4.0 EFFLUENT CONTROL SYSTEMS

During the Project, gaseous/airborne, liquid, and solid effluents will be produced from the processes associated with ISR operations. All the effluents are typical for ISR projects currently operating in Wyoming; and existing technologies are amenable to all aspects of effluent control in the Permit Area. Additional details about the types of effluents and storage, treatment, reuse/recycling, and disposal practices and their potential impacts are provided below.

Effluents will be reduced by minimizing disturbance and reusing/recycling materials whenever possible. On-site waste handling facilities will have proper storage to segregate the materials and signage to indicate the types of materials present. These areas will be routinely checked to ensure proper waste segregation and storage. All materials delivered to or transported from the facility, including wastes, will be packaged in accordance with US DOT requirements. Employees will receive training, guidance, and personal protective equipment (PPE) to safely handle, store, decontaminate, and dispose of waste materials. Employees will also be trained to recognize potential hazards and to perform assigned duties in a safe and healthy manner to help reduce the possibility of accidental release. Standard Operating Procedures (SOPs) will be accessible for guidance on routine activities, and for unusual circumstances, an approved work plan and/or approved Radiation Work Permit (RWP) will provide guidance for non-routine work or maintenance activities. Spill Prevention and Response Plans will also be in place to help reduce the possibility of accidental release and provide for appropriate action in the event of a release.

4.1 Gaseous Emissions and Airborne Particulates

Non-radioactive and radioactive airborne effluents are anticipated during the Project. Non-radioactive airborne effluents will be limited to gaseous emissions and fugitive dust. The radioactive airborne effluent will be radon gas. The types of effluents and the control systems that will be in place for them are summarized below.

4.1.1 Non-Radioactive Emissions and Particulates

Gaseous emissions will result from the operation of internal-combustion engines. Exhaust from diesel drilling rigs and other diesel or gasoline-fueled vehicles will produce small amounts of CO, SO_2, and other internal-combustion engine emissions. Regular maintenance, SOPs, and pollution prevention equipment will be used to reduce gaseous emissions. Bussing of employees or credit for employee car-pooling will be considered to help reduce fuel consumption and emissions.

Most of the airborne particulates will be dust from traffic on unpaved roads and wind erosion of disturbed areas, such as during installation of wells at a mine unit. Restricted vehicular access and speed limits will be used to minimize dust from roads; and additional dust control measures may include water spraying, application of gravel, or application of organic/chemical dust suppressants. Disturbance will be minimized to the extent possible; and disturbed areas will be revegetated during the first available seeding window.

Airborne particulates may also include minor amounts of salt and soda ash releases during deliveries to the Plant, and drilling mud or cement dust during the installation of wells at the mine units. Construction activities may also generate airborne particulates. Examples of this might be welding fumes or dust from grinding on steel. Standardized delivery procedures that minimize material loss (and address health and safety concerns) and efficient construction practices will be used to minimize generation of such particulates.

An analysis of soda ash emissions shows that approximately 13.5 pounds of particulate will be released per year. The analysis assumes that 5.2 pounds of particulate is created per ton used, and 521.1 tons of soda ash will be used each year. Although 1.35 tons of particulate is created each year, a standard passive bag house filter will capture 99.5% of the material (using emission factors from EPA's AP-42, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources (EPA, 1995), resulting in a total emission of 13.5 pounds. A similar analysis of salt emissions, using a passive bag house filter, indicates that approximately 17.5 pounds of salt will be emitted per year.

Carbon dioxide and oxygen will be used as part of the extraction and concentration of uranium during mining; and hydrogen sulfide may be used during groundwater restoration after mining. However, use of these gases will be controlled to prevent waste and potential adverse safety conditions. Similarly, any fumes from the limited use of liquid chemicals, such as hydrochloric or sulfuric acid, will be controlled (e.g., laboratory hoods). Pressure venting at the mine units and supporting facilities will produce some non-radioactive gaseous emissions, such as carbon dioxide, oxygen, and water vapor, but the primary effluent of concern from pressure venting is radon gas, as discussed in more detail below.

4.1.2 Radioactive Emissions

Radioactive airborne effluents will be minimal, as compared to other ISR operations in Wyoming, in part because yellowcake drying and packaging will not occur within the Permit Area and because the Storage Ponds will be kept wet.

4.1.2.1 Particulates

Accident scenarios resulting in the exposure of a member of the public to airborne particulate in concentrations above dose limits established in 10 CFR 20.1301 are highly improbable given the remoteness of the facility and the engineering and administrative controls that will be employed. This conclusion is supported by Section 4.2 of NUREG/CR-6733, which discusses the potential sources of effluent resulting from accidents at an in situ facility. The NUREG considers several accident scenarios, of which the failure of a thickener tank (Section 4.2.1 in the NUREG) would be the most representative of a potentially large source of particulates from an accident at the Lost Creek Project, such as failure of a yellowcake slurry tank, as outlined below

Comparison of NUREG and Lost Creek Scenarios

The Lost Creek Plant will not have a thickener tank but will have tanks containing bulk quantities of yellowcake slurry. The authors of the NUREG, using extremely conservative assumptions, found that the only way the dose to a member of the public could occur from a thickener tank failure is if at least 20 percent of the thickener tank contents escaped the facility and a member of the public was less than one hundred meters from the accident. The nearest boundary to the Lost Creek Plant will be 333 meters away from the Plant. The scenario also assumes that there will be no timely accident response to recover the spill and the slurry will be allowed to dry. Given that the slurry storage tanks will be positioned a considerable distance from exterior walls and within a bermed area, it is highly unlikely that a ruptured yellowcake slurry tank could reach the outdoor environment. Further, LC ISR, LLC will have procedures for addressing such events and will train employees to follow the procedures in a timely manner. The containment volume within the Lost Creek Plant is outlined below, and the solubility of the Lost Creek product, as compared to the NUREG accident scenario, is also discussed below.

Containment Volume

Two slurry storage tanks are planned (**Plate 3.1-1**). The total containment volume of the bermed area will be enough to hold the contents of both slurry vessels if they were both ruptured. The following numbers are approximate because they are rounded to work in whole numbers:

- Volume of one yellowcake slurry vessel ≈ 1,722 ft^3
- Volume of containment:
  - Area of precipitation/yellowcake slurry room: 39 ft x 178.5 ft ≈ 6,961 ft^2
  - Area taken up by tanks/filter presses/pumps/ramps ≈ 700 ft^2
  - Total useable area: 6,961 ft^2 – 700 ft^2 = 6,261 ft^2
  - Volume of sloping foundation: 0.5 x 6,261 ft^2 x 0.396 ft ≈ 1,240 ft^3
  - Minimum height of berm = 0.5 ft
  - Volume of bermed area: 0.5 ft x 6,261 ft^2 ≈ 3,130 ft^3
  - Volume of sumps (2 at 18 ft^3 each) = 36 ft^3
  - Total containment volume: 1,240 ft^3 + 3,130 ft^3 + 36 ft^3 = 4,406 ft^3

Solubility Assumptions

The NUREG accident scenario assumes insoluble uranium, the worst-case assumption. If the material involved in the accident were more soluble, the dose to a worker on-site would be reduced by the ratio of the more soluble annual average DAC to the insoluble DAC. The dose to a member of the public would be reduced by the ratio of the annual average effluent release limit for the more soluble uranium to the effluent limit for insoluble uranium. This is quantified below.

The products of interest are uranyl peroxide (UO_4), uranyl trioxide (UO_3) and/or their hydrates (not "U_3O_8") as a direct result of the elution and precipitation chemistry to be used. These products are historically considered much more soluble than U_3O_8. A detailed discussion of the relative solubility of these and related industrial uranium products is provided in **Sections 5.7.4** and **5.7.5** of this report.

Uranium exists in various oxide compounds depending upon the Eh and pH of the processing system as shown in the Pourbaix diagram (**Figure 4.1-1**). Additional assumptions stated in the thickener failure and spill scenario of NUREG/CR-6733 also would tend to "maximize" dose to both workers and the public relative to more realistic and credible emergency response circumstances at the Lost Creek Permit Area. This comparison is summarized in **Table 4.1-1**.

NUREG/CR-6733 Figure 4.2, reproduced as **Figure 4.1-2** in this report, indicates all doses to members of the public are well below any applicable standards, and would be further reduced to about 1 mrem per year if just solubility alone were considered and less if other factors presented in **Table 4.1-1** were taken into account.

With regard to potential on-site (occupational) doses, the analysis in NUREG/CR-6733 for an accident involving thickener failure shows a potential dose at the center of the spill, to someone standing in the spill for four hours after the spill had dried, could exceed 5 rem. The assumption is that the spill consists of insoluble Class Y U_3O_8. Reducing the dose estimate based on solubility considerations alone (ratio of DACs – see **Table 4.1-1**) results in a worker dose projection of about 500 mrem, not taking into account other credible emergency response mitigating actions as presented in **Table 4.1-1**. On page 4-22 of NUREG/CR-6733 it is stated that, "It is reasonable to assume that cleanup personnel would be outfitted with protective equipment including respirators." It is also likely that any spill would be cleaned up before it dried. The implication is that the dose is minimal while the spill is wet. Maintaining the spill "wet" during cleanup is an expected method of collection which will ensure dust control and minimize exposure potential. Air sampling during the cleanup process will provide a record of actual exposure.

Yellowcake Dryer

NUREG/CR-6733 also considers the risk of accidents involving a yellowcake dryer. Since LC ISR, LLC will not have a yellowcake dryer these scenarios are not applicable. Section 2.8.1 of NUREG/CR-6733 considers the yellowcake dryer and packaging system the normal source of airborne particulate at an in situ facility.

4.1.2.2 Radon

Radon will be the radioactive gaseous emission from the mining and ore processing, as it is present in the orebody and concentrated in the lixiviant solution. Radon will be released occasionally from the mine unit wells as gas is vented from the injection wells. Production wells will be continually vented to the surface; however, water levels will typically be low and radon venting will be minimal. All of the well releases will be outside of buildings and are directly vented to the atmosphere. Radon will also be released during ion exchange resin transfers and subsequent ore processing steps, as described in more detail below. Potential radon exposure will be reduced or eliminated with ventilation to the outside of the buildings using high-volume exhaust fans, PPE, and limited exposure durations, in accordance with SOPs, or in the case of an unanticipated release, an RWP.

The radon will be discharged into the atmosphere, where it will disperse rapidly. Occupational and public exposures to radon emitted from the mine units and from the ore processing were analyzed using the MILDOS computer model to ensure the discharged amount will be within regulatory dose limits (see **Section 7.2** Public and Occupational Health for results).

The work areas of concern for radon exposure are at the vents from: the bleed storage tanks, the resin transfer points, the fluid collection sumps, and the yellowcake slurry loading area, as well as low-lying areas and confined spaces. The bleed storage tanks will be used for temporary storage of the production bleed fluid. Because these tanks will be at atmospheric pressure (unlike other tanks in the ore processing circuits) and not always full, radon (as well as oxygen and carbon dioxide) present in the bleed fluid may be liberated into the headspaces of the tanks. Therefore, these tanks will be vented to the atmosphere outside the building via a stack. On non-pressurized tanks and sumps, the vent will be assisted by redundant exhaust fans to ensure continuous ventilation even in the failure of the primary exhaust fan. Discharge stacks will be located away from building ventilation intakes and will typically be several feet above roof level.

All redundant exhaust fans described in the above paragraphs will be of the same size and model as the primary exhaust fans. The redundant exhaust fans will be connected to the same power supply as the primary exhaust fans. The redundant fans will be in place to ensure ventilation when the primary fans go down for mechanical or maintenance reasons. In the event of a power loss, the emergency and critical processes will continue to run on the backup generator. Ventilation, including the primary and redundant exhaust fans, is considered a critical process and will be tied into the backup generator.

