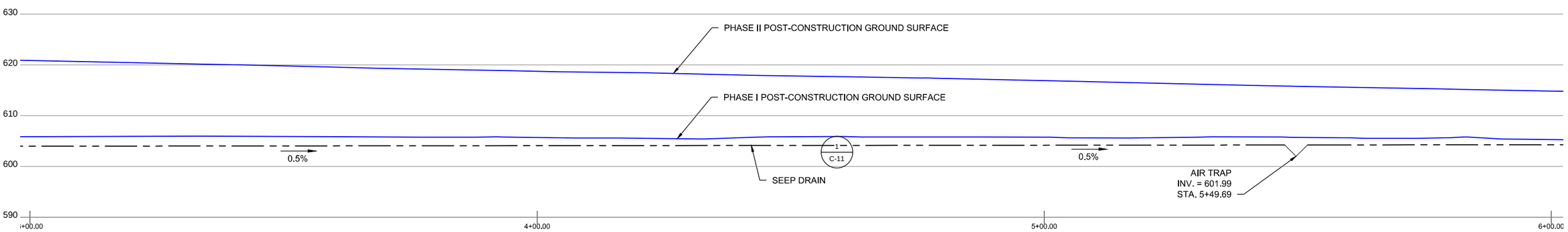
PROJECT RECORD DRAWINGS
PHASE II: SEEP DRAIN - SOUTH PROFILE

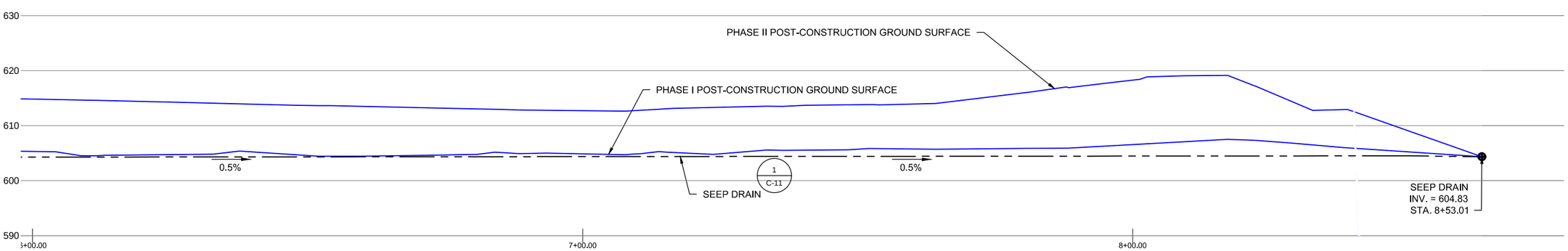
FILENAME
FR_P2_RD-12.DWG
BC PROJECT NUMBER
142889
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-12

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P2 FINAL\FR_P2_RD-12.DWG April 5, 2013

April 5, 2013







0 10' 20'
GRAPHIC SCALE

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER
APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: NG
CHECKED: RI
CHECKED:
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

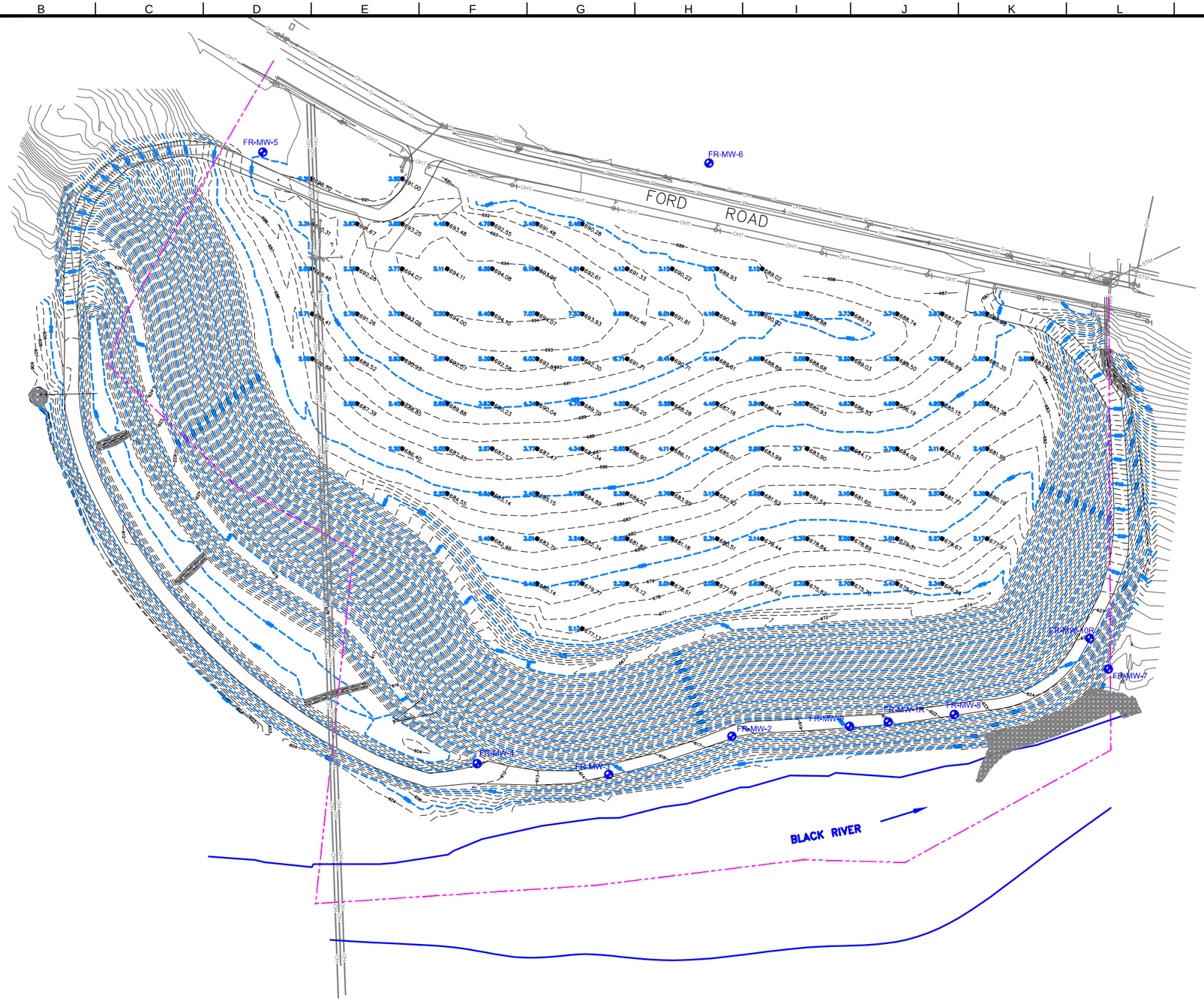
FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: SEEP DRAIN - NORTH PROFILE

FILENAME
FR_P2_RD-13.DWG
BC PROJECT NUMBER
142889
CLIENT PROJECT NUMBER
DRAWING NUMBER
RD-13

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P2 FINAL\FR_P2_RD-13.DWG April 5, 2013

April 5, 2013



LEGEND:

- EXISTING GROUND CONTOUR
- 670 FINAL GRADE INDEX CONTOUR
- 682 FINAL GRADE INTERMEDIATE CONTOUR
- 3.32 688.50 FINAL COVER THICKNESS (FEET) AND SURFACE ELEVATION
- PROPERTY LINE
- OH OVERHEAD POWER LINE
- G GAS LINE
- OHT TELEPHONE LINE
- W WATER LINE
- STM STORM LINE
- RIVER EDGE
- RIP RAP
- FR-MW-8 FINAL MONITORING WELL LOCATION

NOTES:

1. BOUNDARY AND EXISTING TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 1/20/2004.
2. UPDATED TOPOGRAPHIC SURVEY OF THE SITE PROVIDED BY KS ASSOCIATES ON 10/19/2012.
3. NEW GROUNDWATER MONITORING WELL LOCATIONS (FR-MW-1R, FR-MW-2, FR-MW-3, FR-MW-4, FR-MW-8, FR-MW-9, AND FR-MW-10R) PROVIDED BY BAIR GOODIE & ASSOCIATES, ON 10/11/2012.
4. RIVER EDGE IS APPROXIMATE.

0 60' 120'
GRAPHIC SCALE

Brown AND Caldwell
COLUMBUS, OHIO

SUBMITTED: _____ DATE: _____
PROJECT MANAGER
APPROVED: _____ DATE: _____
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: RI
DRAWN: BF
CHECKED: RI
CHECKED: BF
APPROVED: RI

EXTERNAL REFERENCE FILES

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FORD ROAD LANDFILL
ELYRIA, OHIO

PROJECT RECORD DRAWINGS
PHASE II: UPPER SURFACE AREA
FINAL COVER SYSTEM CAP THICKNESS

FILENAME FR_P2_RD-14.DWG
BC PROJECT NUMBER 142889
CLIENT PROJECT NUMBER
DRAWING NUMBER RD-14

P:\FORD ROAD\CONSTRUCTION\FIELD CQA\PROJECT RECORD DRAWINGS\UPDATED - MARCH 2013\P2 FINAL\FR_P2_RD-14.DWG April 2, 2013

April 2, 2013

Appendix E: Contractor Submittal Reviews

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Phase I Remedial Action

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SUBMITTAL COVER SHEET

CONTRACTOR: OP-TECH Environmental Services, Inc.

SUBMITTAL NO.: 004a

ADDRESS: 150 Rotterdam Industrial Park
Schenectady, New York

DATE OF SUBMITTAL: 9/14/11

CONTRACT NO.: 137335

MANUFACTURER:

NAME OF PROJECT: Ford Rd. Landfill Remedial Action Phase 1 Construction

SUBMITTAL DESCRIPTION: Slurry Wall Work Plan

REFERENCES:

Specification Section(s) 315613.19 Paragraph(s) 1.6

Contract Drawing(s)

CONTRACTOR SIGNATURE

BROWN AND CALDWELL REVIEW

BROWN AND CALDWELL

DOCUMENT REVIEW STATUS

STATUS NO:

1 ☒ NO EXCEPTION TAKEN

2 ☐ MAKE CORRECTIONS NOTED
RESUBMITTAL NOT REQUIRED

3 ☐ REVISE AND RE-SUBMIT
RESUBMITTAL REQUIRED

4 ☐ REJECTED – SEE REMARKS

REVIEWED BY: RMGQ TITLE: CERTIFYING ENGINEER

DATE: 9/14/11

REMARKS:

WORKPLAN
FOR
CONVENTIONAL PORTLAND/SLAG CEMENT-BENTONITE SLURRY WALL

OP-TECH
Ford Road Landfill
Elyria, Ohio

PREPARED BY

SLURRY SYSTEMS INC. (SSI)

September 08, 2011

I. INTRODUCTION

Slurry Systems, Inc. (SSI) has developed this submittal work plan for the conventional Portland/Slag cement-bentonite slurry cutoff wall at the Ford Road Landfill in Elyria, Ohio. This work plan describes SSI's proposed cut-off wall design, installation procedures, and equipment to complete the contract.

SSI was established in 1977 as a specialty contractor. SSI has installed over 100 impervious slurry cut-off walls nationwide, including Canada. SSI is the innovator of the vibrated beam slurry wall technique in North America. On a local level, SSI works as a pile driving and sheet pile contractor. In addition, SSI is a licensed Waterloo Barrier and CHANCE anchor installer. In addition, SSI is a certified Women Owned Business.

II. CUT-OFF WALL DESIGN

The slurry trench excavator and its bucket used for the cut-off wall construction will be provided by Op-Tech with a width of 30-inches. The unconfined compressive strength is specified to be greater than 30 psi. The permeability of the mix, less than or equal to 1 x 10-6 cm/sec, will be verified with a sampling program.

Typically, cement-bentonite (CB) slurry walls yield a permeability less than $1x10^{-6}$ cm/sec utilizing a mixture of Portland Type I – II cement and sodium bentonite as the primary backfill constituents. The ultimate permeability of the backfill is based upon several factors, including the ratio of cement to bentonite, and the influx of groundwater and or meteoric water into the mix, and/or the addition of various additives to the mix. In addition, compressive strengths of Portland Type I-II cement-bentonite walls are very low (typically less than 10 psi), however, by adding more cement to the mix the unconfined compressive strength can be manipulated, albeit with the side effect of raising the permeability. There is a direct relationship between the increase of compressive strength and the raising of the permeability in a Portland Type I-II cement-bentonite slurry wall. SSI's solution to this is to utilize a mix that will yield the best of both worlds. SSI will substitute 50% of the Portland Type I-II cement with slag cement, which will give us a mix ratio of 5% Portland Type I-II, 5% slag cement, and 5% bentonite. This should allow us to meet specification for permeability as well as compressive strength with a normal set time.

The hydraulic excavator will dig the slurry trench from the top of the work platform to the bedrock interface with limited to no key-in into the bedrock, other than scratching to the best of our ability with the equipment that will be employed by others. The bedrock interface will be determined by refusal of the excavator bucket.

III. STAGING AND ACCESS PLAN

There will be one staging area at any given time, within the work limits, at the site. The staging area will be used for the mixing plant, material storage, equipment, fuel, employee parking, and additional storage. SSI will not fence the staging area.

All construction work will be performed off of the site access road(s). During construction, delivery trucks will utilize the site access roads. Deliveries will be scheduled to minimize impact to all other operations taking place at the site.

Traffic will be maintained and protected, if necessary, on all roads affected by construction activities throughout the project duration by others. Procedures for the protection and diversion of traffic will be implemented by others if construction activities are interfering with the operations of other contractors.