Resin transfer will occur when an ion exchange vessel is fully loaded with uranium and is transferred from the Ion Exchange Circuit to the Elution Circuit. The ion exchange and elution vessels are normally pressured columns. When ready for resin to be transferred, the pressure is relieved from the vessels via a manifold connected to a sealed knockout tank prior to leaving the building via a vent line. The knockout tank is used to ensure fluid particulate does not exit the building through the vent line. Because radon may be liberated during the transfer, ventilation will be provided at the resin transfer points and operated during the transfers. These will be in the form of hooded, redundant exhaust systems over each of the resin shakers on the shaker deck. Each of the exhaust fans will have a backup fan to ensure the removal of radon from the area. The design of the hoods and fans will take into account the capture velocity of radon at the furthest point of the shakers.

A sump will be used to collect any fluids released from the ion exchange vessels during resin processing, from tanks during maintenance procedures and from routine washdown of the area. To prevent radon accumulation, the sump will be covered and vented through stacks out of the Plant roof which have redundant exhaust fans to maintain a negative pressure on the sump. The yellowcake slurry will be transferred from storage tanks into trucks for transport to a drying and packaging facility. During this transfer, radon gas will potentially escape; so ventilation will be provided in the transfer area. The UIC Class I well pumphouses will also be vented.

In addition to the tank-specific ventilation described above, a general area ventilation system will be installed to keep radon levels As Low As Reasonably Achievable (ALARA) during routine operations and upset conditions. The general ventilation system will consist of fans distributed along exterior walls at floor level as shown in **Figure 4.1-3**. The fans will displace air in the plant by blowing it outside. The initial capacity of the general ventilation system will be sufficient to create six air changes per hour. Preliminary HVAC designs are included in **Attachment 4.1-1**, and show the location of all of the planned ventilation systems. The calculated air space is approximately 470,240 cubic feet. The fans, located at the center of the Plant on floor level, are sized to remove air from the building at a rate of 50,000 cfm (25,000 cfm each). This is enough to ensure six air changes per hour. For the tank specific ventilation, each area will typically be equipped with a utility set fan to remove the air. Each system will typically also have a redundant exhaust fan to allow for maintenance on the primary fan while maintaining ventilation. A summary of the preliminary fan specifications are in **Table 4.1-2**. All of the utility set fans will typically vent through a "knock-out" pot. The purpose of the "knock-out" pot is to ensure the fans are only venting air. The ducting from the tank and columns will go into a tank partially filled with fresh water. Any particulates or moisture will be trapped in the water in the "knock-out" pot, and the fans will just vent the air. The Radiation Safety Officer (RSO) will monitor air quality within the plant to determine if the installed general ventilation capacity is sufficient to maintain ALARA levels of radon during routine operations and to quickly expel the radon in an upset condition.

Due to the remoteness of the facility, the administrative and engineering controls to be implemented and the nature of ISR, the potential for a member of the public to be exposed to radon levels exceeding the limits outlined in 10 CFR 20.1301 is minimal. Radon is the only effluent which will be allowed to routinely leave the controlled site in a manner which may allow a dose to a member of the public. MILDOS modeling in **Attachment 7.3-1** of this report demonstrates that the possible dose at the nearest downwind Permit Area boundary from the Plant due to radon is 3 millirem (mrem) per year while the regulatory limit is 100 mrem/year. Operational monitoring for radon is described in **Section 5.7.3.2**.

NUREG/CR-6733 considers the risk involved with the spill of a large quantity of lixiviant and the resulting release of radon. The NUREG demonstrates that even if the spill event is uncorrected for eight hours the exposure to a member of the public at the boundary will be below regulatory limits. However, the dose to an employee may exceed regulatory limits if the spill is not handled properly. In order to ensure the dose limit is not exceeded, the engineering and administrative controls found in **Section 5** will be implemented; including the use of routine monitoring described in **Section 5.7.3.2** and the use of a Continuous Working Level (CWL) monitoring system. The CWL monitor will include an alarm system to alert employees of increasing radon levels. If the working level for radon exceeds 25 percent of the Derived Air Concentration (0.08 Working Level), workers will open the garage doors and investigate to determine the source of the elevated radon. The RSO or Health Physics Technician (HPT) will be notified of the elevated radon level.

It is LC ISR, LLC's goal to minimize radioactive effluent during normal operations and upset conditions. To achieve this goal, LC ISR, LLC will design and operate the facility with the ALARA philosophy in mind. The facility will be designed to comply with accepted in situ industry practices; electrical, fire, and building codes; and all other applicable local, state, and federal regulations. Plant employees will be trained in carefully developed emergency response procedures so that any incident resulting in the release of radioactive material can be mitigated in a safe and timely manner. LC ISR, LLC will rely on the inspections detailed in **Section 5.3.1** to identify and correct potential operations problems that may result in a release of radioactive materials. All employees will be qualified to perform their assigned tasks in accordance with **Section 5.4** as well as trained according to **Section 5.5**. Exposure to members of the public will be minimized through the implementation of security procedures found in **Section 5.6**. Routine and upset condition monitoring described in **Section 5.7** will be implemented to ensure exposures to employees and members of the public are ALARA and to identify any trends which may be an indication of an inoperable safety feature.

4.2 Liquid Wastes

The Project will generate several different types of liquid wastes, including three classified as 11(e)(2) byproduct materials by NRC. The different types of liquid wastes the Project will generate are:

- "native" groundwater generated during well development, sample collection, and pump testing;
- storm water runoff;
- waste petroleum products and chemicals;
- domestic sewage; and
- the three 11(e)(2) byproduct materials:
    - liquid process wastes, including laboratory chemicals,
    - "affected" groundwater generated during well development, and
    - groundwater generated during aquifer restoration.

Appropriate storage, treatment, and disposal methods for these wastes differ, as outlined below.

4.2.1 "Native" Groundwater Recovered during Well Development, Sample Collection, and Pump Testing

Groundwater is recovered during well installation, sample collection, and pump testing conducted prior to mining or from portions of the Permit Area not affected by mining. This "native" groundwater has not been exposed to any mining process or chemicals. During well development, sample collection, and pump testing, this water will be discharged to the surface under the provisions of a general Wyoming Pollutant Discharge Elimination System (WYPDES) permit, in a manner that mitigates erosion, or reused in the drilling process.

During lixiviant injection in a mine unit and prior to completion of mine unit restoration, liquid 11(e)(2) byproduct or source material that may be generated from activities such as well completion and development will be carefully collected in a manner that minimizes direct employee contact. For example, when completing or developing a well that contains NRC regulated material, the water will be directed to a lined pit or directly to a water tank to prevent soil contamination. The water will be collected and disposed of in the facility's licensed waste water system.

The RSO shall develop an SOP for these activities to ensure that the dose to employees is minimized by time, distance and shielding as appropriate. Potentially affected employees will be trained in the SOP. The RSO shall also, upon initiation of operations, perform an analysis to determine the potential dose from the source material based on actual radionuclide chemistry. The results of the analysis will be used to write the SOP in an ALARA manner. Since these solutions will be contained in pits, tanks and piping conveyances, the external radiologic consequence to employees and members of the public will be less than that generated by the solution spill scenario contemplated in Section 4.2.3 of NUREG/CR-6733 which is characterized as having "no significant external radiological consequences". As long as the solutions are contained, the only pathway for exposure would be external.

4.2.2 Storm Water Runoff

Procedural and engineering controls will be implemented such that storm water runoff from the area of the Plant will not pose a potential source of pollution. Per the requirements of the WYPDES, the applicable permits for runoff control during construction and operation of the Plant will be obtained from the Water Quality Division (WQD) of WDEQ.

4.2.3 Waste Petroleum Products and Chemicals

These wastes will be typical for ISR facilities, and will include items such as waste oil and out-of-date reagents, none of which will have been closely associated with the processing of 11(e)(2) byproduct materials. Any of these wastes that are non-hazardous will be stored in appropriate containers, prior to disposal by a contracted waste disposal operator, at an approved off-site waste disposal facility, such as the Carbon County Landfill.

Waste petroleum products will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of the Occupational Safety and Health Administration (OSHA) and EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes. LC ISR, LLC will generate about 40 to 80 gallons of waste petroleum products per year, and will be a Conditionally Exempt Small Quantity Generator of hazardous wastes, per EPA definition.

Waste chemicals not closely associated with the processing of 11(e)(2) byproduct material will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of OSHA and EPA. These wastes will be periodically collected by a commercial business for recycling or disposal in a licensed disposal facility. An estimated five to ten gallons of waste chemicals will be disposed of per year.

4.2.4 Domestic Liquid Waste

Domestic liquid wastes will be disposed of in an approved septic system that meets the requirements of WDEQ-WQD. A permit will be obtained for the septic system prior to construction of the system. The septic system will receive waste from restrooms, shower facilities, and miscellaneous sinks located within the office. In addition, chemical toilets may be temporarily placed in mine units and other drilling areas. An estimated 500 to 700 gallons of domestic liquid waste will be disposed of daily; and the septic system and chemical toilets will be maintained by a licensed contractor.

4.2.5 Liquid 11(e)(2) Byproduct Material

The three 11(e)(2) byproduct materials:

- liquid process wastes, including laboratory chemicals;
- "affected" groundwater generated during well development and sample collection; and
- groundwater generated during aquifer restoration,

will be treated and disposed of on-site through a system of Storage Ponds and UIC Class I wells, as described below. Procedures to prevent and remediate accidental releases will also be in place, as described below.

4.2.5.1 Liquid Process Wastes

The ore processing produces three wastes, a production bleed, and eluant bleed, and yellowcake wash water. In addition, the laboratory analyses for evaluating uranium content of the production fluid and similar operational parameters will generate waste. These wastes will be collected, treated and the waste discharged to the Storage Ponds and UIC Class I wells (**Section 4.2.5.4**). The expected chemical and radiological composition of the liquid waste stream to be disposed of in the deep wells is provided in **Table 4.2-1**.

4.2.5.2 "Affected" Groundwater Generated during Well Development and Sample Collection

It may be necessary to develop (or redevelop) wells and collect samples of groundwater that has been affected by the mining operation to the extent that surface discharge of the water is not appropriate. During well development and sample collection, this water will be collected and treated; and the waste will be discharged to the Storage Ponds and UIC Class I wells.

4.2.5.3 Groundwater Generated during Aquifer Restoration

During the various steps of aquifer restoration (**Section 6.2**), groundwater will be generated; and disposal of some or all of the water will be required. During sweep, groundwater will be pumped from the production zone, creating an area of drawdown. This will create an influx of water from outside the production zone that will "sweep" the affected mining zone. In most cases, the water produced during sweep will be processed for residual uranium content through the ion exchange circuit, and then disposed directly to the UIC Class I wells. In some cases, the groundwater pumped from the production zone may be treated by RO to reduce the waste volume; and the treated water (permeate) may be used in Plant processes or for makeup water in other restoration activities. To maintain the area of drawdown, the permeate will not be reinjected into the production zone, but will be transferred to other mine units for use as makeup water or injected into the UIC Class I wells. The concentrated byproduct material (brine) will also be injected into the UIC Class I wells.

During RO, groundwater will be pumped from the production zone. The pumped water will be treated by RO; and the permeate will be injected back into the production zone. To maintain an area of drawdown, an effective bleed will occur by adding additional permeate from other RO activities or by adding clean water to the permeate at a rate less than the produced rate. The brine from the RO treatment will be injected into the UIC Class I wells. Similarly, during other restoration steps, the amount of groundwater pumped from the aquifer will exceed the amount pumped back to the aquifer; and that excess water will be disposed of in the UIC Class I wells.

4.2.5.4 Disposal of Liquid 11(e)(2) Byproduct Materials

The liquid 11(e)(2) byproduct materials generated during the Project will be managed by deep well injection in conjunction with Storage Ponds.

Storage Ponds

Two 155-feet by 260-feet Storage Ponds will be constructed at the site in accordance with NRC and Wyoming State Engineer's Office (WSEO) standards and equipped with leak detection systems. The primary purpose of the ponds is to allow for shut down of the UIC Class I wells for maintenance (such as MITs) or repair while the Plant remains in operation. The total pond capacity will be designed to accommodate two weeks of Plant operation, which would generate 60 gpm of liquid at peak operating capacity.