Mixing Plant

The mixing plant will be located within the working limits, in the staging area as discussed earlier, and will be moved as necessary to supply slurry to the slurry wall operation. The mixing plant consists of a 700-gallon colloidal mixer, several pumps, a generator and associated fittings and piping to prepare the fresh Portland/Slag cement-bentonite slurry and deliver it to the trench excavation.

Stockpile Areas

Onsite stockpile areas may be necessary due to unusable excavated material, imported clay, or other reasons. These areas will be located greater than 10-feet from the center of the wall alignment, and will be managed by others.

IV. MIX DESIGNS AND MIX COMPONENT MATERIALS

The proposed mix design for the project is a colloidal mixture of Portland Type I-II Cement, slag cement, bentonite, water, and Fritz Pak cement additive that forms a stable, semi-rigid, low strength, low permeability barrier to reduce fluid movement in the subsurface. The backfill mix is composed of the following materials:

- Portland Type I-II Cement ~5% by weight.
- Slag Cement ~ 5% by weight.
- Bentonite slurry (a mixture of water and ~ 5% bentonite by weight; the bentonite shall be a natural clay consisting of at least 85% sodium montmorillonite).
- Fritz Pak cement additive to prevent bentonite flocculation.

The Portland/Slag cement-bentonite slurry shall be mixed to achieve:

- Viscosity of 40 seconds or greater.

- A pH of between 8 and 10.
- Density at least 70 -72 pounds per cubic foot.

V. CONSTRUCTION SCHEDULE

The slurry cutoff wall operations will consist of the following tasks:

- Mobilization
- Slurry Cutoff Wall Construction
- Site Cleanup and Restoration/Demobilization

For just the installation of the slurry cutoff wall, based on approximately 228 lineal wall feet at an average depth of 10' which totals 2,280 SQFT, a minimum of 3 working days will be required. It is anticipated to work 10 hours per day.

VI. EQUIPMENT

It is anticipated that SSI will utilize the following equipment and facilities during construction:

- Hydraulic excavator provided by others.
- 8,000 pound Rough Terrain Forklift for material handling, provided by others.
- Mixing Plant - specially fabricated high-speed high shear colloidal mixing plant along with associated pumps and piping.
- 250 KW Generator for operation of the mixing plant.
- Water source to be provided by others, per phone discussion with Mr. David Curran (Op-Tech Foreman), the water supply is from a City fire hydrant on the west side of Ford Road, and no meter or permit was required for this water source, and
- Trucks and other small tools.

Earthwork and all associated heavy equipment will be performed and provided by others.

VII. LABOR

It is anticipated that SSI will utilize the following labor during construction (Attachment A – Resumes):

- Project Superintendent (1)
- Quality Control Specialist (1)
- Operators (IUOE Local No. 150) – Class 1 (1)
- Pile Drivers (Local 578)
- Laborers (Local Union #81) – Category 1 or 2 (1)

VIII. CONSTRUCTION PROCEDURES

Slurry walls are subsurface walls that act as barriers to lateral flow of groundwater. The major characteristic of slurry cutoff construction is the use of bentonite-water slurry, which allows excavation without the use of other lateral supports. Slurry cutoff walls are built by excavating a narrow trench while pumping slurry in the trench and maintaining its level at or near the top of the trench during the excavation process. Usually, the trench is excavated down to a layer of relatively low permeability or aquiclude. The aquiclude forms the bottom, and the slurry wall forms the barrier for the containment wall. This trench is then backfilled with low permeability material (i.e. Portland/Slag cement-bentonite mix) to form a permanent cutoff. SSI plans to use a 50% Portland Type I-II/50% Slag cement-bentonite backfill mixture as the backfill for this project.

The following was prepared in accordance with the guidelines outlined in Section 315613.19 entitled Cement-Bentonite Slurry Walls, of the Project Specifications.

1.0 Mobilization

Following approval of the contract, SSI and will mobilize equipment, materials and personnel to the site. SSI will assemble the mixing plant in the appropriate staging area. SSI will stage Portland Type I-II cement bags (94 pound bags), Slag Cement (80 pound bags), and bentonite bags (100 pound bags) for Portland/Slag cement-bentonite slurry mixing in the vicinity of the mixing plant. Refer to Attachment B – Material Certification Documentation.

2.0 Site Preparation

Site preparation activities will be performed by others and should include but are not limited to the following tasks:

- Field location of utilities & groundwater monitoring wells with appropriate protection measures
- Set-up of field offices and facilities
- Marking and surveying the work limits
- Installing erosion and sedimentation controls
- Installation of project sign and safety signs

3.0 Work Platform & Staging Area Construction

Prior to clearing & grubbing for the slurry cutoff wall construction by others, off-set stakes must be set for barrier wall alignment and to establish stationing. A minimum of a 20' wide working area and a staging area will be cleared. All trees and brush cleared will be stockpiled by others in the approved location.

A silt fence will be installed on the outside edge of the work platform by others. The work platform will be level, dry, and stable to support construction

equipment, and is to be maintained by others. The final elevation of the work platform will be as required by the plans and specifications by others. The work platform will be left in place upon completion of the cutoff wall and all disturbed areas will be restored to pre-existing conditions by others.

4.0 Cutoff Wall Construction

SSI will mix water and the cement additive, then bentonite, then Portland Cement, and then Slag Cement for slurry preparation for construction of the Portland/Slag cement-bentonite slurry cutoff wall in the colloidal mixing plant. The cut-off wall materials are detailed in the mix design section of this workplan.

The cut-off wall is installed by excavating a narrow trench width (3 feet) to the design depth (10 feet) utilizing a hydraulic excavator, and will be completed by others. The trench shall be dug to a minimum key to the underlying bedrock or refusal. The trench will be at its required depth at Station 0+00. Consequently, a starter trench will be excavated under fresh Portland/Slag cement-bentonite slurry (a colloidal mixture of 50% Portland and 50% Slag Cement, bentonite, and water). As excavation progresses, the level of the slurry will be maintained at no less than 2 feet below the level of the work platform. The Portland/Slag cement-bentonite slurry maintains a positive head on the trench and will aid in maintaining the stability of the trench. The excavation will be completed using the panel by panel methodology. The lineal footage of each panel is to be determined and approved in the field.

The excavated soils will be placed into a truck or at the work platform surface at least 10 feet adjacent to the slurry trench alignment. The excavated spoils are to be handled and managed by others.

At the close of the day, the completed panels will be topped off with cement-bentonite mix to address any shrinkage due to stiffening of the cement-bentonite wall. The next morning, the weep water will be removed from the trench and the trench topped off with cement-bentonite mix. An overlap of 2-feet will be cut into the previous days ending panel to begin the next days beginning panel, and will proceed in this manner until the end of the project.

5.0 Cap Construction

As soon as the cut-off wall has hardened sufficiently to support the weight of the fill, a cut-off wall cap will be constructed by others.

6.0 Site Restoration & Demobilization

After project completion and acceptance of work, SSI and subcontractors will demobilize all personnel, equipment, unused materials, and temporary construction facilities. All site restoration to be completed by others.

IX. RECORD KEEPING

SSI will perform field quality control measurements and testing, as necessary, to ensure the specifications are met. SSI will provide the overseeing Construction Quality Assurance (CQA) Engineering Manager a daily field report containing, at minimum, all QC results for the day. The QC, provided by SSI, shall measure the following:

Trench Sounding

- Depth of trench every 10 lineal feet, classification of panel tie-ins and corner tie-ins.

Portland/Slag Cement-Bentonite Slurry

- Water source and testing by others
- Initial bentonite slurry – viscosity, density, and pH at mixing plant (2 per shift)
- Portland/Slag Cement-bentonite slurry – density at mixing plant (4 per shift)
- Portland/Slag Cement-bentonite slurry – viscosity at mixing plant (2 per shift)
- Portland/Slag Cement-bentonite slurry – pH of grout at trench (1 per shift)
- Portland/Slag Cement-bentonite slurry – temperature at trench (1 per shift)
- Bleed water will be measured daily prior to trench top-off
- Daily panel overlap and corner tie-ins will be documented
- Over-break will be calculated daily

Portland/Slag Cement-Bentonite Slurry Wall Final (a minimum of 100 lineal feet)

- In lieu of standard penetrometer testing of the top of the wall, SSI will rely on the compressive strength laboratory tests results, as the final cap will be installed before the penetrometer tests can be properly administered.
- Sample every 100 lineal feet of trench for 2"x12" PVC cylinders for backup archive.
- Sample every 100 lineal feet of trench for laboratory testing: unconfined compressive strength and hydraulic conductivity.

Construction

- The trench length along the working bench using centerline stationing at intervals not to exceed 20 lineal feet (to be completed by others).
- The trench depth from the working bench to the bottom of the wall at intervals not to exceed 10 lineal feet.
- The level of cement-bentonite slurry will not be lower than 2-feet from the top of the work platform, and will be measured at the beginning and end of each shift.

X. CLEAN-UP

After the completion of final backfilling, any excess cement-bentonite slurry remaining will be stabilized utilizing soil or a stabilization agent, e.g. fly ash, kiln dust, or cement, prior to transport and disposal. Clean-up will involve the stockpiling of all excess unused slurry with disposal by others.

ATTACHMENT A

RESUMES

Slurry Systems INC.
THE DRIVING FORCE℠

David S. Pachan

Quality Control Manager Safety Oversight
Slurry Systems, Inc.

Project Responsibility

Mr. Pachan will serve as the slurry wall specialist.

Introduction

Mr. David Pachan has over 15 years experience in the supervision/ safety associated with environmental construction projects, specifically soil and groundwater remediation/containment and environmental emergency response issues, e.g. soil and groundwater remediation design, hazardous waste management/permitting/disposal/treatment and containment. He has extensive experience in working with local, state, and federal governmental entities such as the Michigan Department of Environmental Quality, (MDEQ), Indiana Department of Environmental Management (IDEM), Ohio Environmental Protection Agency (OEPA), Illinois Environmental Protection Agency (IEPA), US Environmental Protection Agency (EPA), and the US Army Corps of Engineers (USACE). Past projects include: numerous soil and groundwater remediation design projects, quality control oversight of small dam remediation, slurry wall construction, vibrated beam containment wall construction, auger cast soil stabilization projects, and projects associated with the placement of sheet wall and other shoring and underpinning construction.

Relevant Slurry Wall Experience, 2007 - 2011

LOCATION	DESCRIPTION OF WORK	COMPANY
McCook, IL	Construction of 300,000 SQFT conventional soil-bentonite groundwater cutoff wall	USACE
Addison, IL	Installation of IMPERMIX® vibrated beam slurry wall, approx. 17,000 SQFT (907 LF @ 18') for PCB containment.	Robinette
Warsaw, IN	Construction of 3,450 SQFT (150 LF @ 23") conventional Impermix cutoff wall	Maple Leaf Farms, Inc
Hammond, IN	Installation of IMPERMIX® vibrated beam slurry wall, approx. 20,628 SQFT (764 LF @ 27') for groundwater control.	Gough, Inc.
Carroll County, TN	Installation of IMPERMIX® vibrated beam slurry wall, approx. 70,000 SQFT (1,900 LF @ 37') for dike strengthening at Reedy Creek Dam.	Ronald Franks
Waukegan, IL	Installation of IMPERMIX® vibrated beam slurry wall, approx. 20,240 SQFT (920 LF @ 22') for containment at Yeoman Creek Landfill.	Hard Hat Services

Education & Certifications

B.Sc. Geology – Wayne State University
M.Sc. Structural Geology – The University of Texas
HAZMAT 40 Hour & Yearly Updates
OSHA 10 Construction Safety
AED/CPR & First Aid Certified – Updated as Required
Chance Anchor Certification

Slurry Systems INC.
THE DRIVING FORCE SM

Vincent O. Turner
Superintendent
Slurry Systems, Inc.

Project Responsibility
Mr. Turner will serve as the superintendent for the slurry wall project.

Mr. Vincent Turner, Superintendent, has over 20 years experience in the construction business. He has worked on numerous projects as Foreman and Superintendent over the past several years in Ohio, Texas, Illinois, and Indiana. His duties have included everything from bid estimating to field mechanic plus the daily field operations of multi-phased projects.

Related Experience

Private Entity – Addison Tool and Die (Vibrated Beam Slurry Wall)
Location – Addison, Illinois
Status – Completed 2011

Private Entity – Indiana Dunes State Park (Remedial Soil Stabilization/Permeation Grouting)
Location - Portage, Indiana
Status – Completed 2011

Private Entity - Rockton Road over I-90 (completed 20 tiebacks)
Location - Rockford, Illinois
Status - Completed 2008

Private Entity – Construction project (completed 5 tiebacks)
Location - Valparaiso, Indiana
Status - Completed 2008

Private Entity – I-65 and 80/94 (completed 60 tiebacks)
Location - Gary, Indiana
Status - Completed 2008

Private Entity - (1,400 LF Bridge over I-75)
Location - Cincinnati, Ohio - Ludlow Viaduct Bridge
Status - Completed 1995

USACE – Chicago District (4,200 LF Sheet Pile Shoreline Protection System)
Location - Chicago, IL – Montrose Shoreline Protection
Status - Completed 2004

Certifications

HAZWOPER 40 Hour & Yearly Updates
10-Hour OSHA
CPR & First Aid Certified – Updated as Required
Certified CHANCE® Installer

Slurry Systems INC.
THE DRIVING FORCE℠

Terry A. Palade

Batch Plant Operator
Slurry Systems, Inc.