A Professional Engineer with many years of experience designing ponds completed the design of the two storage ponds including the selection of polypropylene as the pond liner material. The chemical compatibility of polypropylene was checked against several published chemical compatibility charts including the Cole-Parmer charts found online at http://www.coleparmer.com/techinfo/ChemComp.asp. The water contained in the storage ponds will be mostly ground water with minor quantities of salts including sodium chloride, bicarbonate and sodium chloride. The compatibility charts show that polypropylene has excellent compatibility with sodium bicarbonate, sodium carbonate, sodium chloride, and brines saturated in sodium chloride. In rare instances permeate from the reverse osmosis system may be sent to the storage ponds. Permeate is similar in content to de-ionized or distilled water of which both have excellent compatibility with polypropylene. If an upset condition were to occur in the plant it would also be possible for the polypropylene to be exposed to dilute solutions of caustic, hydrogen peroxide, and hydrochloric acid. The compatibility chart shows that the polypropylene liner has excellent compatibility with 50% caustic, good compatibility with 50% hydrogen peroxide, and fair compatibility with 37% hydrochloric acid. A fair rating means that the materials are not suitable for continuous use. The concentrations reviewed reflect the maximum concentration of the chemicals that will be used at the plant. If any of these chemicals were spilled in the plant, the concentration would be diluted with wash down water, water in the waste water tank, and the water in the storage ponds. There are no credible scenarios that could result in undiluted hydrochloric acid remaining in contact with the pond liner for an extended period of time.

A permit from the State Engineer is required prior to construction of the ponds. Maps and plans will be submitted with the application including detailed cross sections of the embankment, liner and leak detection system. The proposed pond designs will comply with the WSEO Safety of Dams program.

The proposed ponds construction will require geotechnical borings to determine compaction and soil density specifications for the proposed ponds site. Upon completion of the geotechnical analysis, a final engineering design will be completed by a Wyoming Professional Engineer and submitted to the WSEO for construction approval. After receipt of approval, approximately 5,000 cubic yards of topsoil will be stripped and stockpiled followed by excavation and construction of the embankment. Road base will be deposited and compacted next as the pond base. The base will then be covered by an impermeable liner. A leak detection system consisting of 4-inch slotted pipe and sand will be installed next. The slotted pipe will be tied into a "dry" well (standpipe) at the perimeter of the ponds, which will be routinely monitored to determine if the liner is leaking. Another liner will be then placed over the leak detection layer and "keyed" in to the ground surrounding the embankments.

The maximum fluid depth is proposed to be four feet with three feet of freeboard. Two ponds will be constructed measuring 155 feet by 260 feet each. **Attachment 4.2-1** provides the specifications of the storage ponds. The purpose of two ponds is to allow for complete removal of fluid from one pond to the other in the event of a leaking liner.

In addition, four shallow monitor wells will be installed prior to operations (three of the four have already been installed and did not encounter groundwater above the first significant aquitard). These wells will be installed to the first shale below surface and checked prior to operation of the ponds to determine: a) if groundwater exists; and b) the pre-operational water quality of such groundwater. Once operations have begun, the wells will continue to be sampled as noted above on a quarterly basis. The analysis criteria will be specific conductance, chloride, alkalinity, sodium, and sulphate. If a change is noted in either groundwater content or quality, the ponds will be investigated for damage to the liner. If a leak or damage to the liner is found, use of the damaged pond will be discontinued until repairs have been completed. Any affected water in the monitored zone will be removed and/or treated as necessary.

To help maintain the integrity of the ponds by reducing liner exposure to sun, wind, and freezing temperatures, water will be kept in the ponds at all times by diverting a portion of the water that would normally go to the UIC Class I wells. The exception would be during pond maintenance or repair, at which times the liquid would be piped directly to the UIC Class I wells.

Routine pond inspections and monitoring will be conducted as specified in **Section 5.3.2** of this report. The inspection reports and monitoring results will be maintained on-site and summarized in the Annual Report submitted to NRC and WDEQ-LQD. Any maintenance issues identified during an inspection will be addressed in a timely manner to reduce the chance for damage to the pond integrity or liquid release to the environment.

UIC Class I Wells

Two to five UIC Class I wells are planned in the Permit Area as the primary disposal method for the liquid 11(e)(2) byproduct materials. LC ISR, LLC is preparing the UIC Class I permit application for submittal to WDEQ-WQD, which has primacy in Wyoming for the UIC program. In addition to the liquid 11(e)(2) byproduct materials, other compatible liquid wastes will be disposed of in the wells (**Section 4.2.3**). The wells will be monitored in accordance with the requirements of the UIC permit; and an evaluation of the well performance will be included in the Annual Report submitted to NRC and WDEQ.

The number of disposal wells is directly related to the injectivity associated with each. The following maximum disposal requirements are necessary:

Restoration RO:	640 gpm x 25% =	160 gpm
Restoration GWS:	160 gpm x 25% =	40 gpm
Total Stage 1 RO:		200 gpm
		+
Production Bleed:	6,000 gpm x 1% =	60 gpm
Total Before Stage 2 RO:		260 gpm
Final RO:	260 gpm x 50% =	130 gpm

A minimum of two disposal wells will be constructed regardless of injectivity to allow for routine testing and maintenance. The redundancy of the wells in conjunction with the storage capacity of the ponds at the Plant will allow for little or no effect on the Project if one of the wells' operating status is upset.

The disposal well injection system will typically be controlled by the Plant Operators. The transfer pump and the injection pump will be interlocked to insure that one cannot operate without the other. Pressure and flow rate will be measured and compared at each of the pumps. If there is a discrepancy outside allowable tolerances, the system will alarm the Operator and shut down. The transfer pump is planned to be located in the Plant building while the injection pump is planned for the wellhead building at the disposal well.

If all disposal capacity is lost (short or long term), all unnecessary operations will cease and reverse osmosis will be utilized where possible to minimize waste. All waste fluids will be stored in plant tanks (approximately 30,000 gallons) and the lined ponds will be utilized for storage (1.25 million gallons per pond). These systems will be utilized until repairs can be affected on the disposal wells.

Alternatives

There are no alternate plans for liquid effluent disposal at this time. Three potential alternatives not proposed are land application, evaporation ponds and NPDES discharge. The waste disposal well system adequately supports the liquid effluent needs of the Project and eliminates the needs for some type of surface discharge. Two to four deep disposal wells are planned for installation to support continued operations during maintenance and testing.

4.2.5.5 Prevention and Remediation of Accidental Releases

The significant criteria to reduce the potential for accidental releases are: appropriate engineering design, construction, and maintenance; development and implementation of SOPs, covering topics such as inspections, notification procedures, and response actions; and on-going employee training in those SOPs and general health and safety procedures.

Given the anticipated low concentration of radionuclides in injection and production fluids and the fact that spilled solutions are not likely to become airborne until they dry, it is unlikely that an employee will receive a significant radiation dose while responding to a spill. Section 4.2.3 of NUREG/CR-6733 presents a conservative calculation that supports this conclusion. However, to maintain ALARA, once operations commence and the radionuclide content of the mining solutions is known, the RSO shall perform an analysis to determine if a credible scenario exists that could result in a significant dose to an employee or to a member of the public. For purposes of this determination, significant shall mean any dose greater than 10% of applicable regulatory limits. A spill response SOP will be in place before the initiation of operations, but the RSO will use the results of the analysis to ensure the SOP is adequate to ensure ALARA spill response. The RSO shall review the SOP at least annually to ensure continued accuracy and relevance. If a spill scenario is not described in an SOP, then an RWP must be written, pursuant to **Section 5.2** of this report, before remediation can begin.

Inspections play an important role in preventing and discovering leaks. **Sections 5.3.1** and **5.7.6.5** of this report address the inspection practices and frequencies. With regard to instrumentation used to detect leaks, see also **Sections 3.2**, **4.2.5.5** and **5.7.1.4** of this report.

The facilities which will require specific attention are outlined below.

Storage Ponds

It is possible that a storage pond could fail, either in a catastrophic fashion or as a result of a slow leak. In addition, a pond could overflow due to excess inflow from the Plant or excessive precipitation.

The criteria for determining if a leak has been detected include both water level and water quality criteria. If there is an abrupt increase in the water level in one of the leak detection standpipes or if six or more inches of water are present in one of the standpipes, the water in that standpipe will be analyzed for specific conductance. If the specific conductance is more than half the specific conductance of the water in the pond, the water will be further sampled for chloride, alkalinity, sodium, and sulfate. In addition, the liner will be immediately inspected for damage and the appropriate agencies will be notified. Upon verification of a liner leak in one of the ponds, the water level in that pond will be lowered by transferring the contents to the other pond and/or to the UIC Class I wells.

With respect to pond overflow, SOPs will be such that neither pond is allowed to fill to a point where overflow is considered a realistic possibility. Since the primary disposal method will be the UIC Class I wells, the flow rates to the pond are expected to be minimal; and there will be sufficient time to reroute the flow to another pond, or to modify Plant operations to reduce flow for the critical period. If precipitation is excessive, the freeboard allowance of the ponds will be designed to contain significant quantities of precipitation before an overflow occurs. The freeboard allowance will also reduce the possibility of water blowing over the pond walls during high winds.

Pipelines, Fittings, Valves, and Tanks

The most common accidental release from ISR operations is from breaks, leaks, or separations in the piping that transfers mining fluids to and from the Plant and the mine units. Failures of fittings and valves at the wellheads, in the header houses, at tanks, and other junctions are also a common cause of accidental releases at ISR operations.

Pipelines will generally be buried at a depth of six feet below ground surface, minimizing the possibility of freezing in adverse weather and of being damaged by surface traffic. Pipelines will be a minimum of six feet below the lowest point of a road installation (typically the borrow ditch) to minimize affects of travel compaction on the piping. In general, piping to and from the Plant and the mine units and within the mine units will be constructed of HDPE with butt-welded joints or the equivalent.

All pipelines, associated fittings and valves, and any tanks that will be under pressure during operations will be pressure tested before use. Flow through the pipelines will be monitored and will be at a relatively low pressure. Pressurized tanks will also be monitored for performance within specified limits. Sensors wired to automatic alarms and pipeline shutoffs will be installed to detect significant changes in flow rates or pressures in the pipelines and tanks to help prevent significant releases.

Wells

Casing and coupling failures in wells, either at the surface or in the subsurface, may release production or injection fluid. Monitoring of well construction, pressures in the ISR system, and appropriate mine unit balancing, as well as routine MIT of injection wells, will help prevent casing and coupling failures. Down-hole casing repair (with follow-up MIT) is generally sufficient to correct the problem; but well abandonment and replacement and delineation drilling may be necessary to address more serious situations.

Buildings

The buildings of most concern with respect to accidental releases include the header houses, the Plant, and the pumphouse(s) for the UIC Class I wells. Header houses and the pumphouse(s) are not considered as potential sources of pollutants during normal operations, as there will be no liquids stored within them. However, in the event of a pipeline or pump failure in a header house or pumphouse, the impact of that failure will be reduced by sumps equipped with fluid detection sensors wired to automatic alarms and shutoffs. Similarly, the Plant will be constructed with concrete containment curbing and sumps to allow for containment and recovery of any releases within the Plant.

Spill Response and Remediation

In the event of a spill of mining or process solutions, LC ISR, LLC will recover as much of the fluid as possible using equipment designated for this purpose. SOPs will be established to provide ALARA methods for spill recovery. The RSO or HPT will be notified of the spill immediately so they can visit the site and perform an assessment of the radiologic risks. The assessment will include:

- A drawing of the affected area so the location can be identified at decommissioning;
- a determination of the amount of fluid spilled;
- a calculation or analysis to determine the concentration of radionuclides in the soil;
- a determination of the cause of the spill;
- a determination of safety precautions that need to be taken immediately, if any;
- a determination of the extent and timing of soil cleanup; and
- a determination as to whether or not reporting is required pursuant to 10 CFR 20.2202 and 20.2203 and 10 CFR 40.60. If reporting is necessary the RSO shall complete the report in the time frame designated in the applicable regulations.