Project Responsibility

Mr. Palade will serve as the operator of the colloidal mix plant.

Introduction

Mr. Terry Palade has over 25 years experience as a union equipment operator, specifically heavy highway and civil construction projects. Mr. Palade is a member in good standing with the International Union of Operating Engineers Local 150. SSI has utilized Mr. Palade's expertise during the installation of conventional slurry walls, vibrated beam containment wall construction, auger cast soil stabilization projects, and underpinning construction.

Relevant Slurry Wall Experience, 2008 - 2011

LOCATION	DESCRIPTION OF WORK	COMPANY
McCook, IL	Operated Forklift, front end loader, and batch plant during the construction of 300,000 SQFT conventional soil-bentonite groundwater cutoff wall	USACE
Addison, IL	Operated forklift during the Installation of IMPERMIX® vibrated beam slurry wall, approx. 17,000 SQFT (907 LF @ 18') for PCB containment.	Robinette
Hammond, IN	Operated forklift and mini excavator during the Installation of IMPERMIX® vibrated beam slurry wall, approx. 20,628 SQFT (764 LF @ 27') for groundwater control.	Gough, Inc.
Orland Park, IL	Installation of CHANCE ancor underpinning for protection of electrical transformer pads at new construction.	Weis Builders

Certifications

HAZMAT 40 Hour & Yearly Updates
OSHA 10 Construction Safety
AED/CPR & First Aid Certified – Updated as Required
Certified Rigger
Certified Signalman

ATTACHMENT B

MATERIAL CERTIFICATION

BLACK HILLS BENTONITE, LLC

Manufacturers of High Grade Wyoming Bentonite

Box 9 - Mills, Wyoming 82644
Telephone 307-265-3740
FAX 307-235-8511

Black Hills Gel

Black Hills Gel MSDS Sheet

Description *Polymer Extended Wyoming Bentonite*

Application *Recommended for oil well drilling, slurry trenching, pond sealing and most other civil engineering applications.*

Typical Yield *Black Hills Gel will yield 91 barrels (minimum) of API fluid to one ton of material*

Typical Chemical Analysis

ELEMENT	%	ELEMENT	%
SiO_2	64.7	CaO	1.3
Al_2O_3	17.6	K_2O	.46
Fe_2O_3	4.4	Na_2O	2.5
MgO	1.8	TiO_2	.16
		H_2O (Crystal)	5.9

Specifications

SPECS	TYPICAL ANALYSIS	API SPECS
Fann @ 600 rpm	35 - 40	30.00

Fann @ 300 rpm	25 - 30	
Plastic Viscosity	10	
Yield Point/Plastic Viscosity Ratio	1.5 - 2.0	3 Maximum
Filtrate	13.5 ml.	15.0 Maximum
Dry Sieve Analysis	78% - 80% (-200 Mesh)	
Wet Sieve Analysis	2.5% - 3.0%	4.0 Maximum
Moisture	7.0% - 9.0%	10.0% Maximum
pH (6.0% solution)	8.5 - 9.5	

**NOTE: This product has been treated with a small amount (0.25%) of non toxic polyacrylate polymer to strengthen the viscosity of the bentonite. Please write or call if further information is needed on this.*

Testing conforms to API specification 13A, Section 9.

The information contained herein is based on tests believed to be reliable, however no warranty is implied.

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Material Safety Data Sheet

NFPA	HCS Risk Phrases	Protective Clothing
1 / 1 / 0	HCS CLASS: Irritating substance.	Goggles Respirator Gloves

Section I. Chemical Product and Company Identification

Common Name/ Trade Name	FRITZ-PAK SS-1		
Supplier/ Manufacturer	FRITZ-PAK CORPORATION 4821 Eastover Circle Mesquite, TX, 75149, U. S. A. Tel: 214-221-9494 Fax: 214-349-3182	TSCA	
Chemical Family	Cement Bentonite Dispersant	Last Update:	01/31/2008

Section II. Composition and Information on Ingredients

Name	CAS #	% by Weight	TLV/PEL	LC_{50}/LD_{50}
Calcium Lignosulfonate	8061-52-7	N/A	N/A	N/A
Tetrasodium Pyrophosphate	7722-88-5	N/A	10 mg/m3	N/A
Sodium Carbonate	497-19-8	N/A	N/A	N/A

Section III. Hazards Identification

Potential Acute Health And Chronic Effects	May irritate skin. May irritate eyes.

Section IV. First Aid Measures

Eye Contact	IMMEDIATELY flush eyes with running water. Remove contact lenses. Consult a physician.
Skin Contact	Wash skin with soap and water. Seek medical attention if irritation persists.
Inhalation	Move to fresh air to relieve suisance symptoms.
Ingestion	Rinse mouth. Immediately dilute by drinking large quantities of water. After dilution, induce vomiting. Seek immediate medical attention. Never give anything by mouth to an unconscious person.

Section V. Fire and Explosion Data - Non-Flammable

Flash Point	Not applicable.
Unusual Fire and Explosion Hazards	Dust explosions may occur when finely divided particles are mixed with air in the presence of an ignition source. Avoid excessive accumulation of dust on floors, beams, or machinery.

Section VI. Accidental Release Measures

Small Spill	Use appropriate tools to put the spilled solid in a convenient waste disposal container.
Large Spill	Use a shovel to put the material into a convenient waste disposal container. Dispose of it in an approved chemical waste landfill.

Section VII. Handling and Storage

Precautions	DO NOT breathe dust. In case of insufficient ventilation, wear suitable respiratory equipment.
Storage	Store in a dry place and keep sealed until ready to use to preventcaking from moisture pickup.

Continued on Next Page

Section VIII. Exposure Controls/Personal Protection

Engineering Controls	Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep airborne contaminants below recommended exposure limit.
Personal Protection	Goggles. Dust respirator. Rubber gloves.

Section IX. Physical and Chemical Properties

Physical state and appearance	Solid	**Odor**	No odor.
pH (1% soln/water)	11.3	**Color**	Light tan.
Specific Gravity	0.5 (Water = 1)		
Percent Volatile	2 - 10%.		
Melting Point (Degrees Farenheit):	Decomposes.		
Solubility	Soluble in water.		

Section X. Stability and Reactivity Data

Stability	The product is stable.
Incompatibility with various substances	Caution necessary with oxidizing agents.
Hazardous Decomposition Products	Sulfur dioxide (SO_2) possible.

Section XI. Toxicological Information

Routes of Entry	Eye contact. Inhalation. Ingestion. Skin contact.
Effects of Overexposure	Prolonged exposure to high levels of dust in air may causesneezing, coughing, or other nuisance symptoms.

HMIS (U. S. A.)	**Health Hazard**	n/a	**National Fire Protection Association (U. S. A.)**	**Health** 1 / 1 / 0 **Fire Hazard** / **Reactivity** / **Specific Hazard**
	Fire Hazard	n/a		
	Reactivity	n/a		
	Personal Protection	n/a		

Section XII. Ecological Information - Not Available

Section XIII. Disposal Considerations

Waste Disposal	Customary plant procedures for industrial waste treatment.

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Fritz-Pak Corporation assumes no responsibility for personal injury or property damage to vendees, users or third parties caused by or material. Such vendees or users assume all risks associated with the use of the material.

Section XIV. Transport Information - Non-Hazardous

Section XV. Other Regulatory Information and Pictograms

Other Classifications	**WHMIS (Canada)**	Not controlled under WHIMS (Canada).
	DSCL (EEC)	

Product Data Sheet

NewCem®

LAFARGE

NewCem slag cement is engineered for strength and durability. Benefits start at the pour with easier workability, improved pumpability and less heat at hydration. NewCem delivers higher 28-day strengths, reduced permeability and increased resistance to chemical attack. As a "green" product, NewCem is also the environmentally friendly choice.

Product Description
NewCem is a Ground Granulated Blast Furnace Slag (GGBFS) conforming to ASTM C 989 Grade 120, AASHTO M302 Grade 120, CSA A363 and CSA A23.5 Type S.

Applicable Specifications
Produced in accordance with ASTM C 989 *Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars*, AASHTO M302 *Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars*, CSA A363 *Cementitious Hydraulic Slag* and CSA A23.5 *Supplementary Cementing Materials*.

General Statement
NewCem is generally used in varying percentages as a portland cement replacement in concrete and mortars. Higher ultimate strengths, improved durability, economics and aesthetics are potential reasons for using NewCem. As with most cementitious products, care is needed when proportioning, batching, placing, finishing and curing concrete containing this product.

NewCem and the Environment
NewCem is a by-product material that is derived from the iron-making process. The use of NewCem in concrete saves virgin raw materials that would otherwise be needed for the production of portland cement. NewCem also requires less energy to produce than portland cement, so the amount of greenhouse gases released into the environment is reduced when NewCem partly replaces portland cement in concrete.

LAFARGE NORTH AMERICA

Cement

Product Data Sheet

NewCem®

Properties of "Fresh Concrete"

Water Requirements: Concrete mixes containing NewCem will require about the same amount of water for a given slump as concrete containing only portland cement.

Air Content: The use of NewCem as a partial replacement for portland cement will not appreciably change the dosage rate requirements of air entraining agents. When changing mix ingredients, it is recommended to check dosage rates and adjust if necessary.

Bleeding: The bleeding characteristics of concrete containing NewCem will not be appreciably affected.

Segregation: There is no segregation issue related to the use of NewCem.

Heat of Hydration: NewCem can be used to moderate the development of heat in mass concrete. It is recommended that replacement factors above 60% be used for this type of application. It is highly recommended that mix designs be assessed on an individual basis.

Setting Time: Concrete containing NewCem may have extended set times compared to straight portland mixes, especially at lower ambient/concrete temperatures and higher replacement levels. At normal summertime temperatures, set times will only be slightly affected.

Finishability: The finishability of concrete is generally improved with the use of NewCem.

Pumping: Concrete containing NewCem generally has improved pumpability.

Proportioning: NewCem has a lower specific gravity than normal portland cement. Consequently, the mix design should be modified to accommodate this change. ACI 211 should be followed for proportioning and mix proportions should be verified.

Curing: Proper curing of all concrete is essential. It is recommended that the procedures in ACI 308 *Standard Practice for Curing Concrete* be followed.

Properties of "Hardened Concrete"

Strength: Generally, later strengths (beyond 7 days) both compressive and flexural, are enhanced with NewCem. Early strengths (up to 14 days) can be reduced when compared to straight portland mixes, especially at higher replacement rates and at cooler temperatures.

Permeability and Absorption: When properly proportioned, concrete containing NewCem is less permeable and has a lower absorption rate than mixes containing only portland cement.

Concrete Color: Concrete made with NewCem as a replacement for portland cement will be lighter in color. A green or blue-green color may occasionally be observed in freshly cured concrete; however, this is very rare and will only occur under certain conditions. This tint normally disappears once the concrete surface is exposed to air and dries out.

Alkali-Silica Reactivity: Concrete containing NewCem can help mitigate ASR. This is dependent on the qualities of the aggregate and the replacement rate as well as other variables. Concrete mixtures should be assessed on an individual basis.

Resistance to Sulfate Attack: NewCem can be used as part of a system to improve the resistance of concrete to sulfate attack. The degree of resistance achieved is dependent on the replacement rate and other factors. Mixes should be assessed individually.

Corrosion of Embedded Steel: There is a direct relationship between permeability and corrosion resistance. Corrosion can be reduced by replacing part of the portland cement with NewCem in concrete mixtures.

Carbonation: When used in a properly designed concrete mix, and with appropriate finishing and curing procedures applied in the field, the use of NewCem will not significantly affect the depth of carbonation.

Freeze-Thaw Resistance: When used in a properly designed concrete mix with an adequate air-void system and with proper finishing and curing procedures applied in the field, the use of NewCem will not detract from the freeze-thaw resistance of concrete.

Deicer Salt Scaling: When using NewCem as a replacement for portland cement in concrete that will be exposed to deicing salts, the limits specified in ACI 318 *Building Code Requirements for Structural Concrete* and ACI 301 *Specifications for Structural Concrete* must be followed.

Chemical Resistance: Reduced permeability, and therefore improved chemical resistance, can be achieved through the use of NewCem in concrete mixtures.

Note: Appropriate testing should be conducted with different NewCem/portland levels to assure desired results are achieved. Results may vary with the use of different portland cements.

Product Name
NewCem

Manufacturer
Lafarge North America Inc.
12950 Worldgate Drive, Suite 500
Herndon, Virginia 20170
www.lafargenorthamerica.com

Precautions
Direct contact with wet cement should be avoided. If contact occurs, the skin should be washed with water as soon as possible. Exposure can cause serious, potentially irreversible tissue destruction in the form of chemical (caustic) burns. If cement gets into the eyes, immediately rinse thoroughly with water and seek medical attention. For more information, reference the applicable Lafarge Material Safety Data Sheet (MSDS). The MSDS should be consulted prior to use of this product and is available upon request and online at www.lafargenorthamerica.com.

Contact your Lafarge Regional Office for specific product information, availability and ordering.

Great Lakes Region
Southfield, Michigan
Phone 248-354-9050

Northeast Region
Montreal, Quebec
Phone 514-861-1411

River Region
Lee's Summit, Missouri
Phone 816-251-2100

Southeast Region
Alpharetta, Georgia
Phone 678-746-2000

Western Region
Calgary, Alberta
Phone 403-271-9110

Limited Warranty
Lafarge warrants that Lafarge NewCem meets the requirements of ASTM C 989 *Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars* and CSA A23.5 *Supplementary Cementing Materials*. Lafarge makes no other warranty, whether of merchantability, or fitness for a particular purpose with respect to Lafarge NewCem. Having no control over its use, Lafarge will not guarantee finished work in which Lafarge NewCem is used.