The RSO or HPT may call upon the expertise of the area supervisor to assist with the assessment. The results of the assessment will be filed in a decommissioning file until the license is terminated.

At least once per year, the Manager of Environmental Health and Safety (EHS) and Regulatory Affairs will convene a Spill Committee to review the cause of recent spills. The Spill Committee will consist of at least three individuals with experience in operations. After reviewing the causes of recent spills, the Committee will send a report to mine management detailing reasonable recommendations on how to prevent and minimize future spills.

4.2.5.6 Activity Concentration Cleanup Criteria

Accident scenarios for ISR facilities are described in detail in NUREG/CR-6733 (NRC, 2001). Potential doses from such incidents are estimated based on the assumption that a spill would not be cleaned up immediately and would be allowed to dry (The term U_3O_8 has historically been used by both the industry and the NRC to refer to uranyl peroxide and various uranium oxides. Technically, U_3O_8 does not exist but the term is commonly used in marketing the end product. When LC ISR, LLC refers to U_3O_8, it is referring to uranyl peroxide in solution, slurry, or dried yellowcake. This usage of the term is consistent with the analysis performed in NUREG/CR-6733. A further review of other portions of NUREG/CR-6733 reveals that the terms uranyl peroxide and U_3O_8 are used interchangeably.). In such a case, the most significant potential route of exposure to workers and members of the public would be limited to inhalation of airborne radioactive material. However, with regard to residual contamination remaining after spill cleanup is completed, the doses to workers would include direct radiation dose as well as inhalation of particulates. The dose to a member of the public with unrestricted access to and use of the impacted area could include a variety of pathways.

LC ISR, LLC will conduct operations, to include spill cleanup, in agreement with the ALARA principle and the "member of the public" and worker dose requirements of 10 CFR 20 and the "member of the public" requirements of 40 CFR 190.10. However, since access to spill locations will be restricted during the years of operation, only those exposure pathways consistent with the site access restrictions and existing land use will be used to meet these regulatory requirements.

LC ISR, LLC's direct radiation surveys and correlations to measured soil Ra-226 (R^2=0.88; **Figure 2.9-7**) and soil Ra-226 correlations to measured soil uranium (R^2=0.73; **Figure 2.9-8**) provide the basis for uranium and radium soil background concentrations characterized over the Lost Creek Permit Area. However, should spills occur, LC ISR, LLC will collect additional soil samples outside the spill margins to further characterize the soil radionuclide concentrations so that when combined with the radionuclide analysis of the spill content, accurate cleanup levels can be established to meet the decommissioning "Radium Benchmark Dose" of 10 CFR 40, Appendix A, Criterion 6. This will assure there will be no appreciable radionuclide migration off the spill location, and final decommissioning will be facilitated.

The following discussion illustrates how LC ISR, LLC will use RESRAD analysis to establish soil cleanup criteria, and presents proposed initial cleanup criteria.

Activity Concentration Cleanup Criteria for a Spill at the Lost Creek Permit Area

NUREG/CR-6733 (NRC, 2001) describes spill scenarios involving solid or liquid materials, including thickener failure and spill, pregnant lixiviant spill, and loaded resin spill.

NUREG/CR-6733 assumes no initial cleanup in its risk assessments for the spill scenarios and assumes the spill would be allowed to dry. LC ISR, LLC is committed to taking all necessary precautions to ensure that such spills do not occur. However, in the unlikely event of a spill of solids or liquids containing radioactive material, appropriate actions will be taken initially to remove spilled material and clean up the impacted areas to levels such that residual radiation doses to workers from the spill following initial cleanup would be less than 100 mrem per year (LC ISR, LLC perceives this as an initial

ALARA target for workers) and doses to members of the public, no greater than 25 mrem per year. Spill-impacted areas will be cleaned up to reduce doses to ALARA below these levels. Further cleanup of impacted areas, if necessary to meet criteria for unrestricted use, would be included in the final decontamination and decommissioning of the facility. LC ISR, LLC will use RESRAD as appropriate, using analysis results from cleanup samples to verify that the above goals have been met.

The following analyses assume that a spill inside the restricted area would impact workers during operations, and that a spill outside the restricted area could impact members of the public with unrestricted access to, and use of, the impacted area. Since the intent of these analyses is to develop criteria for residual contamination after spill cleanup, it does not need to address dose from the spill itself or resulting cleanup operations to workers (whose dose will be controlled under the in place, approved radiation protection and ALARA programs) or members of the public (who cannot have unrestricted access during licensed operations or who would not have access to affected unrestricted areas during cleanup). The initial LC ISR, LLC cleanup criteria discussed in the following paragraphs are summarized in **Table 4.2-2**.

Thickener Failure and Spill

NUREG/CR-6733 postulates a spill of 73,500 gallons of slurry containing 24,200 kg of U_3O_8. If such an incident were to occur, the cleanup criteria would be dependent on the potential dose from natural uranium. According to NUREG/CR-6733, the sole substantial radiological hazard would be inhalation of airborne particulate matter. However, based on a RESRAD analysis, the primary contributor to dose from natural uranium would be external exposure (ground) presumably from beta and gamma radiation from the immediate decay products of U-238 (Th-234 and Pa-234m).

Any portion of the spill inside a building or containment would be cleaned up immediately and would not have the opportunity to dry out and become airborne. Therefore, doses to workers would be limited to the initial cleanup phase. The criterion for immediate cleanup within a building or containment would be based on the presence of visible residues, i.e., any visible loose spill material would be removed. Liquids that are absorbed into surface material such as concrete would not present a significant inhalation hazard as the uranium would not become airborne. A spill outside the building with the potential to contaminate soils would also be cleaned up immediately before the material could dry sufficiently to become an airborne dust hazard.

Spills within the restricted area will be cleaned up to levels that are ALARA. At a minimum, the impacted areas will be cleaned up to levels that would limit the residual, post cleanup dose to a worker to less than 100 mrem per year. Based on a RESRAD analysis, a U-nat concentration in soil equal to100 pCi/g would result in an annual dose of 2.5 mrem/year. Since the dose is proportional to the concentration of uranium in soil, a cleanup level of 4000 pCi/g would result in an annual dose to a worker spending all of his or her 2,000 hr working year in the spill area approximately equal to 100 mrem per year, 76% from direct external exposure, 14% from inhalation of particulate matter, and 10% from soil ingestion. The RESRAD default dust concentration (0.1 mg/m^3) was used in the analysis. However, an increase in the assumed dust concentration to 1 mg/m^3 (to allow for possible LC site wind and dust conditions) would decrease the estimated cleanup criterion to 1,800 pCi/g due to the increased dose from inhalation of airborne particulate matter. An appropriate cleanup standard for spills within the restricted area, based on protection of workers, including a reasonable safety factor, is 1,500 pCi/g U-nat. LC ISR, LLC proposes this as the initial cleanup criterion for a spill of this nature.

Based on a RESRAD analysis, the dose to a member of the public at 100 pCi/g U-nat would be approximately 8 mrem per year, approximately 60% from direct external exposure, 10% from inhalation of particulate matter, and 30% from ingestion of locally grown plants, meat, and milk, as well as ingestion of soil. The estimated U-nat concentration in soil resulting in a dose of 25 mrem per year would be approximately 300 pCi/g above soil background concentration. This analysis is very conservative because it includes food chain pathways even though it is unlikely that food would be raised in the impacted area. LC ISR, LLC proposes this as the initial cleanup criterion for a spill of this nature in an unrestricted area.

Pregnant Lixiviant and Loaded Resin Spills

In its risk analysis, NUREG/CR-6733 assumes the pregnant lixiviant and loaded resin contains Ra-226 at a concentration of 3.4E3 pCi/L and U-nat at a concentration of 1.7E5 pCi/L. The short-lived decay products of Rn-222 were assumed to be in equilibrium with the Ra-226. As with the thickener spill scenario, the impacted area would be cleaned up immediately. The criteria for cleanup were calculated assuming a maximum annual dose to a worker of 100 mrem per year and 25 mrem per year for a member of the public. The RESRAD analysis was performed assuming a nominal U-nat concentration of 100 pCi/g in soil and a Ra-226 concentration of 2 pCi/g in soil, the ratio of the nuclides specified in NUREG/CR-6733. The appropriate clean up criterion was determined by scaling the nominal concentration.

Based on the most conservative RESRAD analysis, assuming an air particulate concentration of 1 mg/m^3, (again allowing for possible LC site wind and dust conditions) the estimated annual dose to a worker at a U-nat concentration in soil of 100 pCi/g and a Ra-226 concentration of 2 pCi/g, was approximately 10 mrem/year. Therefore, the cleanup criterion for U-nat would be 1,000 pCi/g with 20 pCi/g Ra-226 above soil background levels. LC ISR, LLC proposes this as the initial cleanup criterion for a spill of this nature.

The RESRAD-estimated dose to a member of the public from residual contamination after a spill of pregnant lixiviant (loaded resin spills will only occur in restricted areas since LC ISR, LLC does not intend to ship loaded resin at this time. If, in the future, resin is shipped from or to the site, additional analysis will be performed), assuming a U-nat concentration of 100 pCi/g and a Ra-226 concentration of 2 pCi/g, was 20 mrem/year. Therefore, based on a dose limit of 25 mrem per year, the cleanup criterion for members of the public would be 120 pCi/g U-nat, 2.2 pCi/g Ra-226. LC ISR, LLC proposes this as the initial ALARA target cleanup criterion for a spill of this nature; however, following a spill of this nature, LC ISR, LLC will use RESRAD with appropriate current land use and actual spill concentrations of Ra-226 and U-nat to re-determine the appropriate and justifiable cleanup criterion. Regardless, the cleanup criterion will meet the decommissioning "Radium Benchmark" of 10 CFR 40, Appendix A, Criterion 6.

Yellowcake Spill

LC ISR, LLC will apply the same cleanup criterion for a yellowcake spill, as for the thickener spill since in both cases the only nuclide of concern is uranium (NUREG/CR-6733).

In all cases, LC ISR, LLC will clean spills up as soon as practicable and will restrict access to the impacted area until the cleanup criteria are met. The above calculations are based on the assumed concentration ratio of U-nat to Ra-226 in the plant radioactive materials. The criteria will be adjusted if site specific data show a different assumption should be used.

4.3 Solid Wastes

Solid wastes, some of which will be classified as NRC 11(e)(2) byproduct materials, will be produced during construction, operation, and reclamation activities of the Project. Appropriate storage, treatment, and disposal methods for these wastes differ, as outlined below.

4.3.1 Solid Non-11(e)(2) Byproduct Materials

The solid non-11(e)(2) byproduct materials will include: non-hazardous materials typical of office facilities, such as paper, wood products, plastic, steel, biodegradable items, and sewage sludge; and hazardous materials also typical of office and ISR facilities, such as waste petroleum products and used batteries. None of these materials are closely associated with ISR and ore processing.

Materials which can be decontaminated may include piping, valving, instrumentation, and various other types of equipment. Decontamination (where possible) will be accomplished by completing a preliminary radiological survey to determine the location and extent of the contamination and to identify any hazards. The preliminary review will be in the form of an alpha survey. The primary step will be to remove loose contamination from the object by use of high pressure washing. If required, secondary decontamination will consist of washing with a dilute acid or equivalent compatible solution. Upon completion of decontamination, a final alpha survey will be performed to insure that the unrestricted release limits noted below are met:

- Removable alpha contamination of 1,000 disintegrations per minute (dpm)/100 square cm.
- Average total alpha contamination of 5,000 dpm/100 square cm over an area no greater than one square meter.
- Maximum total alpha contamination of 15,000 dpm/100 square cm over an area no greater than 100 square cm.

Equipment which cannot be decontaminated to these standards will be either used on site or sent to an NRC-licensed facility for disposal. Those materials meeting the above decontamination standard will be released unrestricted and shipped to the nearest public landfill (Carbon County Landfill).

The non-hazardous materials, with the exception of sewage sludge, will be recycled when possible or temporarily stored in commercial bins prior to disposal by a contracted waste disposal operator at an approved off-site solid waste disposal facility, such as the Carbon County Landfill. An estimated 500 to 700 cubic yards of non-11(e)(2) byproduct materials will be generated annually. An estimated three to five cubic yards of sewage sludge will be disposed of annually off-site at an approved facility by a licensed contractor.

Hazardous wastes will be clearly labeled and stored in sealed containers above ground in accordance with the requirements of OSHA and EPA. These wastes will be periodically collected by a commercial business for recycling or energy recovery purposes. LC ISR, LLC will be a Conditionally Exempt Small Quantity Generator of hazardous wastes, per EPA definition, generating about ten to 20 pounds of batteries and similar items per year.

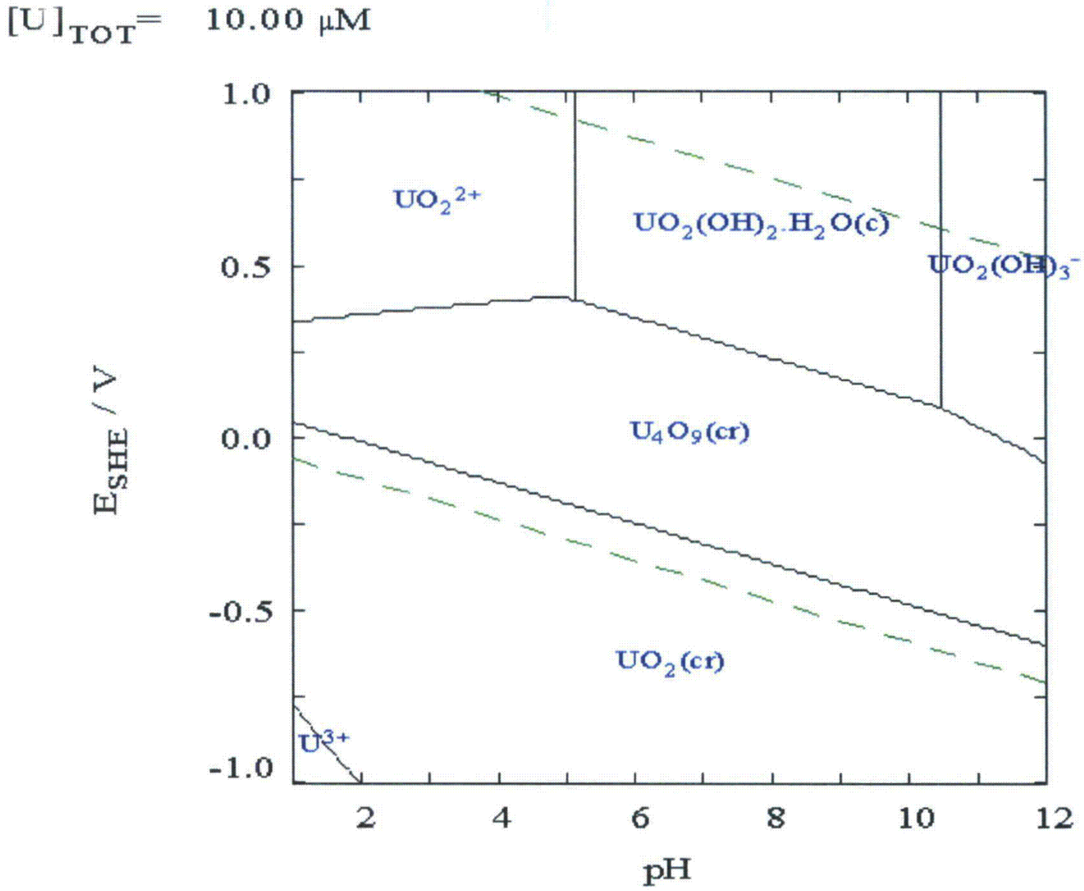
4.3.2 Solid 11(e)(2) Byproduct Materials

The solid 11(e)(2) byproduct materials will include process wastes, such as spent ion exchange resin, filter media, and tank sludge, generated during ISR and ore processing, and will include equipment that becomes contaminated during ISR and ore processing. These items include tanks, vessels, PPE, and process pipe and equipment. Such wastes could also include soils contaminated from spills.

Where possible, equipment will be decontaminated for disposal as non-11(e)(2) material or for re-use. Equipment that cannot be decontaminated and process wastes will be placed in clearly labeled, covered containers and temporarily stored in restricted areas with clearly visible radioactive warning signs. The solid 11(e)(2) byproduct materials will then be disposed of at an NRC-licensed facility, typically a uranium mill tailings impoundment, by personnel qualified to dispose of radioactive wastes. An estimated 80 to 100 cubic yards of solid 11(e)(2) byproduct material will be generated annually exclusive of final reclamation material. LC ISR, LLC is in the process of negotiating a written contract with an NRC-licensed facility for disposal of this material.

LC ISR, LLC commits to developing a disposal agreement with a facility licensed by the NRC or an Agreement State to accept 11(e)(2) materials. In the event such an agreement is terminated, LC ISR, LLC will notify NRC within seven days and will submit a new agreement for NRC approval within 90 days of expiration or termination.

Figure 4.1-1 Pourbaix Diagram for Uranium in a Non-Complexing Aqueous Media

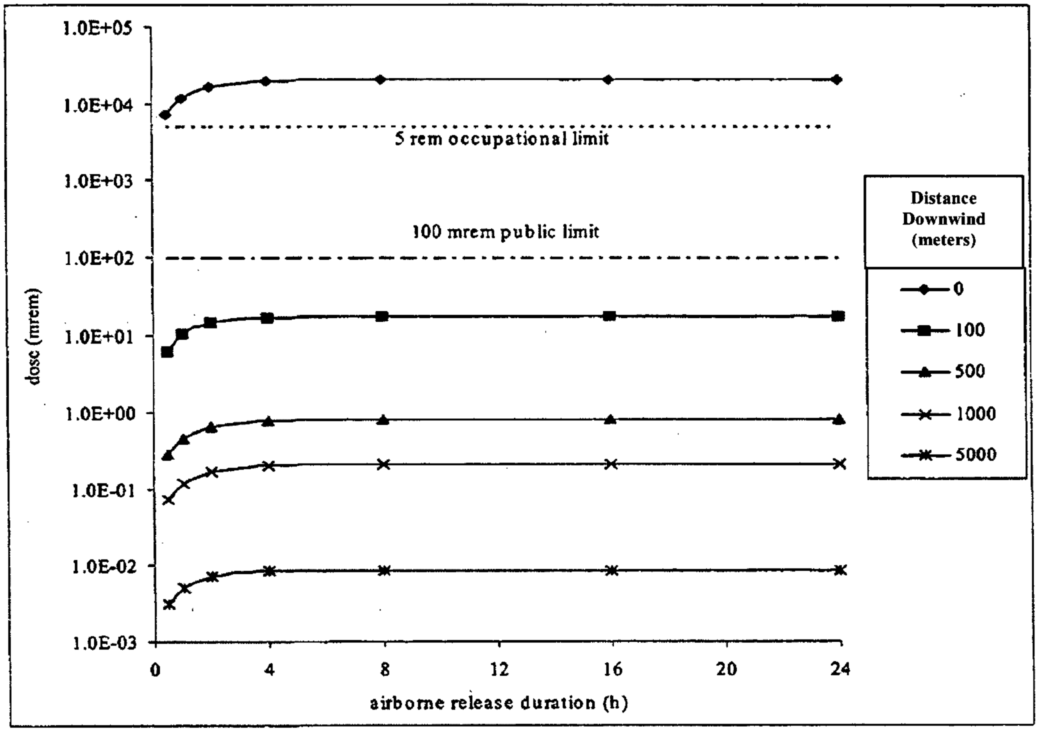


Source: Pourbaix, 1974

This diagram is for 25 degrees Centigrade and shows the variety of compounds present at varying Ehs and pHs.

Examples of non-complexing aqueous media are perchloric acid and sodium hydroxide.

Figure 4.1-2 Logarithmic Plot of Downwind Doses versus Distance from U_3O_8 Spill

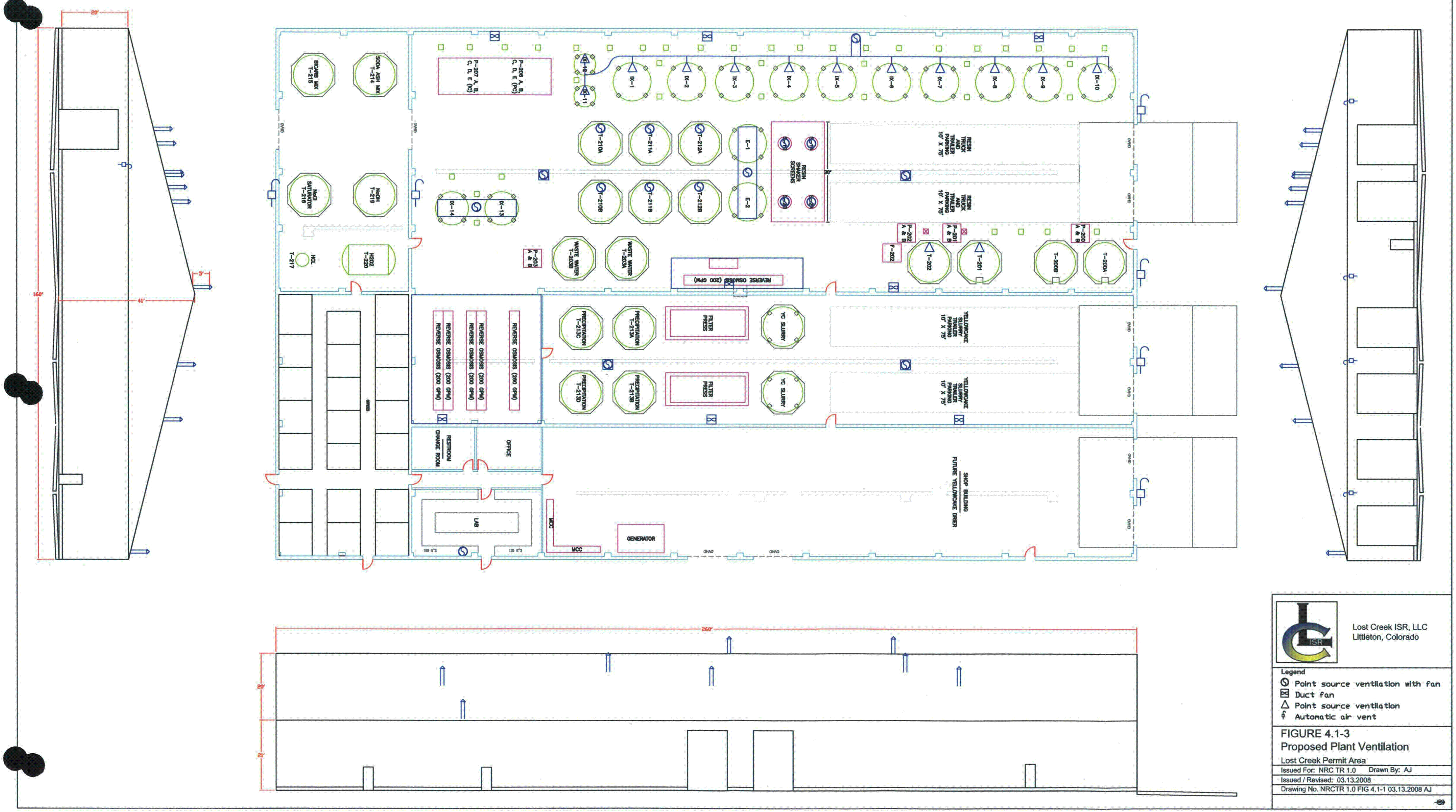


Source: NRC (2001)

Height of dose = 1 meter.

Duration = Length of time that the spill receives no mitigating action after drying to a point when airborne release is possible.

Assumes no remedial or personnel protection actions are implemented.