LAFARGE NORTH AMERICA

LAFARGE NORTH AMERICA

NewCem

Mill Test Certificate - Sparrows Point Plant

Chemical

		Specification
Sulfide Sulfur (S), %	1.0	**2.5 max.**
Sulfate Ion (as SO_3), %	2.5	**4.0 max.**
Equivalent Alkalies, %	0.52	**n/a**

Certification, NSF 61

Physical

		Specification
Slag Activity Index, %:		
7 Day	113	**95**
28 Day	134	**115**
Compressive Strength: psi		
7 Day	5,123	**n/a**
28 Day	7,949	**n/a**
Fineness:		
Blaine; cm^2/g	5,469	**n/a**
45 Micron; % retained	2	**20 max.**
Other:		
Air Content, %	4	**12 max.**
Specific Gravity;	2.88	**n/a**

Sample Identification

NewCem shipping composite sample results for the month of :

February-09

This ground granulated blast furnace slag complies with the current specification of the chemical and physical requirements of ASTM C-989, AASHTO M-302; Grade 120. NewCem is guaranteed to meet all applicable MDOT, FDOT, GADOT, PennDOT, SCDOT, NJDOT, NY DOT and VADH specifications.

US East Region
Sparrows Point Plant
2001 Wharf Rd, Baltimore, MD 21219
Telephone: (410) 388-1177 x202

Thomas R. Griffiths

Quality Control Manager

3/20/2009

Date

PRODUCT DATA SHEET

LAFARGE PORTLAND CEMENT

LAFARGE

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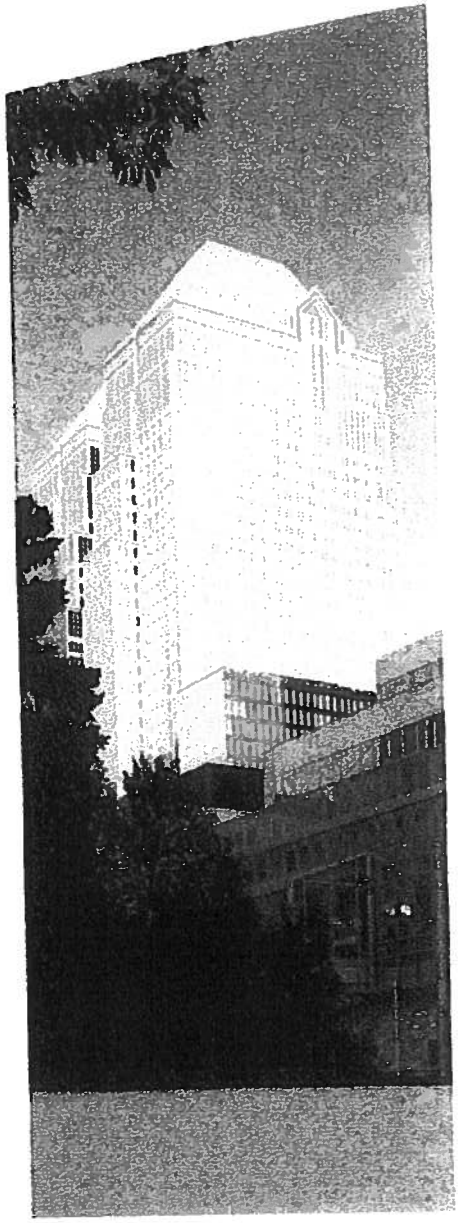


A versatile, cost-effective quality building material

Lafarge Portland Cement is a high quality, cost-effective basic building material used in virtually all forms of construction, from hospitals and homes to schools, tunnels and airports. Lafarge Portland Cement meets or exceeds all applicable chemical and physical requirements of ASTM C 150 and CSA A3000-08.

Product Description

Portland Cement
ASTM C 150 Type I, Type IA, Type II, Type III, Type V
CSA A3000-08, GU, GUL, MH, MHL, MS, HE, HEL, LH, LHL, HS

Basic Use: Lafarge Portland Cement is a cost-effective basic building material. It can be used in a wide variety of commercial and architectural concrete construction applications. Uses include cast-in-place, pre cast, tilt up, water tanks, drains, bridges, roads, pipes, concrete masonry units, pre-stressed concrete members, masonry mortars and grouts.

Lafarge
Portland Cement

Uses

Type I This is a general-purpose cement suitable for all uses where the special properties of other types of portland cement are not required.

Type IA This cement contains an additive that will entrain air to aid in durability when concrete is exposed to freezing temperatures

Type II For general use, especially when moderate sulfate resistance or moderate heat of hydration is desired.

Type III This cement provides high early strength when compared with Type I.

Type V This is for use when high sulfate resistance is desired. Type V generally gains strength more slowly than Type I.

Canada

GU, GUL* General use cement, suitable for all applications where the special properties of any other type of portland cement are not required.

MS Moderate sulphate resistant cement for use in applications requiring moderate levels of sulphate resistance.

MH, MHL* Moderate heat cement for use in applications requiring moderately low levels of heat generation during the hydration process.

HE, HEL* High early strength cement for use where high early strengths are required.

LH, LHL* Low heat cement for use in applications that require significantly low levels of heat generation during the hydration process.

HS High sulphate resistant cement for use in applications that require high levels of sulphate resistance. HS cement generally gains strength more slowly than the other types.

* NOTE: The suffix "L" indicates a portland-limestone cement

Options

Select Lafarge manufacturing plants produce air-entrained (Type IA) portland cement that contains an additive that will entrain air to aid in durability when concrete is exposed to freezing temperatures. Certain locations manufacture cements meeting the optional physical and chemical requirements of ASTM and CSA AASHTO cements are available in certain geographic areas. Contact your Lafarge Cement representative for product use and availability.

Technical data

Lafarge Portland Cement meets or exceeds all applicable chemical and physical requirements of ASTM C 150 and CSA A3000-08.

Use and limitations

Lafarge manufactures all products in accordance with strict QA/QC (quality assurance and quality control) procedures to ensure optimum product performance and uniformity. However, there are many variables that affect concrete performance that are beyond the control of the cement manufacturer. Good concreting practices in accordance with the American Concrete Institute, The National Building Code, Provincial, Municipal and other local building codes are required to achieve desired results. Skilled persons should use these products with special attention given to formwork, batching, mixing, placing, finishing and curing. In most applications, quality aggregates, admixtures and additives should be utilized. For detailed information, contact your Lafarge sales office.

Product Name
Lafarge Portland Cement

Manufacturer
Lafarge North America Inc.
12018 Sunrise Valley Drive
Suite 500
Reston, VA 20191

Lafarge Canada Inc.
334 avenue Avro
Pointe-Claire, Quebec
H9R 5W5

www.lafarge-na.com

Precautions

Direct contact with wet cement should be avoided. If contact occurs, the skin should be washed with water as soon as possible. Exposure can cause serious, potentially irreversible tissue destruction in the form of chemical (caustic) burns. If cement gets into the eyes, immediately rinse thoroughly with water and seek medical attention. For more information, reference the applicable Lafarge Material Safety Data Sheet (MSDS). The MSDS should be consulted prior to use of this product and is available upon request and online at www.lafarge-na.com.

Limited Warranty

Lafarge warrants that Lafarge Portland Cement meets all applicable requirements of ASTM C 150 and CSA A3000-08. Lafarge makes no other warranty, whether of merchantability or fitness for a particular purpose, with respect to Lafarge Portland Cement. Having no control over its use, Lafarge will not guarantee finished work in which Lafarge Portland Cement is used.

Contact your Lafarge Cement office for specific product information, availability and ordering.

Lakes and Seaway Business Unit
Bingham Farms, Michigan
Phone: 248-594-1991

River Business Unit
Lee's Summit, Missouri
Phone: 816-251-2100

U.S. East Business Unit
Alpharetta, Georgia
Phone: 678-746-2000

Western Business Unit
Calgary, Alberta
Phone: 403-271-9110

LAFARGE
bringing materials to life

Material Safety Data Sheet

Section 1: PRODUCT AND COMPANY INFORMATION

Product Name(s): Lafarge Portland Cement (cement)

Product Identifiers: Cement, Portland Cement, Hydraulic Cement, Oil Well Cement, Trinity® White Cement, Antique White Cement, Portland Limestone Cement, Portland Cement Type I, IA, IE, II, I/II, IIA, II L.A., III, IIIA, IV, IVA, V, VA, 10, 20, 30, 40, 50, GU, GUL, MS, MH, HE, LH, HS, OWH, OWG Cement, OW Class G HSR

Manufacturer:
Lafarge North America Inc.
12018 Sunrise Valley Dr, Suite 500
Reston, VA 20191

Information Telephone Number:
703-480-3600 (9am to 5pm EST)

Emergency Telephone Number:
1-800-451-8346 (3E Hotline)

Product Use: Cement is used as a binder in concrete and mortars that are widely used in construction. Cement is distributed in bags, totes and bulk shipment.

Note: This MSDS covers many types of Portland cement. Individual composition of hazardous constituents will vary between types of Portland cement.

Section 2: COMPOSITION/INFORMATION ON INGREDIENTS

Component	Percent (By Weight)	CAS Number	OSHA PEL -TWA (mg/m^3)	ACGIH TLV-TWA (mg/m^3)	LD_{50} (mouse, intraperitoneal)	LC_{50}
Portland Cement*	100	65997-15-1	15 (T); 5 (R)	1 (R)	NA	NA
Calcium Sulfate*	2-10	13397-24-5	15 (T); 5 (R)	10 (T)	NA	NA
Calcium Carbonate*	0-15	1317-65-3	15 (T); 5 (R)	3 (R), 10 (T)	NA	NA
Calcium Oxide	0-5	1305-78-8	5 (T)	2 (T)	3059 mg/kg	NA
Magnesium Oxide	0-4	1309-48-4	15 (T)	10 (T)	NA	NA
Crystalline Silica	0-0.2	14808-60-7	[(10) / (%SiO_2+2)] (R); [(30) / (%SiO_2+2)] (T)	0.025 (R)	NA	NA

Note: Exposure limits for components noted with an * contain no asbestos and <1% crystalline silica

Cement is made from materials mined from the earth and is processed using energy provided by fuels. Trace amounts of chemicals may be detected during chemical analysis. For example, cement may contain trace amounts of calcium oxide (also known as free lime or quick lime), free magnesium oxide, potassium and sodium sulfate compounds, chromium compounds, nickel compounds, and other trace compounds.

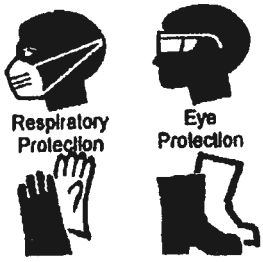
Section 3: HAZARD IDENTIFICATION

WARNING

Corrosive - Causes severe burns.
Toxic - Harmful by inhalation.
(Contains crystalline silica)

Use proper engineering controls, work practices, and personal protective equipment to prevent exposure to wet or dry product.

Read MSDS for details.



Section 3: HAZARD IDENTIFICATION (continued)

Emergency Overview: Cement is a solid, grey, off white, or white odorless powder. It is not combustible or explosive. A single, short-term exposure to the dry powder presents little or no hazard. Exposure of sufficient duration to wet cement, or to dry cement on moist areas of the body, can cause serious, potentially irreversible tissue (skin, eye, respiratory tract) damage due to chemical (caustic) burns, including third degree burns.

Potential Health Effects:

Eye Contact: Airborne dust may cause immediate or delayed irritation or inflammation. Eye contact with large amounts of dry powder or with wet cement can cause moderate eye irritation, chemical burns and blindness. Eye exposures require immediate first aid and medical attention to prevent significant damage to the eye.

Skin Contact: Cement may cause dry skin, discomfort, irritation, severe burns, and dermatitis.

Burns: Exposure of sufficient duration to wet cement, or to dry cement on moist areas of the body, can cause serious, potentially irreversible damage to skin, eye, respiratory and digestive tracts due to chemical (caustic) burns, including third degree burns. A skin exposure may be hazardous even if there is no pain or discomfort.

Dermatitis: Cement is capable of causing dermatitis by irritation and allergy. Skin affected by dermatitis may include symptoms such as, redness, itching, rash, scaling, and cracking.

Irritant dermatitis is caused by the physical properties of cement including alkalinity and abrasion.

Allergic contact dermatitis is caused by sensitization to hexavalent chromium (chromate) present in cement. The reaction can range from a mild rash to severe skin ulcers. Persons already sensitized may react to the first contact with cement. Others may develop allergic dermatitis after years of repeated contact with cement.

Inhalation (acute): Breathing dust may cause nose, throat or lung irritation, including choking, depending on the degree of exposure. Inhalation of high levels of dust can cause chemical burns to the nose, throat and lungs.

Inhalation (chronic): Risk of injury depends on duration and level of exposure.

Silicosis: This product contains crystalline silica. Prolonged or repeated inhalation of respirable crystalline silica from this product can cause silicosis, a seriously disabling and fatal lung disease. See Note to Physicians in Section 4 for further information.

Carcinogenicity: Cement is not listed as a carcinogen by IARC or NTP; however, cement contains trace amounts of crystalline silica and hexavalent chromium which are classified by IARC and NTP as known human carcinogens.

Autoimmune Disease: Some studies show that exposure to respirable crystalline silica (without silicosis) or that the disease silicosis may be associated with the increased incidence of several autoimmune disorders such as scleroderma (thickening of the skin), systemic lupus erythematosus, rheumatoid arthritis and diseases affecting the kidneys.

Tuberculosis: Silicosis increases the risk of tuberculosis.

Renal Disease: Some studies show an increased incidence of chronic kidney disease and end-stage renal disease in workers exposed to respirable crystalline silica.

Section 3: HAZARD IDENTIFICATION (continued)

Ingestion: Do not ingest cement. Although ingestion of small quantities of cement is not known to be harmful, large quantities can cause chemical burns in the mouth, throat, stomach, and digestive tract.

Medical Conditions Aggravated by Exposure: Individuals with lung disease (e.g. bronchitis, emphysema, COPD, pulmonary disease) or sensitivity to hexavalent chromium can be aggravated by exposure.

Section 4: FIRST AID MEASURES

Eye Contact: Rinse eyes thoroughly with water for at least 15 minutes, including under lids, to remove all particles. Seek medical attention for abrasions and burns.

Skin Contact: Wash with cool water and a pH neutral soap or a mild skin detergent. Seek medical attention for rash, burns, irritation, dermatitis, and prolonged unprotected exposures to wet cement, cement mixtures or liquids from wet cement.

Inhalation: Move person to fresh air. Seek medical attention for discomfort or if coughing or other symptoms do not subside.

Ingestion: Do not induce vomiting. If conscious, have person drink plenty of water. Seek medical attention or contact poison control center immediately.

Note to Physician: The three types of silicosis include:

- Simple chronic silicosis – which results from long-term exposure (more than 20 years) to low amounts of respirable crystalline silica. Nodules of chronic inflammation and scarring provoked by the respirable crystalline silica form in the lungs and chest lymph nodes. This disease may feature breathlessness and may resemble chronic obstructive pulmonary disease (COPD).
- Accelerated silicosis – occurs after exposure to larger amounts of respirable crystalline silica over a shorter period of time (5-15 years). Inflammation, scarring, and symptoms progress faster in accelerated silicosis than in simple silicosis.
- Acute silicosis – results from short-term exposure to very large amounts of respirable crystalline silica. The lungs become very inflamed and may fill with fluid, causing severe shortness of breath and low blood oxygen levels.

Progressive massive fibrosis may occur in simple or accelerated silicosis, but is more common in the accelerated form. Progressive massive fibrosis results from severe scarring and leads to the destruction of normal lung structures.

Section 5: FIREFIGHTING MEASURES

Flashpoint & Method: Non-combustible

General Hazard: Avoid breathing dust. Wet cement is caustic.

Extinguishing Media: Use extinguishing media appropriate for surrounding fire.

Firefighting Equipment: Cement poses no fire-related hazard. A SCBA is recommended to limit exposures to combustion products when fighting any fire.

Combustion Products: None.

Section 6: ACCIDENTAL RELEASE MEASURES

General: Place spilled material into a container. Avoid actions that cause the cement to become airborne. Avoid inhalation of cement and contact with skin. Wear appropriate protective equipment as described in Section 8. Scrape wet cement and place in container. Allow material to dry or solidify before disposal. Do not wash cement down sewage and drainage systems or into bodies of water (e.g. streams).

Waste Disposal Method: Dispose of cement according to Federal, State, Provincial and Local regulations.

Section 7: HANDLING AND STORAGE

General: Keep bulk and bagged cement dry until used. Stack bagged material in a secure manner to prevent falling. Bagged cement is heavy and poses risks such as sprains and strains to the back, arms, shoulders and legs during lifting and mixing. Handle with care and use appropriate control measures.

Engulfment hazard. To prevent burial or suffocation, do not enter a confined space, such as a silo, bin, bulk truck, or other storage container or vessel that stores or contains cement. Cement can buildup or adhere to the walls of a confined space. The cement can release, collapse or fall unexpectedly.

Properly ground all pneumatic conveyance systems. The potential exists for static build-up and static discharge when moving cement powders through a plastic, non-conductive, or non-grounded pneumatic conveyance system. The static discharge may result in damage to equipment and injury to workers.

Usage: Cutting, crushing or grinding hardened cement, concrete or other crystalline silica-bearing materials will release respirable crystalline silica. Use all appropriate measures of dust control or suppression, and Personal Protective Equipment (PPE) described in Section 8 below.

Housekeeping: Avoid actions that cause the cement to become airborne during clean-up such as dry sweeping or using compressed air. Use HEPA vacuum or thoroughly wet with water to clean-up dust. Use PPE described in Section 8 below.

Storage Temperature: Unlimited. **Storage Pressure:** Unlimited.

Clothing: Promptly remove and launder clothing that is dusty or wet with cement. Thoroughly wash skin after exposure to dust or wet cement.

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering Controls: Use local exhaust or general dilution ventilation or other suppression methods to maintain dust levels below exposure limits.

Personal Protective Equipment (PPE):

Respiratory Protection: Under ordinary conditions no respiratory protection is required. Wear a NIOSH approved respirator that is properly fitted and is in good condition when exposed to dust above exposure limits.

Eye Protection: Wear ANSI approved glasses or safety goggles when handling dust or wet cement to prevent contact with eyes. Wearing contact lenses when using cement, under dusty conditions, is not recommended.

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION (continued)

Skin Protection: Wear gloves, boot covers and protective clothing impervious to water to prevent skin contact. Do not rely on barrier creams, in place of impervious gloves. Remove clothing and protective equipment that becomes saturated with wet cement and immediately wash exposed areas.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid (powder).	**Evaporation Rate:**	NA.
Appearance:	Gray, off white or white powder.	**pH (in water):**	12 – 13
Odor:	None.	**Boiling Point:**	>1000° C
Vapor Pressure:	NA.	**Freezing Point:**	None, solid.
Vapor Density:	NA.	**Viscosity:**	None, solid.
Specific Gravity:	3.15	**Solubility in Water:**	Slightly (0.1 - 1.0%)

Section 10: STABILITY AND REACTIVITY

Stability: Stable. Keep dry until use. Avoid contact with incompatible materials.

Incompatibility: Wet cement is alkaline and is incompatible with acids, ammonium salts and aluminum metal. Cement dissolves in hydrofluoric acid, producing corrosive silicon tetrafluoride gas. Cement reacts with water to form silicates and calcium hydroxide. Silicates react with powerful oxidizers such as fluorine, boron trifluoride, chlorine trifluoride, manganese trifluoride, and oxygen difluoride.

Hazardous Polymerization: None. **Hazardous Decomposition:** None.

Section 11 and 12: TOXICOLOGICAL AND ECOLOGICAL INFORMATION

For questions regarding toxicological and ecological information refer to contact information in Section 1.

Section 13: DISPOSAL CONSIDERATIONS

Dispose of waste and containers in compliance with applicable Federal, State, Provincial and Local regulations.

Section 14: TRANSPORT INFORMATION

This product is not classified as a Hazardous Material under U.S. DOT or Canadian TDG regulations.

Section 15: REGULATORY INFORMATION

OSHA/MSHA Hazard Communication: This product is considered by OSHA/MSHA to be a hazardous chemical and should be included in the employer's hazard communication program.

CERCLA/SUPERFUND: This product is not listed as a CERCLA hazardous substance.

EPCRA SARA Title III: This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 and is considered a hazardous chemical and a delayed health hazard.

EPRCA SARA Section 313: This product contains none of the substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Section 15: REGULATORY INFORMATION (continued)

RCRA:	If discarded in its purchased form, this product would not be a hazardous waste either by listing or characteristic. However, under RCRA, it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste.
TSCA:	Portland cement and crystalline silica are exempt from reporting under the inventory update rule.
California Proposition 65:	Crystalline silica (airborne particulates of respirable size) and Chromium (hexavalent compounds) are substances known by the State of California to cause cancer.
WHMIS/DSL:	Products containing crystalline silica and calcium carbonate are classified as D2A, E and are subject to WHMIS requirements.

Section 16: OTHER INFORMATION

Abbreviations:

>	Greater than	NA	Not Applicable
ACGIH	American Conference of Governmental Industrial Hygienists	NFPA	National Fire Protection Association
CAS No	Chemical Abstract Service number	NIOSH	National Institute for Occupational Safety and Health
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	NTP	National Toxicology Program
CFR	Code for Federal Regulations	OSHA	Occupational Safety and Health Administration
CL	Ceiling Limit	PEL	Permissible Exposure Limit
DOT	U.S. Department of Transportation	pH	Negative log of hydrogen ion
EST	Eastern Standard Time	PPE	Personal Protective Equipment
HEPA	High-Efficiency Particulate Air	R	Respirable Particulate
HMIS	Hazardous Materials Identification System	RCRA	Resource Conservation and Recovery Act
IARC	International Agency for Research on Cancer	SARA	Superfund Amendments and Reauthorization Act
LC_{50}	Lethal Concentration	T	Total Particulate
LD_{50}	Lethal Dose	TDG	Transportation of Dangerous Goods
mg/m^3	Milligrams per cubic meter	TLV	Threshold Limit Value
MSHA	Mine Safety and Health Administration	TWA	Time Weighted Average (8 hour)
		WHMIS	Workplace Hazardous Materials Information System

This MSDS (Sections 1-16) was revised on March 1, 2011.

An electronic version of this MSDS is available at: www.lafarge-na.com under the Sustainability section.

Lafarge North America Inc. (LNA) believes the information contained herein is accurate; however, LNA makes no guarantees with respect to such accuracy and assumes no liability in connection with the use of the information contained herein which is not intended to be and should not be construed as legal advice or as insuring compliance with any federal, state or local laws or regulations. Any party using this product should review all such laws, rules, or regulations prior to use, including but not limited to US and Canada Federal, Provincial and State regulations.

NO WARRANTY IS MADE, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR OTHERWISE.

SUBMITTAL COVER SHEET

CONTRACTOR: OP-TECH Environmental Services, Inc.

SUBMITTAL NO.: 005

ADDRESS: 150 Rotterdam Industrial Park

Schenectady, New York

DATE OF SUBMITTAL: 8/24/11

CONTRACT NO.: 137335

MANUFACTURER:

NAME OF PROJECT: Ford Rd. Landfill Remedial Action Phase 1 Construction

SUBMITTAL DESCRIPTION: Silt Fence

REFERENCES:

Specification Section(s) 312500 Paragraph(s) 2.1

Contract Drawing(s)

CONTRACTOR SIGNATURE

BROWN AND CALDWELL REVIEW

BROWN AND CALDWELL

DOCUMENT REVIEW STATUS

STATUS NO:

1 ☒ NO EXCEPTION TAKEN

2 ☐ MAKE CORRECTIONS NOTED RESUBMITTAL NOT REQUIRED

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REVIEWED BY: RJQ TITLE: CERTIFYING ENGINEER

DATE: 8/24/11

REMARKS:

ACF ENVIRONMENTAL
Customer Focused, Environmentally Committed

SILT FENCE SPECIFICATION

Width: 36" x 100'

Stakes: 1 ½" x 1 ½" x 48" Nominal Oak Stakes on 10' centers
11 stakes per roll

Fabric: LS125

Property	Test Method	Min. Avg. Roll Values
Grab Tensile Strength	ASTM D4632	125 x 125 Lbs
Grab Tensile Elongation	ASTM D4632	15-20 %
Trapezoid Tear Strength	ASTM D4533	60 Lbs
Puncture Strength	ASTM D4833	60 Lbs
Mullen Burst Strength	ASTM D3786	200 Lbs
UV Resistance @ 500 Hours	ASTM D4355	80%
Permittivity	ASTM D-4491	0.05 (sec-1)
Apparent Opening Size (AOS)	ASTM D4751	20 Sieve

Results quoted above are the mean of multiple tests conducted at an independent testing facility. Commercial Grade meets or exceeds values listed.

The information presented herein, is to the best of our knowledge, true and accurate. Except when agreed to in writing for specific conditions of use, no warranty or guarantee expressed or implied is made regarding the performance of any product, since the manner of use and handling are beyond our control. Nothing contained herein is to be construed as permission or as a recommendation to infringe on any patent.

2831 Cardwell Road, Richmond, VA 23234
Sales: 800-448-3636 • Corporate: 800-223-9021 • Fax: 804-271-3074
www.acfenvironmental.com

SUBMITTAL COVER SHEET

CONTRACTOR: OP-TECH Environmental Services, Inc.

SUBMITTAL NO.: 006

ADDRESS: 150 Rotterdam Industrial Park
Schenectady, New York

DATE OF SUBMITTAL: 8/24/11

CONTRACT NO.: 137335

MANUFACTURER:

NAME OF PROJECT: Ford Rd. Landfill Remedial Action Phase 1 Construction

SUBMITTAL DESCRIPTION: Geotextile Fabric

REFERENCES:

Specification Section(s) 136000 Paragraph(s) 1.7

Contract Drawing(s)

CONTRACTOR SIGNATURE

BROWN AND CALDWELL REVIEW

BROWN AND CALDWELL

DOCUMENT REVIEW STATUS

STATUS NO:

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REVIEWED BY: RMQ TITLE: CERTIFYING ENGINEER

DATE: 8/24/11

REMARKS:

Sales Office:
Engineered Synthetic Products, Inc.
Tel (770) 564-1857
Fax (770) 564-1818
www.espgeosynthetics.com

Geotextile Product Description Sheet
SKAPS GE-180
Nonwoven Geotextile

SKAPS GE-180 is a needle-punched nonwoven geotextile made of 100% polypropylene staple fibers, which are formed into a random network for dimensional stability. SKAPS GE-180 resists ultraviolet deterioration, rotting, biological degradation, naturally encountered basics and acids. Polypropylene is stable within a pH range of 2 to 13. SKAPS GE-180 conforms to the physical property values listed below:

PROPERTY	TEST METHOD	UNIT	M.A.R.V. (Minimum Average Roll Value)
Weight	ASTM D 5261	oz/yd^2 (g/m^2)	8.0 (271)
Grab Tensile	ASTM D 4632	lbs (kN)	225 (1.0)
Grab Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	lbs (kN)	90 (0.4)
Thickness*	ASTM D 5199	mils (mm)	100 (2.5)
CBR Puncture Resistance	ASTM D 6241	lbs (kN)	600 (2.67)
Permittivity*	ASTM D 4491	sec^{-1}	1.26
Permeability*	ASTM D 4491	cm/sec	0.3
Water Flow*	ASTM D 4491	gpm/ft^2(l/min/m^2)	100 (4074)
AOS	ASTM D 4751	US Sieve (mm)	80 (0.18)
UV Resistance	ASTM D 4355	%/hrs	70/500

PACKAGING	
Roll Dimensions (W x L) – ft	15 x 690
Square Yards Per Roll	1150
Estimated Roll Weight – lbs	620

* At the time of manufacturing. Handling may change these properties.