Lost Creek ISR, LLC
Littleton, Colorado

Legend
- ⊘ Point source ventilation with fan
- ☒ Duct fan
- △ Point source ventilation
- ♂ Automatic air vent

FIGURE 4.1-3
Proposed Plant Ventilation
Lost Creek Permit Area

Issued For: NRC TR 1.0   Drawn By: AJ
Issued / Revised: 03.13.2008
Drawing No. NRCTR 1.0 FIG 4.1-1 03.13.2008 AJ

Table 4.1-1 Comparison of NRC Accident Scenario for Thickener Failure and Spill with Lost Creek Project Emergency Response

NUREG CR-6733 Assumption (Section 4.2.1)	Lost Creek Project Most Credible Case	Impact on Worker Dose[1]	Impact on, Public Dose[1]
Product is insoluble $U_3 0_8$, ICRP 19 Class Y / ICRP 66 Class S.[2]	Product is relatively soluble U04 and/or U03 hydrates - ICRP 19 Class D or W / ICRP 66 Class F or M.	DAC (Y) = 2E-11; DAC (W) = 3E-10; Therefore Class W dose = 15% of Class Y dose.	Effluent concentration (Y) = 9E-14; (W) = 9E-13; Therefore Class W dose = 10% of Class Y dose.
Design features (berms, sumps) at thickener inadequate to contain entire thickener contents; 20% escapes building.	Berms are designed to contain at least the volume of the two largest tanks combined.	Cleanup within a building equipped with berms, sumps, and wash-down water minimizes cleanup time and exposure.	Spill contents remain within building thereby virtually eliminating the potential for wind blown particulate.
Takes no credit for "immediate" emergency response actions, assumes entire volume dries and is available for dispersion.	Plant alarms and/or observation would alert staff to occurrence of event quickly. Cleanup actions would be initiated before majority of volume can dry, including wetting /wash down techniques to move spilled material to bermed areas and sumps and other wet collection methods.	Much less source term available (lower release fraction) for dispersion and therefore less dose.	Much less source term available (lower release fraction) for dispersion and therefore less dose.
Takes no credit for use of PPE by cleanup workers.	Workers involved in cleanup of spilled material would be wearing respirators in accordance with an approved respiratory protection program per, e.g., 10 CFR 20, Subpart H.	Dose assignment can be reduced by appropriate protection factor for device(s) used.	None.
Takes no credit for emergency response planning, procedures and associated training.	Response to spill would be conducted in accordance with previously developed and approved emergency response protocols, which minimizes time to respond. Equipment needed is readily available, which enhances efficiency of worker performance to affect cleanup with in-place emergency response procedures, exercises and training.	In-place and exercised emergency response procedures, readily available equipment and trained workers will reduce worker dose.	In-place and exercised emergency response procedures, readily available equipment and trained workers will reduce source term and therefore off-site dose to public.

[1] DAC for workers and effluent concentrations released to unrestricted areas from 10 CFR 20, App B, Tables 1 and 2 respectively; units in µCi/mL. Although the products of interest are likely to be TGLD Class D, Class W is conservatively assumed.

[2] *The metabolism of compounds of plutonium and other actinides* (ICRP, 1972); *Human respiratory tract model for radiological protection* (ICRP 66, 1994)

Table 4.1-2 Preliminary Fan Specifications

Quantity	Name	Area Served	Use	Flow Rate
2	EF-7 (A/B)	IX Columns and Guard Columns	On/Off as needed	300 cfm
2	EF-8 (A/B)	Waste Water Tanks and Area Sumps	Always On	300 cfm
2	EF-9 (A/B)	Elution Tanks and Permeate Tank	On/Off as needed	300 cfm
2	EF-10 (A/B)	Resin Shaker Screens and Elution Columns	On/Off as needed	6,000 cfm
2	EF-11 (A/B)	Resin Water Tanks and Area Sumps	Always On	400 cfm
2	EF-12 (A/B)	Precipitation Tanks	Interlocked with PLC to be on during a precipitation cycle	200 cfm
2	EF-13 (A/B)	Restoration Columns	On/Off as needed	300 cfm
1	EF-14	Transfer Bay	On/Off as needed	7,000 cfm

Table 4.2-1 Example of Waste Stream Composition for Deep Well Disposal *

Parameter	RO Brine	Resin Rinse	Elution Bleed	Yellowcake Wash Water	Restoration Wastes
Flow Rate [1] (gpm)	60	< 3	3	7	130
Inorganic Parameters (ppm)					
Ammonia	-- [2]	--	<1 [3]	--	--
Arsenic	--	--	--	--	0.1 to 0.3
Bicarbonate	--	600 to 900	--	--	400 to 700
Calcium	3,000 to 5,000	--	--	--	--
Carbonate	--	500 to 800	--	--	300 to 600
Chloride	15,000 to 20,000	10,000 to 15,000	12,000 to 15,000	4,000 to 6,000	--
Magnesium	1,000 to 2,000	--	--	--	--
Sodium	10,000 to 15,000	6,000 to 11,000	6,000 to 8,000	3,000 to 4,000	380 to 720
Selenium	--	--	--	--	0.05 to 0.15
Sulfate	< 1	--	--	--	100 to 200
Radiological Parameters (pCi/L)					
Gross Alpha	--	--	--	--	2,000 to 3,000
Gross Beta	--	--	--	--	2,500 to 3,500
Radium-226	< 5	100 to 200	100 to 300	20 to 50	50 to 100
Thorium-230 [4]	--	50 to 100	10 to 30	10 to 20	50 to 150
U (ppm)	--	1 to 3	5 to 10	3 to 5	< 1

* Adapted from Table 2.7-3 on Page 2-36 of NRC's Generic Environmental Impact Statement (GEIS) for In Situ Uranium Mining (NRC, 2009). LC ISR, LLC will sample the waste stream components frequently, throughout the life of the mine, to ensure the disposal operations are conducted in accordance with the design and safety parameters of the deep wells.

[1] See Figures 3.2-5 and 6.2-1 of this report for additional information on the water balance.

[2] Not expected to be present.

[3] Table 2.7-3 of the GEIS shows ammonia concentrations of 180 to 640 ppm. However, LC ISR, LLC does not propose to use ammonia during the precipitation process, so the concentration of ammonia is expected to be minimal.

[4] Based on the Lost Creek ore characteristics, the Thorium-230 concentrations are expected to be less than those shown in the GEIS (NRC, 2009).

Table 4.2-2 Summary of Initial Cleanup Criteria

Exposure Scenario	Worker (above background)	Public (above background)
Thickener and Yellowcake	U-nat = 1,500 pCi/g	U-nat = 300 pCi/g
Pregnant Lixiviant and Loaded Resin	U-nat = 1,000 pCi/g Ra-226 = 20 pCi/g	U-nat = 120 pCi/g Ra-226 = 2.2 pCi/g

ATTACHMENT 4.1-1

Preliminary HVAC Specifications

ATTACHMENT 4.2-1

Storage Pond Specifications

TECHNICAL SPECIFICATIONS

Section TS-1 General Requirements

TS 1.1 Summary Of Work

The Work under this contract includes construction of two lined evaporation ponds which includes installation of embankment raises, installation of double ponds with leak detection systems.

The site is located east of the Proposed Lost Creek Plant. Site location maps are provided in the Drawings.

TS 1.2 General Description Of Work

1.2.1 Location

Ponds 1&2 Reservoirs are located in the E1/2, Section 18, T25N, R92W, in Sweetwater County, Wyoming.

1.2.2 Statement Of Work

The work to be performed is shown on the Drawings and described in these specifications. The Work includes, but is not limited to, the following components:

- Site preparation which includes clearing and grubbing, topsoil and subsoil removal and stockpiling;
- Excavation of key cut;
- Construction of embankments;
- Installation of geomembrane and collections system for double lining with leak detection.

1.2.3 List Of Drawings

Included with these specification are the following drawings:

Drawing Number	Title
0802.100	Index, Legend and General Notes
0802.101	Overall Site Plan
0802.102	Embankment Plan
0802.103	Embankment Details
0802.104	Leak Detection Details

TS 1.3 Equipment, Materials, and Labor

The Contractor shall furnish all supervision, personnel, labor, materials, Plant, machinery, tools, equipment, repairs, maintenance and service, and all other facilities and incidentals necessary for the execution and completion of the Work. The Owner shall provide fresh water for soil compaction and dust abatement. The Contractor shall be responsible for all pumping, hauling and dispensing of such water.

TS 1.4 On-Site Material Definitions

For purposes of these specifications, other than payment, materials of earthwork and construction are defined as follows:

A. TOPSOIL

Surficial soil material selectively salvaged and stockpiled for use in reclamation. The depth of topsoil to be salvaged at any particular location shall be directed by the Engineer.

B. SUBSOIL

Soil material beneath topsoil selectively salvaged and stockpiled for use in reclamation. The depth of subsoil to be salvaged shall be directed by the Engineer.

C. UNSUITABLE MATERIAL

Material excavated or removed from the borrow areas, existing pond or embankments which is not suitable for embankment fill. The Engineer shall determine if excavated material is unsuitable.

D. FILL MATERIAL

Material from the borrow excavation which is suitable for embankment construction. The Engineer shall determine if excavated material is suitable for fill material.

TS 1.5 Standard Of Construction

The Work covered by these specifications will be completed in such a manner as to meet the requirements of all applicable federal, state, and local laws, regulations and ordinances, and to conform to modern practices for this type of work.

TS 1.6 Environmental

The Contractor shall insure that no contamination of topsoil, water, and air occurs from oil, fuel, or other fluid spills; from vehicle emissions; or from garbage, waste, or other debris.

The Contractor shall service all equipment in designated areas, and maintain all equipment to prevent leakage of oil, fuel or other fluids; and to prevent unacceptable levels of emissions.

The Contractor shall provide approved sanitary facilities on-site and these facilities shall be properly maintained.

The Contractor shall collect, remove, and properly dispose of all trash, garbage, debris, used oil, and other waste materials off-site at an approved disposal area.

The Contractor shall comply with all State of Wyoming Department of Environmental Quality rules and regulations during construction, including, but not limited to, the handling and storage of fuel, oil, and other liquids.

The Contractor shall keep all access roads and work areas wetted, as directed by the Engineer, to abate fugitive dust.

TS 1.7 Field Engineering

The Engineer will provide initial slope stakes for the embankment raises and will stake topsoil stripping limits and depths. The Engineer will also determine the suitability of borrow material depth.

TS 1.8 OSHA Requirements

The Contractor shall be required to obtain a contractor identification number from the U.S. Office of Safety and Heath Administration (OSHA) and shall assume sole responsibility for compliance with OSHA requirements.

Section TS-2 Mobilization and Demobilization

TS 2.1 Scope

The Work in this Section comprises the Contractor's establishment on Site of all the temporary accommodation, Plant and equipment necessary for the successful completion of the Work and shall include, but not necessarily be limited to the following:

(1) Assemble all necessary Plant and transport to Site.

(2) Establish the Contractor's maintenance facilities, temporary workshops, temporary office accommodation and sanitation facilities.

(3) Provide the Engineer's temporary office accommodations.

(4) Provide temporary accommodation for the Contractor's personnel.

(5) Maintain Plant and services for the duration of the Work.

(6) All things required to move onto the Site for execution of the Work.

(7) On completion of the Work remove all Plant from the Site, and restore the Site to a clean and tidy condition to the satisfaction of the Engineer.

TS 2.2 Execution

2.2.1 Mobilization

The Contractor shall mobilize on the Site, sufficient labor, materials, and equipment to allow commencement of the Work, and shall bring on to the Site, as and when necessary, any additional equipment, labor and materials which may be required to complete the Work as scheduled.

2.2.2 Contractor's Workshops, Stores and Offices

The Contractor shall either transport mobile units or erect, in the area designated on the Drawings or indicated by the Engineer, adequate workshops, offices and other buildings and structures for the completion of the Work. Such workshops and offices, etc., shall be maintained in a neat and tidy condition throughout the duration of the Work to the satisfaction of the Engineer.

2.3.3 Sanitation

The Contractor shall provide and maintain adequate sanitary facilities for his personnel at the Site, including his offices and temporary accommodation and Engineer's office in compliance with local health regulations and to the satisfaction of the Engineer.

2.2.4 Construction Roads

All temporary construction roads which the Contractor may require to complete the Work shall be constructed at the Contractor's expense.

The location of any temporary roads, or portions thereof, on the Site shall be subject to the Engineer's approval.

The Contractor's construction roads shall be available for use by others having permission from the Engineer to carry out work on the Site.

2.2.5 Drainage

Adequate drainage facilities in the form of ditches, culverts or other conduits shall be installed as necessary to maintain temporary construction access roads. These temporary drainage facilities shall be constructed to the satisfaction of the Engineer.

2.2.6 Demobilization

Upon completion of the Work, the Contractor shall remove all Plant from the Site, restore all damaged roads, and remove all haul roads not authorized by the Owner, and shall leave the Site in workman-like condition, to the satisfaction of the Engineer.

TS 2.3 Measurement and Payment

2.3.1 Mobilization

Payment shall be full compensation for Mobilization and shall be limited to an amount not greater than seven percent of the total contract price.

2.3.2 Demobilization

Payment shall be full compensation for Demobilization and shall be limited to an amount not greater than three percent of the total contract price.

PAY ITEMS	PAY UNIT
2-1 Mobilization	LS
2-2 Demobilization	LS

Section TS-3 Earthwork

TS 3.1 Scope

The Work in this Section covers stripping of all topsoil, subsoil, the construction of the downstream embankment raise, installation of the cutoff trench and construction of access roads. The Work shall include the necessary manpower and equipment to construct the embankments from material designated as borrow material on the Drawings or as approved by the Engineer.

TS 3.2 Products/Materials/Equipment

3.2.1 Soils

The following soil types shall be encountered during the Work:

- Topsoil - Topsoil shall be determined using WDEQ-LQD Guideline 1 standards. Stockpiling and protection will also follow WDEQ-LQD Guideline 1 standards.
- Subsoil - Subsoil shall be considered the three feet of soil below the topsoil unless otherwise determined by the Engineer.
- Fill Material-Downstream Embankment - Fill material shall be that material suitable for embankment construction. This material shall be a sand with clay lenses from the Designated Borrow Areas. and from the Interior Borrow Area.
- Road Base Material - Road Base Material shall consist of gravely material imported to the site from a suitable quarry as approved by the Engineer.

3.2.2 Compaction Equipment

The Contractor shall provide sufficient compaction equipment of the types and sizes specified herein as is necessary for compaction of the various fill materials. If the Contractor wishes to use alternative equipment, he shall submit to the Engineer for approval complete details of such equipment and the methods proposed for its use. The Engineer's approval of the use of alternative equipment will be dependent upon the contractor's successful demonstration of the equipment. Suitable test fills will be constructed to the satisfaction of the Engineer. Alternative equipment will compact the fill materials to a density not less than that which would be produced by the equipment and number of coverages specified herein.

Compaction equipment, which includes the following, shall be maintained in good working condition at all times to ensure that the amount of compaction obtained is a maximum for the equipment. The Contractor shall immediately make adjustments to the equipment to achieve this end when necessary.

Smooth Drum Vibratory Roller

Smooth drum vibratory rollers shall be equipped with a suitable cleaning device to prevent the accumulation of material on the drum during rolling. Each roller shall have a total static weight of not less that 20,000 pounds at the drum when the roller is standing on level ground. The drum shall be not less than 60 inches in diameter and 78 inches in width. The vibration frequency of the roller drum during operation shall be between 1100 and 1500 vibrations per minute and the centrifugal force developed by the roller at 1250 vibrations per minute shall not be less than 38,000 pounds. The smooth drum roller compactor shall also contain a timing device for indicating actual roller operating time.

Sheepsfoot Roller

The Contractor may be required to compact the fill with a sheepsfoot roller.

The sheepsfoot roller shall be a self-propelled, fully-ballasted, standard sheepsfoot design developing 6000 lbs. in weigh per liner foot of width at rest on level ground, or equivalent as approved by the Engineer. The sheepsfoot roller machine shall be equipped with a timing device which will indicate actual roller operating time.

Special Compactors

Special compactors shall be used to compact materials which, in the opinion of the Engineer, cannot be compacted properly by the specified sheepsfoot or vibratory rollers because of location or accessibility.

The Contractor shall adopt special compaction measures such as hand-held vibratory compactors or other methods approved by the Engineer to compact fill in trenches, around structures and in other confined areas which are not accessible to the larger vibratory roller or sheepsfoot roller. Such compaction shall consist of not less than 4 coverages of the compaction equipment.

Before commencing work with the proposed compaction equipment, the Contractor will provide the Engineer with a list of each piece of equipment to be used, together with the Manufacturer's specification.

3.2.3 Moisture Conditioning of Soil

In areas requiring moisture conditioning, the Contractor will apply clean water to the borrow area and use a heavy duty discing unit to thoroughly blend the soil producing an even mixture of soil and water.

TS 3.3 Execution

3.3.1 Topsoil/Subsoil Stripping

Topsoil and subsoil shall be removed from the borrow areas.

During all phases of topsoil and subsoil removal, the Contractor shall use extreme caution to avoid a conflict with or contact or damage to existing utilities, overhead or buried, such as gas or oil lines, power lines, poles, cased wells, or other appurtenances. The Contractor shall be responsible for location of, and any damage to, existing utilities during construction activities. Cost of utility location and damage repair shall be solely borne by the Contractor.

Stockpile slopes shall not be steeper than 5h:1v (horizontal:vertical) unless otherwise directed by the Engineer.

3.3.3 Key Cut Installation

A key cut shall be installed under the entire embankment. The key cut shall be a minimum of five feet deep, bottom width of 10 feet and 2:1 (h:v) side slopes. Material from the cutoff trench is suitable embankment fill.

3.3.4 Fill Placement

The Contractor should expect cold weather conditions during a portion of this project. This will require the fill area to be scarified at the beginning of each working shift to insure additional lifts are not placed on frozen surfaces.

All material used for fill shall be loaded and hauled to the placement site, dumped in layers no greater than eight inches, spread and leveled, moisture conditioned if required, and compacted to form a dense integral fill as required by the Engineer. The Contractor shall at all times exercise care to avoid segregation of the material being placed and shall, if required by the Engineer, remove all pockets of segregated or undesirable material and replace it with material which matches the surrounding material. All material in excess of one foot in diameter shall be removed from the fill material either prior to its being placed or after it is dumped and spread but before the compaction operations are started.

For most construction conditions, the fill is to be constructed in near horizontal layers with each layer being completed over the full length and breadth of the embankment before placement of subsequent layers. Each layer shall be constructed only with materials meeting the specified requirements and shall be free from lenses, pockets and layers of materials which are substantially different in gradation from the surrounding material, as determined by the Engineer.

The Contractor shall spread, level and compact the material to ninety percent (90%) of the Modified Density (ASTM D 1557). The Contractor shall control the routing of the scrapers to achieve the specified compaction where practical. In areas where this cannot be accomplished, the embankment shall be rolled with four (4) passes from a vibratory roller or as approved by the Engineer.

Except in areas approved by the Engineer, where space is limited or as otherwise specified, fill shall be placed by routing the hauling and spreading units approximately parallel to the axis of fill. Where impractical limits exist, the hauling units shall be so routed that they do not follow in the same paths but spread their traveled paths evenly over the surface of the fill.

Materials requiring moisture control shall be moisture conditioned in the borrow areas, as required by the Engineer. Moisture conditioning is the operation required to increase or decrease the moisture content of material to within specified limits.

If materials require moisture conditioning, the Contractor shall employ whatever method and equipment are necessary to condition the material to the moisture content designated by the Engineer. The Contractor shall adopt all measures necessary to achieve a moisture content within plus two percent (2%) or minus two percent (2%) of the optimum moisture content, and the moisture shall be distributed uniformly throughout each layer of material being placed, immediately prior to compaction. The Contractor shall adopt whatever measures are necessary to ensure that the designated moisture content is preserved after compaction, until the succeeding layer is placed.

Should the surface of the fill become rutted or uneven subsequent to compaction, it shall be re-leveled and re-compacted, by and at the expense of the Contractor, before the next layer of fill is placed.

If the surface of the fill becomes too dry or hard to permit suitable bonding with the subsequent layer, the material shall be loosened by scarifying or disk harrowing, moistened and re-compacted before an additional lift is placed.

All particles of dimensions such that they interfere with compaction in the layer thicknesses specified, as determined by the Engineer, shall be removed, either prior to or during compaction as specified.

The rolling pattern of all construction joints shall be such that the full number of roller passes required in one side of the construction joint extends completely across the joint.

3.3.5 Compaction Procedures

The Contractor's procedures for compaction of fill shall be subject to the approval of the Engineer. Compaction of each layer of fill shall proceed in a systematic, orderly and continuous manner approved by the Engineer, such as to ensure that all of each layer receives the compaction specified. The compaction shall be carried out by routing the compaction equipment parallel to the axis of the embankment or fill, except that where such routing is impractical such as in roller turning areas, in areas adjacent to foundations or at the lower elevations of the fill, in areas adjacent to pipework and where otherwise required by the Engineer, the compaction equipment may be routed in any direction approved by the Engineer.

For compaction by the vibratory roller, one coverage shall consist of one pass of the roller. A minimum overlap of 12 inches shall be maintained between the surfaces traversed by adjacent passes of the roller drum. During compaction the roller shall be propelled at 2 miles per hour or such lesser speed as may be determined by the Engineer. The power of the motor driving the vibrator shall be sufficient to maintain the specified frequency and centrifugal force under the most adverse conditions which may be encountered during the compaction of the fill. Propulsion equipment for the roller shall be adequate to propel the roller at speeds up to 4 mph.

3.3.6 Road Base Material

Road Base Material shall be placed on the top surface of all embankments and final access roads. The road base shall be placed a minimum of six inches thick and shall be compacted by using a roller compactor or by wheel rolling with loaded scrapers.

3.3.7 Quality Control

The Contractor shall give the Engineer full cooperation in sample taking or making tests and shall render such assistance as is necessary to enable sampling and testing to be carried out expeditiously. Each lift of embankment or other type fill will need to be approved by the Engineer prior to placement of further fill. The Contractor shall allow sufficient time for the Engineer to carry out the required test work in order to determine the acceptability of each lift. The making of such tests by the Engineer or the time taken to interpret their results shall not constitute grounds for a claim by the Contractor for additional compensation or an extension of time.

The Engineer will take samples of fill materials and perform gradation and moisture content tests and will carry out field density tests on the compacted fill and other tests that he considers necessary to ascertain that the fill being placed or already placed meets the specified requirements. The results of the tests carried out by the Engineer will be final and conclusive in determining compliance with the Technical Specifications.

Tests carried out by the Engineer will be performed in accordance with the principles and methods prescribed by the American Society for Testing and Materials (ASTM) and other such recognized authorities. The following quality control testing is anticipated:

Tests on Fill Material Prior to Compaction

Tests for gradation and moisture content where applicable will be made by the Engineer. Samples of fill materials will be taken from test pits after spreading and prior to compaction. Sampling will be at frequencies sufficient to ensure that the placement of fill material is in full compliance with the Specification.

Tests on Fill After Compaction

The Engineer will conduct density and other tests on the fill compacted in place. Samples of the fill for related laboratory testing will be taken at such frequency the Engineer considers necessary for the proper evaluation of the properties of the compacted fill materials.

TS 3.4 Measurement and Payment

3.4.1 Measurement for Payment

Topsoil

Measurement for payment for Topsoil shall be based on volumes determined by the number of scraper loads multiplied by the rated capacity of the scraper.

Embankment Fill

Measurement for payment for Embankment Fill will be made of the net volume in cubic yards of fill placed with scrapers as determined by survey prior to and after completion of the embankment construction.

The surveys shall be performed by the Engineer. The Contractor may have his representative present during field or office work related to the surveys and may obtain copies of field notes, drawings, or calculations to the extent sufficient to verify the calculations.

Key Cut

The key cut shall be considered subsidiary to Embankment Fill and will not be paid separately.