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SKAPS Industries,
335 Athena Dr., Athens, GA 30601,
Phone:(706)-354-3700, Fax(706)-354-3737,
www.skaps.com

Made in U.S.A.

Rev:12/23/09

SUBMITTAL COVER SHEET

CONTRACTOR: OP-TECH Environmental Services, Inc.

SUBMITTAL NO.: 007

ADDRESS: 150 Rotterdam Industrial Park

Schenectady, New York

DATE OF SUBMITTAL: 8/24/11

CONTRACT NO.: 137335

MANUFACTURER:

NAME OF PROJECT: Ford Rd. Landfill Remedial Action Phase 1 Construction

SUBMITTAL DESCRIPTION: 30 mil HDPE Geomembrane

REFERENCES:

Specification Section(s) 136000 Paragraph(s) 1.7

Contract Drawing(s)

CONTRACTOR SIGNATURE

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BROWN AND CALDWELL

DOCUMENT REVIEW STATUS

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REVIEWED BY: TITLE: CERTIFYING ENGINEER

DATE: 8/26/11

REMARKS:

GSE

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SINCE 1972

Product Data Sheet

GSE HD Smooth Geomembrane

GSE HD is a smooth high density polyethylene (HDPE) geomembrane manufactured with the highest quality resin specifically formulated for flexible geomembranes. This product is used in applications that require excellent chemical resistance and endurance properties.

Product Specifications

These product specifications meet or exceed GRI GM13.

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE 30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		120 (21)	152 (26)	243 (42)	327 (57)	410 (71)
Strength at Yield, lb/in-width (N/mm)			66 (11)	84 (14)	132 (23)	177 (30)	212 (37)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (124)	42 (186)	58 (257)	73 (324)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	85 (378)	125 (556)	160 (711)	195 (867)
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note(1)	Note(1)	Note(1)	Note(1)	Note(1)
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length(2), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width(2), ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- (1)Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3
- (2)Roll lengths and widths have a tolerance of ± 1%.
- GSE HD is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified

DSHD 801/13/10

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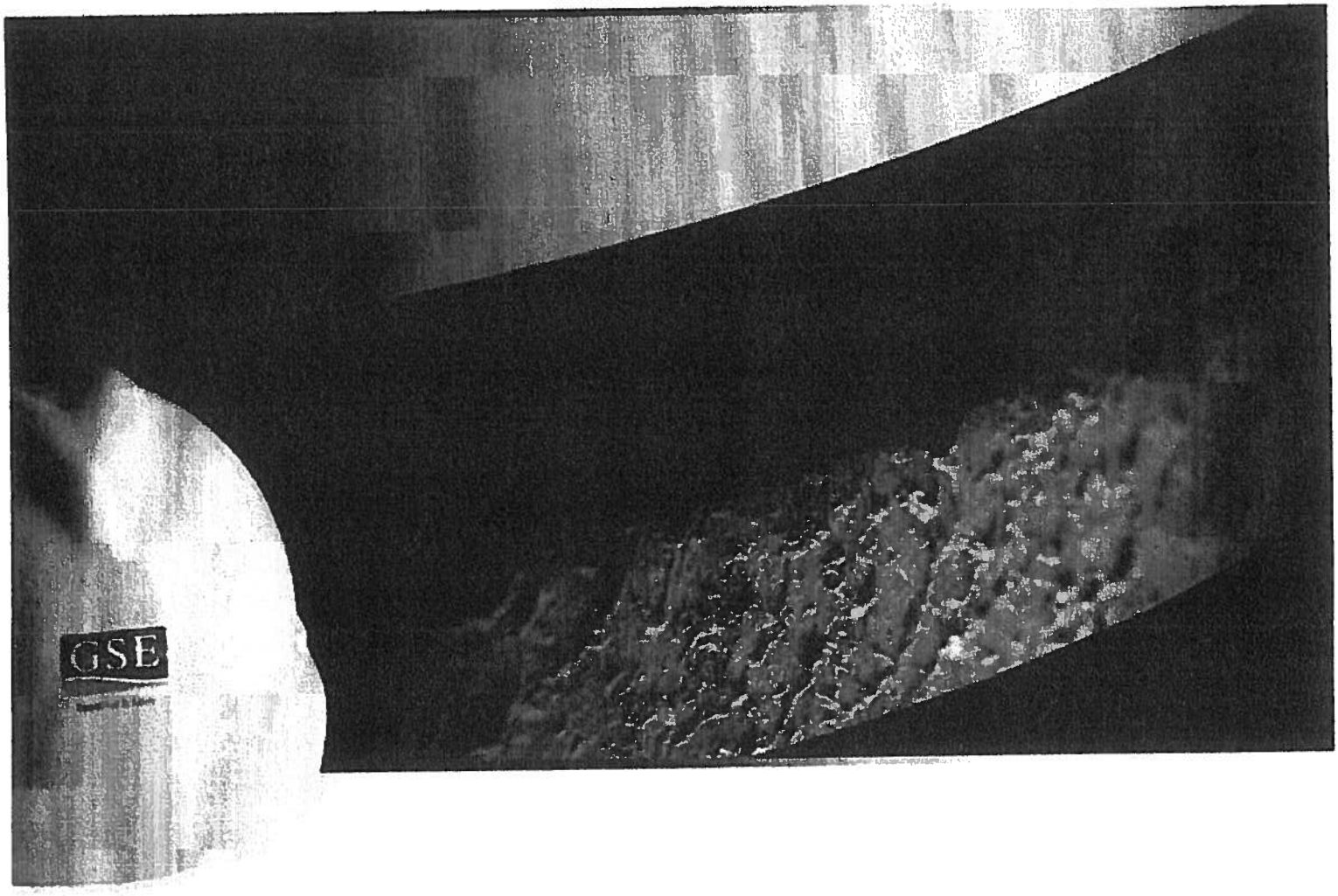
Installation Quality Assurance Manual



Geomembrane Products

GSE

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1.0 INTRODUCTION

This manual provides an overview of the GSE Installation Quality Assurance procedures consistent with industry accepted practices to ensure that the geomembrane products installed will perform for its intended purpose. In addition, all installation work will be performed in strict accordance per the customer's specifications. Please read the procedures below completely before you begin. If you need further clarification, contact GSE Engineering Support Staff for assistance. Remember safety first and use safe practices always on every project.

2.0 STANDARD TEST METHODS

ASTM D 6392: Standard Test Methods For Determining The Integrity Of Non-Reinforced Geomembrane Seams Produced Using Thermo Fusion Methods

ASTM D 5820: Standard Practice For Pressurized Air Channel Evaluation of Dual Seamed Geomembranes

ASTM D 5641: Standard Practice For Geomembrane Seam Evaluation By Vacuum Chamber

ASTM D 6497: Standard Guide For Mechanical Attachment of Geomembrane to Penetrations or Structures

ASTM D 7240: Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)

GRI Standard GM13: Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

GRI Standard GM14: Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes

GRI Standard GM17: Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

GRI Standard GM19: Standard Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

3.0 MATERIAL DELIVERY

A. Upon arrival on site, the QA personnel will inventory all materials on the job site.

B. Roll numbers of geomembrane will be logged on the Inventory Check List (Appendix A) and cross-referenced with the Bill of Lading for materials supplied by GSE.

C. Copies of the Inventory Check List and signed Bill of Lading should be sent to the GSE's corporate headquarters while the QA personnel retains the original copies.

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D. Any visible damage to roll materials should be noted on the roll and Inventory Check List.

4.0 EARTHWORK

A. The general contractor is responsible for preparing and maintaining the subgrade. The subgrade should be prepared and maintained per the job specifications.

B. The site manager shall be responsible for assuring that the subgrade surface has been properly prepared for deployment of geosynthetics. After each day's deployment the Subgrade Surface Acceptance form (Appendix B) will be signed by all parties.

5.0 PANEL PLACEMENT

A. Each panel will be assigned a number as described below.
   1. When there is one layer, panels may be designated with only a number, i.e...1, 2, 3, 4 etc.

   2. When two or more layers are required, use a letter and number, i.e....
      Primary Liner P1, P2, P3, P4 etc...
      Secondary Liner S1, S2, S3, S4 etc...
      Tertiary Liner T1, T2, T3, T4 etc...

B. This numbering system should be used whenever possible. Agreement to a panel numbering system should be made at the pre-construction meeting. However, it is essential that the installer, the owner representative and third party QA inspector agree.

C. Panel numbers shall be written in large block letters in the center of each deployed panel. The roll number, date of deployment and length (gross) should be noted below the panel number. All notes should be made, so that they are easily visible from a distance. On long panels it is beneficial to write information on both ends.

D. Panel numbers shall be logged on the Panel Placement Log (Appendix C) along with the roll number and other information neccessary to complete the form.

E. If there is a partial roll left after deployment, it is important to write the last four digits of the roll number in several locations on the roll along with the estimated length for future identification.

F. Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:

   1. Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage. GSE Conductive should be installed with Conductive layer facing down.

   2. Place temporary ballast, such as sangbags, on geomembrane that will not damage the geomembrane and to prevent wind uplift.

   3. Personnel walking on geomembrane shall not engage in activities or wear shoes that could

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damage it. Smoking is not permitted on the geomembrane.

4. Do not allow heavy vehicular traffic directly on geomembrane. Rubber tired and tracked ATV's and equipment are acceptable if contact pressure is less than 8 psi.

   a. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.

   b. Prior to driving on any geomembrane layer, please check for sharp edges, embedded rocks, or other foreign objects that may protrude in the tires and tracks.

   c. Path driven on geomembranes shall be as straight as possible with no sharp turns, sudden stops or quick starts.

   d. Areas where driving occurs shall be continuously and thoroughly inspected throughout the deployment process by the contractor and the third party CQA.

6.0 TRIAL WELDS

A. Seaming apparatus shall be allowed to warm up a minimum of 10 minutes before performing trial welds.

B. Each seaming apparatus along with a welding technician will pass a trial weld prior to use. Trial welds to be performed in the morning and afternoon, as a minimum, as well as whenever there is a power shutdown.

C. Fusion or wedge welds will always be performed or conducted on samples at least 6.0 ft long. Extrusion welds will be done on samples at least 3.0 ft long.

Note: Always perform trial welds in the same conditions that exist on the job. Run the trial welds on the ground, not the installed liner. Do not use a wind break unless you are using one on the job.

D. Operating temperatures should be monitored while welding. The welding technician should verify that the equipment is capable of maintaining temperature while welding.

E. Sampling Procedure

1. Cut five 1.0 in wide specimens from the trial weld sample. Specimens will always be cut using a 1.0 in die cutter, so the peel values may be used for qualitative analysis.

2. When cutting coupons from the trial weld samples, the inside and outside tracks on the coupon should be identified to assist in troubleshooting problems in case the weld fails. The outside track will be defined as the track, which would be peeled if pulling the overlap exposed in a typical installation, or the seam that is closest to the edge of the top sheet. The inside track is the seam closest to the edge of the bottom sheet.

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F. Cutter
1. Only cut one sample at a time to avoid damaging the die cutter.

2. Samples should be free of sand and grit prior to cutting sample.

3. Inspect the die edge weekly for nicks, dents or signs of dullness. Dullness of the cutting edge may damage the units.

4. Remove die when edge has been dulled and lightly reshape it with a medium hand file. When wear is excessive return it for a replacement die.

5. When the cutting board becomes deeply scored and/or interferes with coupon cutting it should be replaced.

6. To adjust the depth of the die cut into the cutting board, after replacing the cutting board or sharpening the die, 0.015 in washer shims can be added or removed between the cutting ram and the ram extension. Only add shims when cutting is difficult due to lack of depth of cut.

G. Trial Weld Testing
1. Allow coupons to cool prior to testing. Avoid separating the coupons while hot as failure of the sheet may be initiated and false readings indicated.

2. In extreme heat the coupons may need to be cooled, using water or an insulated cooler prior to peel testing. Lab conditions specify 70 degrees (plus or minus 4 degrees) Fahrenheit. Coupon temperatures greater than 70 degrees may result in lowered strengths.

3. Visually inspect the coupons for squeeze-out, footprint, pressure and general appearance.

4. Each of the five coupons will be tested in peel on the field tensiometer at a separation rate of 2 in per minute (for HDPE). Shear tests, in addition to the peel tests, will be performed.

H. Pass/Fail Criteria
1. Criteria for passing trial welds will be as follows:
   a. Seam must exhibit film tear bond (FTB). Trial welds should have no incursion into the weld.

   b. Peel and shear values shall meet or exceed the values as listed in Appendix D, Table 1 for HDPE smooth or textured sheet (@ 2 in/min).

   c. Peel and shear values shall meet or exceed the values as listed in Appendix D, Table 2 for LLDPE smooth or textured sheet (@ 20 in/min).

   d. Both tracks of fusion welded samples must pass for the trial weld to be considered acceptable. If any of the five coupons fail due to seam incursion (no FTB) or low strength values, the trial weld must be performed again.

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e. The QA personnel will give approval to proceed with welding after observing and recording all trial welds.

2. All trial weld data will be logged on the Trial Weld Log (Appendix E).

3. When logging fusion welded peel values on the Trial Weld Log indicate the values. for the outside track first, followed by the inside track.

4. Speed and temperature settings will be recorded for each machine trial weld as appropriate.

7.0 GEOMEMBRANE FIELD SEAMING

A. The seam number takes the identity of the panels on each side. The seam between panels 1 & 2 becomes seam 1/2.

B. Welding technicians will record their initials, machine number, date and time at the start of every seam and on the Seam Log (Appendix F). The technician should also periodically mark temperatures along the seam and at the end of the seam.

C. Approved processes for field seaming and repairing are fusion welding and extrusion welding. All welding equipment shall have accurate temperature monitoring devices installed and working to ensure proper measurement.

D. Fusion welding shall be used for seaming panels together and is not used for patching or detail work. The site manager shall verify that:

1. The equipment used is functioning properly.

2. All work is performed on clean surfaces and done in a professional manner. No seaming will be performed in adverse weather conditions.

E. Extrusion welding shall be used primarily for repairs, patching and special detail fabricating and may be used for seaming. The site manager shall verify that:

1. Equipment used is functioning properly.

2. Welding personnel are purging the extrusion welders of heat degraded extrudate prior to actual use.

3. All work is performed on clean surfaces and done in a professional manner. No seaming will be performed in adverse weather conditions.

F. For seam preparation, the welding technician shall verify that:

1. Prior to seaming, the seaming area is free of moisture, dust, dirt, sand or debris of any nature.

2. The seam is overlapped properly for fusion welding.

3. The seam is overlapped or extended beyond damaged areas at least 4.0 in when extrusion welding.

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4. The seam is properly heat tacked and abraded prior to extrusion welding.

5. Seams are welded with fewest number of unmatched wrinkles or "fishmouths".

G. No seaming will be performed in ambient air temperatures or adverse weather conditions that would jeopardize the integrity of the liner installation.

8.0 FIELD DESTRUCTIVE TESTING

A. Destructive seam tests shall be performed to evaluate bonded seam strength. The frequency of sample removal shall be one sample per 500 ft of seam, unless site specifications differ. Location of the destructive samples will be selected and marked by the QA technician or third party QA inspector. Field testing should take place as soon as possible after seam is completed.

B. Samples should be labeled in numerical order, i.e. DS-1, DS-2 etc....This should carry thru any layer and or multiple ponds, do not start numbering from 1 again. The size of samples and distribution should be approximately 12 in x 39 in (Size may vary depending on job requirements) and distributed as follows:

1. 12 in x 12 in piece given to QA technician for field testing.
2. 12 in x 12 in piece sent to the GSE's corporate headquarters for testing, if required.
3. 12 in x 12 in piece given to third party for independent testing or to archive.

NOTE: All samples will be labeled showing test number, seam number, machine number, job number, date welded and welding tech number.

C. The sample given to the QA technician in the field shall have ten coupons cut and be tested with a tensiometer adjusted to a pull rate as shown below. The strength of four out of five specimens should meet or exceed the values below, and the fifth specimen must meet or exceed 80% of the value below.

1. Seam must exhibit film tear bond (FTB). Welds should have ≤ 25% incursion into the weld.
2. Peel and shear values shall meet or exceed the values as listed in Appendix D, Table 1 for HDPE smooth or textured sheet (@ 2 in/min).
3. Peel and shear values shall meet or exceed the values as listed in Appendix D, Table 2 for LLDPE smooth or textured sheet (@ 20 in/min).

D. All weld destructive test data will be logged on the Destructive Test Log (Appendix G).

E. When logging fusion welded peel values on the Destructive Test Log, indicate the values for the outside track first, followed by the inside track.

F. Test results will be noted in the Destructive Test Log as Pass (P) or Fail (F).

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G. If a test fails, additional samples will be cut, approximately 10 ft on each side of the failed test, and retested. These will be labeled A (After) & B (Before). This procedure will repeat itself until a sample passes. Then the area of failed seam between the two tests that pass will be capped or reconstructed.

9.0 NON-DESTRUCTIVE TESTING

A. All seams shall be non-destructively tested over their full length using an air pressure or vacuum test. The purpose of this test is to check the continuity of the seam.

B. For air pressure testing, the following procedures are applicable to those seams welded with a double seam fusion welder.

1. The equipment used shall consist of an air tank or pump capable of producing a minimum 35 psi and a sharp needle with a pressure gauge attached to insert into the air chamber.

2. Seal both ends of the seam by heating and squeezing them together. Insert the needle with the gauge into the air channel. Pressurize the air channel to 30 psi. Note time test starts and wait a minimum of 5 minutes to check. If pressure after five minutes has dropped less than 2 psi then the test is successful (Thickness of material may cause variance).

3. Cut opposite seam end and listen for pressure release to verify full seam has been tested.

4. If the test fails, follow these procedures.
   a. While channel is under pressure walk the length of the seam listening for a leak.

   b. While channel is under pressure apply a soapy solution to the seam edge and look for bubbles formed by air escaping.

   c. Re-test the seam in smaller increments until the leak is found.

5. Once the leak is found using one of the proceedures above, cut out the area and retest the portions of the seams between the leak areas per 4a to 4b above. Continue this procedure until all sections of the seam pass the pressure test.

6. Repair the leak with a patch and vacuum test.

C. For vacuum testing, the following procedures are applicable to those seams welded with an extrusion welder.

1. The equipment used shall consist of a vacuum pumping device, a vacuum box and a foaming agent in solution.

2. Wet a section with the foaming agent, place vacuum box over wetted area. Evacuate air from the vacuum box to a pressure suitable to affect a seal between the box and geomembrane. Observe the seam through the viewing window for the presence of soap bubbles emitting from the seam.

3. If no bubbles are observed, move box to the next area for testing. If bubbles are observed, mark the area of the leak for repair per section 11.0 and re-test per section 9.0.

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Note: If vacuum testing fusion welded seams, the overlap flap must be cut off to perform the tests

4. All non-destructive tests will be noted in the Non-Destructive Logs (Appendixes H-I).

D. For spark testing GSE Conductive geomembranes, ASTM D 7240 will be the procedure, unless otherwise instructed by the engineer client.

10.0 DEFECTS & REPAIRS

A. All seams and non-seam areas of the geomembrane lining system shall be examined for defects.

B. Identification of the defect should be made using the following procedures:

1. For any defect in the seam or sheet that is an actual breach (hole) in the liner, installation personnel shall circle the defect and mark with the letter P along side the circle. The letter P indicates a patch is required.

2. For any defect that is not an actual hole, installation personnel shall circle the defect indicating that the repair method may be only an extruded bead and that a patch is not required.

3. Each suspect area that has been identified as repair shall be repaired in accordance with section 11.0 and in the non-destructively testing per section 9.0. After all work is completed, the site manager will conduct a final walk-through to confirm all repairs have been completed and debris removed. Only after this final evaluation by the site manager, the owner, and the agent shall any material be placed over the installed liner.

11.0 REPAIR PROCEDURES

A. Any portion of the geomembrane lining system exhibiting a defect that has been marked for repair may be repaired with any one or combination of the following procedures:

1. Patching - used to repair holes, tears, undispersed raw materials in the sheet.

2. Grind and Reweld - used to repair small sections of extrusion welded seams.

3. Spot Welding - Used to repair small minor, localized flaws.

4. Flap Welding - Used to extrusion weld the flap of a fusion weld in lieu of a full cap.

5. Capping - Used to repair failed seams.

B. The following conditions shall apply to the above methods:

1. Surfaces of the geomembrane which are to be repaired shall be prepared according to this section.

2. All surfaces must be clean and dry at the time of the repair.

3. All seaming equipment used in repairing procedures shall be qualified.

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4. All patches and caps shall extend at least 4 in beyond the edge of the defect, and all patches must have rounded corners.

5. All cut out holes in liner must have rounded corners of 3.0 in minimum radius.

C. Patches should be labeled in numerical order, i.e. RP-1, RP-2, etc... This should carry through any layer and/or multiple ponds, and do not start with the number 1 again.

12.0 AS-BUILT DRAWINGS

The installer shall provide the following:

A. As-built drawings will be provided at the completion of the project.

B. As-built drawings will include geomembrane panels and panel numbers with the last four digits of the roll number.

C. Panel numbers and the full roll numbers will correspond with the Panel Placement Log(Appendix C).

D. All destructive testing and repair locations will be placed on the as-built drawings.

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Appendix A

Inventory Check List

Project: ______________________ Site Mgr.: ______________________ Date: ______________________

Project #: ______________________ QA Tech: ______________________ Page: ______ of ______

Material	Roll #	Used	Material	Roll #	Used	Material	Roll #	Used	Material	Roll #	Used

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Appendix B

Subgrade Surface Acceptance

Date: _____

Project: _____ **Site Manager:** _____

Project #: _____

Location: _____ **Partial:** _____ **Final:** _____

This document only applies to the acceptability of surface conditions for installation of geosynthetic products. GSE does not accept responsibility for compaction, elevation or moisture content, nor for the surface maintenance during deployment. Structural integrity of the subgrade and maintenance of these conditions are the responsibility of the owner or earthwork contrator.

_____

_____

_____

_____

_____

For GSE Lining Technology, LLC:

_____

_____

For Owner / Contractor:

_____

_____

Acceptance Number: _____ Area Accepted: _____ s.f. Total Area Accepted to date: _____ s.f.

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Appendix C

Panel Placement Log

Project Name: _____

Location: _____ Site Supervisor: _____

Job Number: _____ Type of Material: _____

Q.A. Tech.: _____ Sheet Thickness: _____

Panel Number	Roll Number	Deployment Date	Width (Feet)	Length (Feet)	Square Feet	Square Feet (Cumulative)	A/T 1	A/T 2

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Appendix D

Table 1. HDPE Seam Strength Properties

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	81	65	52
60	121	98	78
80	162	130	104
100	203	162	130

Table 2. LLDPE Seam Strength Properties

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	60	50	48
60	90	75	72
80	120	100	96
100	150	125	120

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Appendix E

Trial Weld Log

Project Name: _____
Location: _____
Job Number: _____
Q.A. Tech.: _____

Site Supervisor: _____
Type of Material: _____
Sheet Thickness: _____

Fusion (ppi)	
Min. Peel	_____
Min. Shear	_____

Extrusion (ppi)	
Min. Peel	_____
Min. Shear	_____

Trial No.	Date of Trial	Time of Trial	Technicians ID Number	Ambient Temp.	WELDER TYPE	Wedge Mass	Speed Preheat	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Pass Fail

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Appendix F

Seam Log

Project Name: _____

Location: _____ Site Supervisor: _____

Job Number: _____ Type of Material: _____

Q.A. Tech.: _____ Sheet Thickness: _____

Seam Number	Time of Weld	Date of Weld	Type of Weld	Length of Seam	Machine Number	Technician ID Number

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Appendix G

Destructive Test Log

Project Name: _____
Location: _____
Job Number: _____
Q.A. Tech.: _____

Site Supervisor: _____
Type of Material: _____
Sheet Thickness: _____

Fusion (ppi)		Extrusion (ppi)	
Min. Peel	____	Min. Peel	____
Min. Shear	____	Min. Shear	____

Sample Number	Date Welded	Seam Number	Technician ID Number	Machine Type & No.	Location	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Pass/ Fail

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Appendix H

Repair Log - Vacuum Test

Project Name: _____

Location: _____ Site Supervisor: _____

Job Number: _____ Type of Material: _____

Q.A. Tech.: _____ Sheet Thickness: _____

Repair Number	Weld Date	Machine Number	Tech ID	Location	Test Date	Tech ID	Pass/Fail

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Appendix I

Non-Destructive Log - Air Test

Project Name: _____

Location: _____ Site Supervisor: _____

Job Number: _____ Type of Material: _____

Q.A. Tech.: _____ Sheet Thickness: _____

Seam Number	Test Date	Technician ID Number	Air Pressure Test		Test Result (P or F)	Location
			psi start	psi finish		

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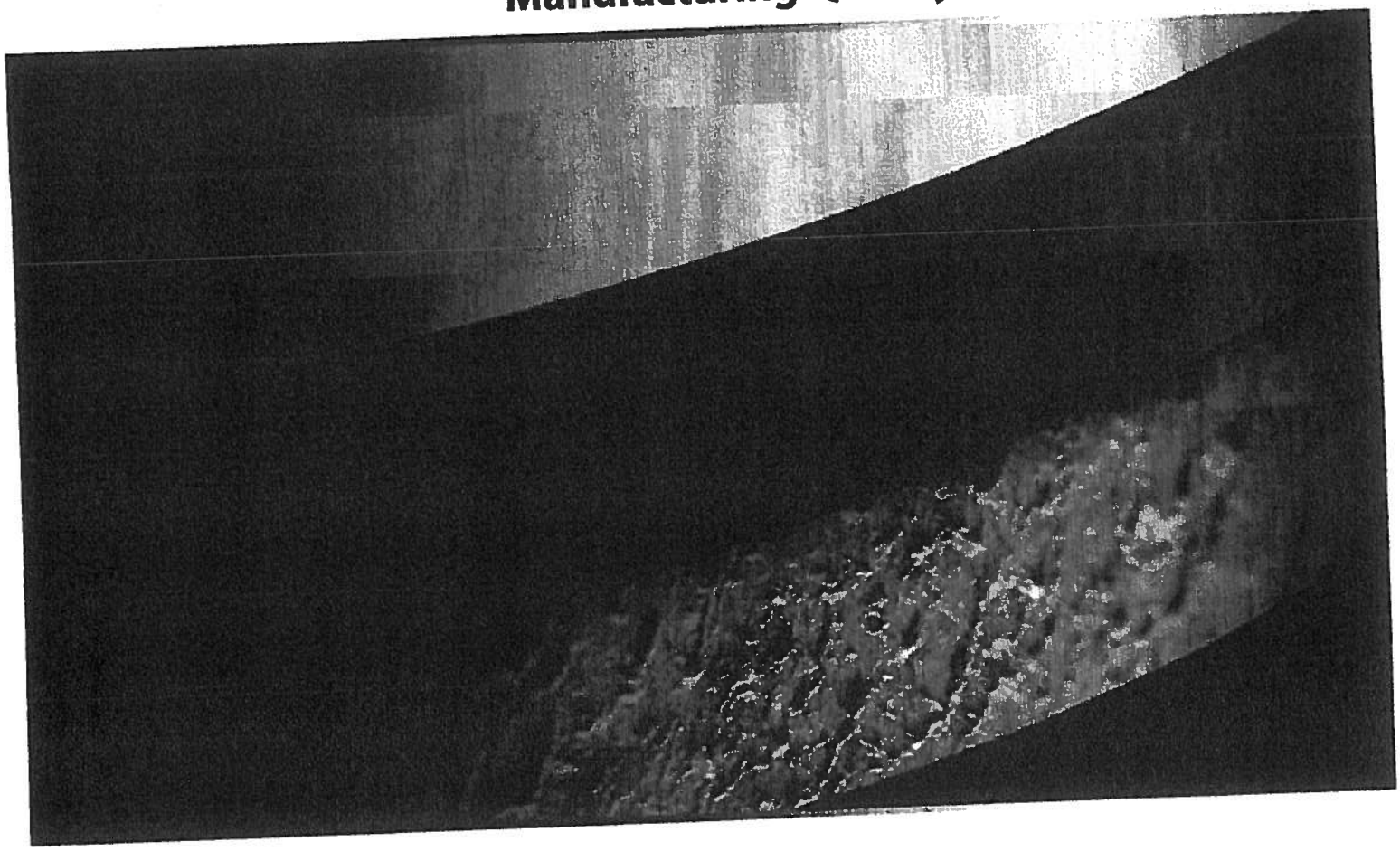
Manufacturing Quality Assurance Manual



Geomembrane Products

GSE

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1.0 INTRODUCTION

This manual provides an overview of the GSE Manufacturing Quality Assurance Program for geomembrane products. It is intended for use by GSE's customers to enhance their understanding of the quality system under which GSE geomembrane products are manufactured.

2.0 COMMITMENT TO QUALITY

GSE is committed to meeting or exceeding customer's requirements and industry standards. This commitment to quality is established through a documented quality management system, continuous employee training, investment in technology and emphasis on process control. GSE has allocated resources to ensure that this commitment to quality translates into the best products and services for its customers.

3.0 MANUFACTURING QUALITY ASSURANCE

GSE has an on-site quality assurance laboratory at each manufacturing facility worldwide. Each facility has a fully equipped, well staffed, dedicated laboratory with strict guidelines to maintain a high level of quality and up-to-the-minute results on GSE's finished products.

GSE has a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. Also raw materials and process parameters are controlled to provide products complying with GSE's minimum characteristics and regulatory standards.

4.0 MANUFACTURING QUALITY ASSURANCE ORGANIZATION

GSE quality assurance department assures that only products meeting GSE and/or the customer's requirements are released for shipment. The quality assurance personnel are directly responsible for monitoring, testing, and providing feedback to the manufacturing department ensuring the production of the specified product quality. Each member of the quality assurance team must participate in detailed training that includes factory exposure.

The GSE quality assurance team consists of the manufacturing quality assurance laboratories, engineering staff and manufacturing personnel. The combination of expertise and experience from these groups provide GSE with the proper tools to maintain the highest level of product quality and customer service in the industry.

5.0 STAFF & SCHEDULING

The quality assurance laboratories are staffed during any manufacturing run. A continuous communication link is maintained between the laboratory and manufacturing personnel, maximizing production efficiency and product quality.

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6.0 PRODUCT IDENTIFICATION & DOCUMENTATION

A. *Roll Numbering*
Each roll of geomembrane is assigned a unique roll number. The quality assurance laboratory maintains records documenting the raw materials and resulting product quality information.

B. *Approval Procedure*
Results for each tested roll of product are checked against GSE and/or customer's specifications for compliance. The quality assurance laboratory approves those materials that meet both of these requirements for shipment.

C. *Non-Conformance*
Material that does not meet GSE's minimum standards is given a roll number, but is rejected and separated from the approved material. The rejected material is identified as non-conformaning and will not be used. Material that meets GSE's minimum standards, but does not meet a stricter customer's specifications will not be allocated to that customer, but will be placed into inventory as a GSE's standard material.

D. *Documentation*
Quality assurance certificates are generated and supplied for each roll of geomembrane product to include all relevant quality assurance information about the material.

7.0 RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy as outlined below.

MATERIAL	ITEM	YEAR
Raw Materials	Resin Supplier Test Reports and Certifications GSE Resin Test Reports Resin Sample Retain (Archive)	≥ 2 ≥ 2 ≥ 2
Geomembranes	Raw Test Data (in computer database) Quality Control Certificates Sample Retain (approximately one square foot)	≥ 5 ≥ 5 ≥ 5

8.0 TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures listed in Appendixes A-H in Houston, Texas. The quality assurance laboratory is accredited by the GAI-LAP Program. The appropriate certificates are maintained for review upon request by authorized parties.

A. *Routine Testing*
GSE has developed a strict and thorough quality assurance program, which exceeds all industry's standards and/or customer's specifications including GRI GM13, "Test Properties, Testing Frequency

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and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes and GRI GM17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes. The testing program covers raw materials as shown in Appendix A and the finished goods as shown in Appendixes B-H and is adhered to by all GSE's quality assurance laboratories. The laboratory equipment used by GSE represents the most modern equipment available and meets or exceeds the requirements of all the test standards used.

B. *Other Testing Capabilities*
In addition to routine testing, GSE laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE's laboratories are fully equipped and able to perform the most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

9.0 MATERIAL QUALITY ASSURANCE

GSE has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer's specifications.

A. *Raw Material*
GSE uses two types of raw materials in the manufacture of geomembrane products: natural resin and masterbatch . Natural resin is the base material that is used to make a geomembrane. It contains stabilizers to prevent degradation from occurring during and after extrusion. Masterbatch is the term referring to the concentrated carbon black material blended with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geomembrane product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization.

When natural resin is received, samples are taken and subjected to the tests outlined in Appendix A. All test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE's specifications. The material is not accepted unless all standard test requirements are met and the GSE's test values meet the requirements set forth in the raw material specifications.

Copies of the supplier's certificate of analysis (COA) for each lot of resin utilized in the production of the materials supplied to a specific project are supplied as standard documentation. In addition, the GSE's test results for each lot of resin are provided in a separate report upon request. Virgin resin is normally received in rail car lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb, 23,000 kg).

B. *Geomembrane Products*

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GSE has implemented a strict and thorough quality assurance program for all geomembrane products. The geomembrane product line can be broken into two primary categories: smooth and textured products. The tables contain GSE's minimum properties and test frequencies for all GSE geomembrane products, such as GSE Green (green surface geomembrane), GSE White (light-reflective geomembrane) and GSE Conductive (field spark-testable geomembrane) as shown in Appendixes B-H.

1. On-Line Manufacturing Quality Assurance
   The quality assurance program for finished product begins during the manufacturing process. Each manufacturing line is equipped with state-of-the-art monitoring devices that provide feedback on the physical quality of the materials being produced. Each geomembrane production line is equipped with both a thickness gauge and spark-testing device.

   a. Thickness Measurement
      As geomembrane is being produced, thickness readings are taken continuously over the length and width of the roll. These data are used to establish the minimum, maximum and average thickness values for each roll and are verified by thickness testing upon sampling of the finished goods.

   b. Spark Testing
      An electrical spark detector is in place on each manufacturing sheet line. This apparatus provides immediate notification of holes in the finished product. If a hole is detected, an alarm is triggered and the hole is identified. Rolls containing holes are rejected from standard product inventory.

2. Smooth Geomembrane Materials
   Smooth geomembrane products available include high density and linear low density polyethylene materials with 2-3% carbon black. Specialty materials include GSE White, GSE Conductive, and GSE Green geomembranes.

   a. *Sampling*
      Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for quality assurance testing. Test specimens are taken from five positions across the width of the roll. A retain or archive sample approximately 12 in x 12 in (30 cm x 30 cm) is taken one of the five positions on an alternating basis from the laboratory sample. The retain is labeled and kept for future reference.

   b. *Evaluation of Results*
      All data are entered into a computer database for calculation and comparison to GSE and/or customer's specifications. If materials do not meet GSE's minimum requirements and/or the customer's specifications, the manufacturing personnel will appropriately make the adjustments. Only products meeting GSE's minimums and/or customer's specifications will be approved for shipment.

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c. *Reporting*
Every roll of material has a quality assurance roll certificate or Roll Test Data Report (RTDR). This report identifies the standards on which the GSE's approval is based along with the actual test results demonstrated by the material.

3. Co-extruded Textured Geomembranes
Textured geomembrane is produced utilizing a round die with co-extrusion technology. The texture is produced in a process in which one or both of the outer layers of a three-layer extrusion are blended with nitrogen gas. Nitrogen bubbles form in the molten resin and escape upon exiting the die, creating a rough, textured surface. GSE standard, GSE White, GSE Green, and GSE Conductive geomembranes are available with co-extruded texturing.

a. *Sampling*
Geomembrane rolls are sampled for QA testing according to the frequencies in Appendixes B-H. An approximate one-foot by roll width sample is cut for quality assurance testing. Specimens for testing are taken from five positions across the width of the roll. Specimens for testing the machine and transverse direction tensile are cut from each of the five positions. A retain or archive sample approximately 12 in x 12 in (30 cm x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference. Evaluation of results and reporting practices are the same as for smooth geomembranes.

C. *Third Party Conformance Sampling*
Some specifications require independent quality assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on-site or after production, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.

GSE encourages customers to audit GSE manufacturing and other manufacturing quality assurance facilities to collect samples and conduct independent conformance testing prior to shipment of materials.

D. *Product Shipping*
It is GSE's policy to ship only products that have been tested and approved. All shipments are packaged according to industry's standard practices and/or customer's specifications. Only approved handling methods are used to move rolls into and out of shipping containers, please see the GSE Installation Quality Assurance Manual for more details.

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Appendix A: Minimum Testing Frequencies and Properties for GSE Raw Materials

TABLE 1. MINIMUM TESTING FREQUENCIES

Property	Test Method[1]	Natural Resin
Density	ASTM D 1505	once per rail car compartment
Melt Flow Index	ASTM D 1238 (190/2.16)	once per rail car compartment
OIT	ASTM D 3895 (1 ATM at 200° C)	once per resin lot[2]
Carbon Black Content	ASTM D 1603, modified	N/A
Carbon Black Dispersion	ASTM D 5996	NA

NOTES:
[1]GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.
[2]OIT for LLDPE/VFPE resin is performed on a representative finished product for each lot of resin rather than on the natural (without carbon black) resin.

TABLE 2. MINIMUM PROPERTIES FOR GSE RAW MATERIALS

Property	Test Method[1]	HDPE	LLDPE/VFPE
Density [g/cm³]	ASTM D 1505	0.932	0.915
Melt Flow Index [g/10 min]	ASTM D 1238 (190/2.16)	≤ 1.0	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 ATM at 200° C)	100	100[2]

NOTES:
[1]GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.
[2]OIT for LLDPE/VFPE resin is performed on a representative finished product for each lot of resin rather than on the natural (without carbon black) resin.

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Appendix B: GSE HD Smooth Data Sheet

These product specifications meet or exceed GRI GM13.

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm) Lowest individual reading (-10%)	ASTM D 5199	every roll	30 (0.75) 27 (0.69)	40 (1.00) 36 (0.91)	60 (1.50) 54 (1.40)	80 (2.00) 72 (1.80)	100 (2.50) 90 (2.30)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		120 (21)	152 (26)	243 (42)	327 (57)	410 (71)
Strength at Yield, lb/in-width (N/mm)			66 (11)	84 (14)	132 (23)	177 (30)	212 (37)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (124)	42 (186)	58 (257)	73 (324)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	85 (378)	125 (556)	160 (711)	195 (867)
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note(1)	Note(1)	Note(1)	Note(1)	Note(1)
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	1,000	1,000	1,000	1,000	1,000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length(2), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width(2), ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:
- (1)Dispersion only applies to near spherical agglomerates 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- (2)Roll lengths and widths have a tolerance of ± 1%.
- GSE HD is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomemhranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified.

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