3.4.2 Payment

Topsoil Removal

Payment for topsoil removal shall be for compensation for excavating, hauling and stockpiling the topsoil. Payment will be based on the contracted unit cost per cubic yard of material removed.

Fill Material

Payment shall be full compensation for ripping, hauling, placing, spreading, shaping, moisture conditioning, and compacting the material. Payment for embankment fill shall be based on the contract unit cost per cubic yard for both downstream embankment and upstream embankment regardless of the source of borrow material.

No separate measurement or payment will be made for moisture conditioning the soil nor other equipment to obtain the specified moisture and density. The cost of moisture conditioning and compacting shall be included in the unit price for the various earthwork items.

PAY ITEMS	**PAY UNIT**
3-1 Topsoil Removal	CY
3-2 Subsoil Removal	CY
3-3 Embankment Fill	CY

Section TS-4 Double Liner w/ Leak Detection

TS 4.1 Scope

Work in this Section covers all Work associated with the installation of the double pond liner with a leak detection system.

Work shall include all labor, material and equipment necessary to perform site preparation to install the liner and leak detection.

The Work consists of installing one layer of liner, placing collection system and placing top layer of liner.

TS 4.2 Products/Equipment

4.1.1 Geomembrane

The impermeable liner shall be a polypropylene geomembrane, manufactured by Lange Containment Systems, Inc. and supplied by Geotech Industrial Supplies, Casper, WY, at telephone number 307-472-0084 or approved equivalent. The geomembrane shall conform to the following values and test methods:

Property	Test Method	Value	Qualifier
Gauge		.048 mil	
Plies		1	
Thickness (min.)	ASTM D 751	41 mil	MIN
Breaking Strength	ASTM D-751	225lbf	MIN
Low Temp Flax °F	ASTM D-2136	-40	
Puncture Resistance	FTMS 101C	350 lbs	MIN
Tear Strengh	ASTM D-5884	55 lbf	MIN
Dim Stability	ASTM D-1204	1.0 %	MAX
Hydrostatic Resistivity	ASTM D-751	70%	MARV
Ply Adhesion	ASTM D-431	20 lbs/in	MIN
Water Absorption	ASTM D-4632	203 lbs	MARV
ESCR Env Stress Check Resistance		Not affected by ESC	
UV Resistance	ASTM G-26	Pass	

Typical Fabricated Seam Properties			
Bonded seam strength Adhesive	ASTM D 751	200	MIN
Peel Adhesion	ASTM D-431	20 or FTB	MIN

4.2.2 Sand

The sand and fine gravel used to cover the drain pipe shall meet the following gradation:

Sieve Designation	Percent Passing
3/8	100
200	<5

4.2.3 Pipe

The leak detection system shall use 4 inch perforated PVC Schedule 40 pipe.

TS 4.3 Execution

4.3.1 Site Preparation

The bottom of the pond shall be graded as smooth as practicable prior to laying geomembrane.

4.3.2 Geomembrane (Bottom Layer)

The geomembrane shall be installed to the lines and grades as shown on the Drawings.

The geomembrane shall be placed in accordance with manufactured specification. A factory representative shall be on site to supervise and direct the welding of seams.

4.3.3 Leak Detection Collection Pipe with Sand Cover

The perforated pipe shall be placed as shown in the drawings. The pipe is place in a herringbone pattern leading to a central drainage pipe going down the center. As each arm of the herringbone pattern is placed, sand shall be placed over the pipe to a nominal thickness of nine inches.

4.3.4 Geomembrane (Top Layer)

The top layer of geomembrane shall be placed to the lines and grades as shown on the drawings.

The geomembrane shall be placed in accordance with manufactured specification. A factory representative shall be on site to supervise and direct the welding of seams.

TS 4.4 Measurement and Payment

4.4.1 Measurement for Payment

Geobembrane - The measurement for payment for placed geomembrane shall be the net square yards of geomembrane placed.

Perforated PVC Pipe - The measurement for payment for placed perforated PVC pipe shall be the lineal feet of placed pipe.

Sand - The measurement for sand shall be the placed be the placed cubic yards of sand placed.

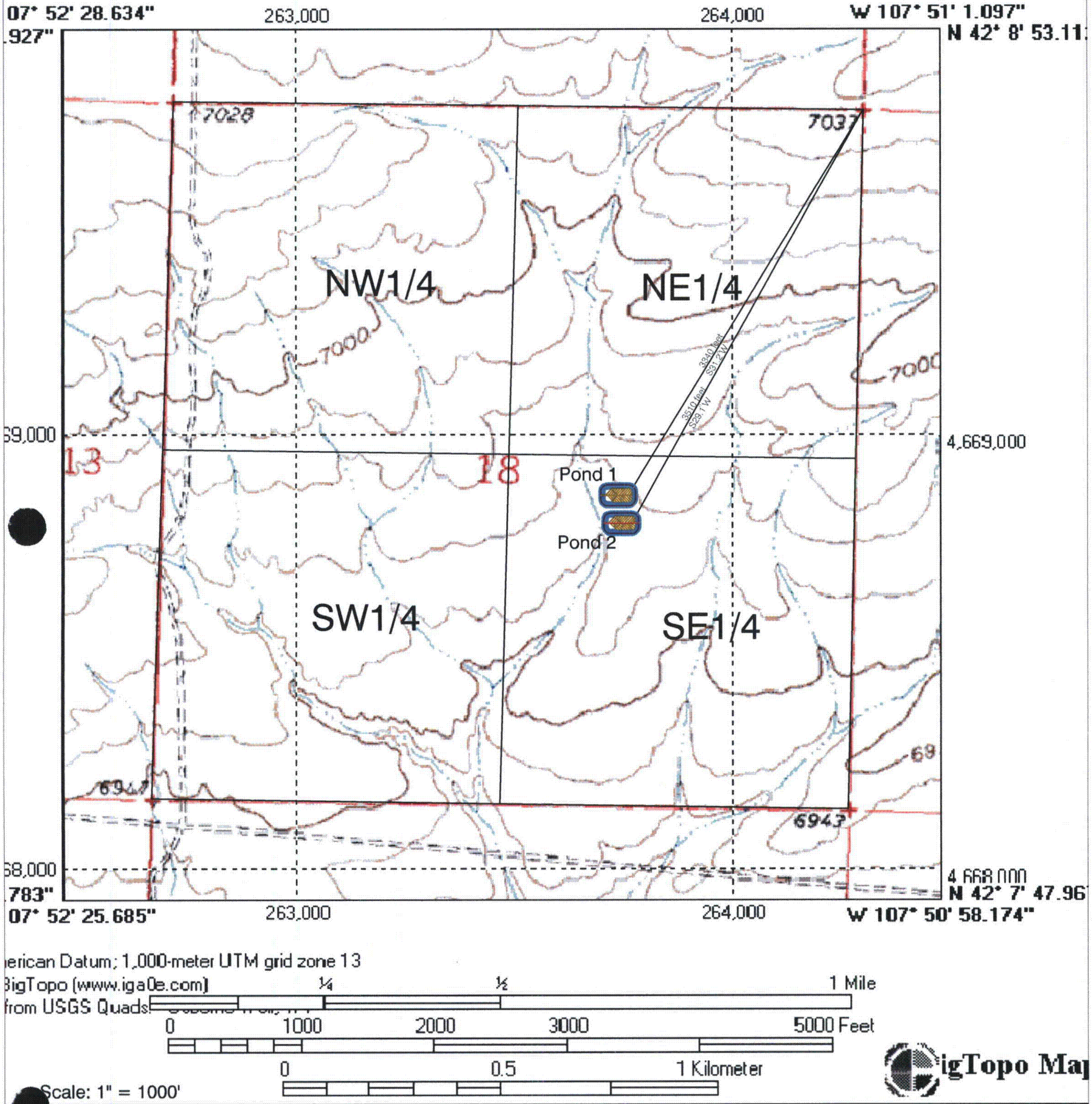
4.4.2 Payment

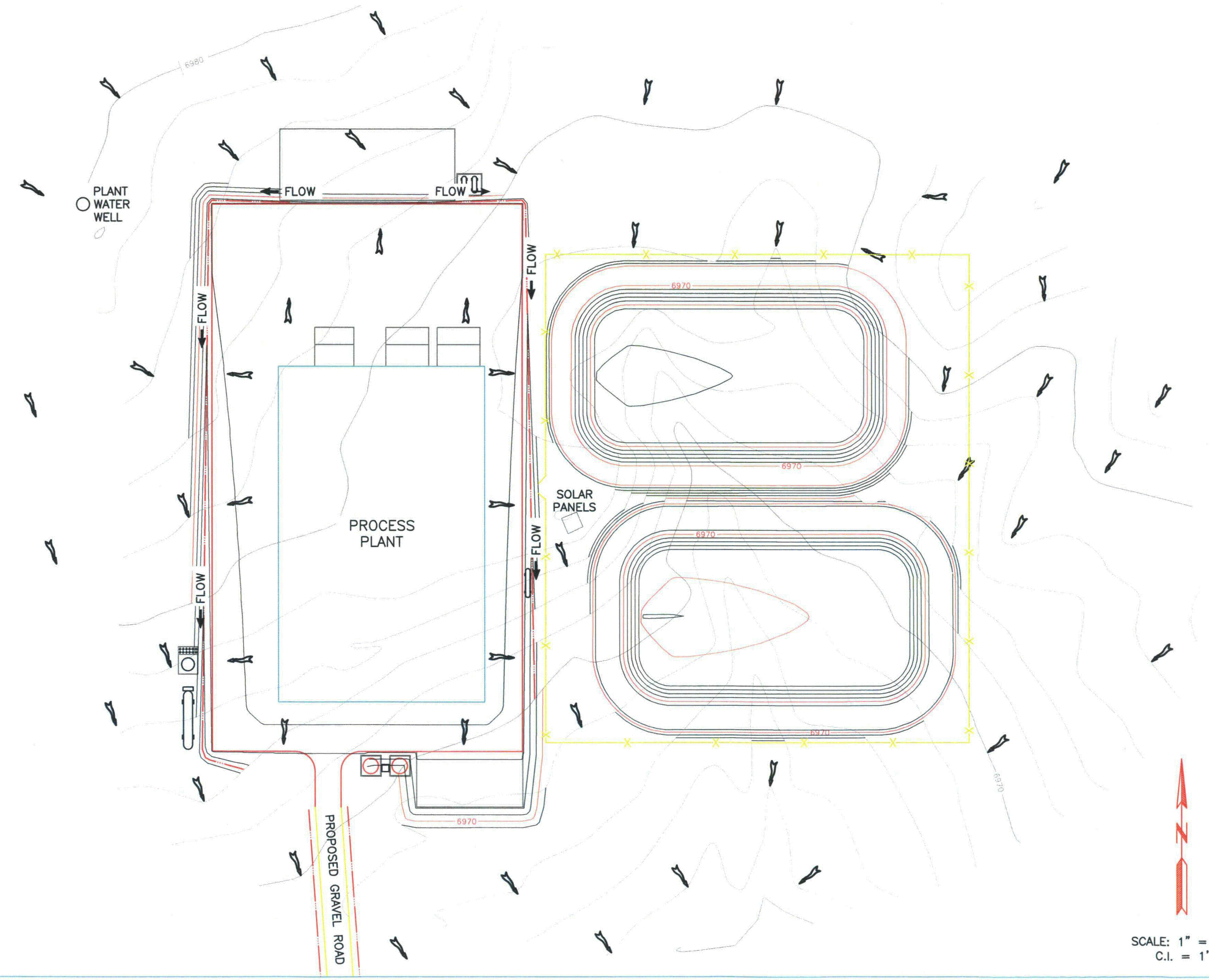
Payment for the double geomembrane liner with leak detection shall be full compensation for the work and be made at the contract price and for those item listed below. Site preparation shall be considered subsidiary to the placement of geomembrane.

PAY ITEMS	PAY UNITS
4-1 Geomembrane	SY
4-2 4 in Perforated Pipe	LF
4-3 Sand	CY

Sec 18, T25N, R92W

Lost Creek ISR





SCALE: 1" = 80'
C.I. = 1'

LEGEND:

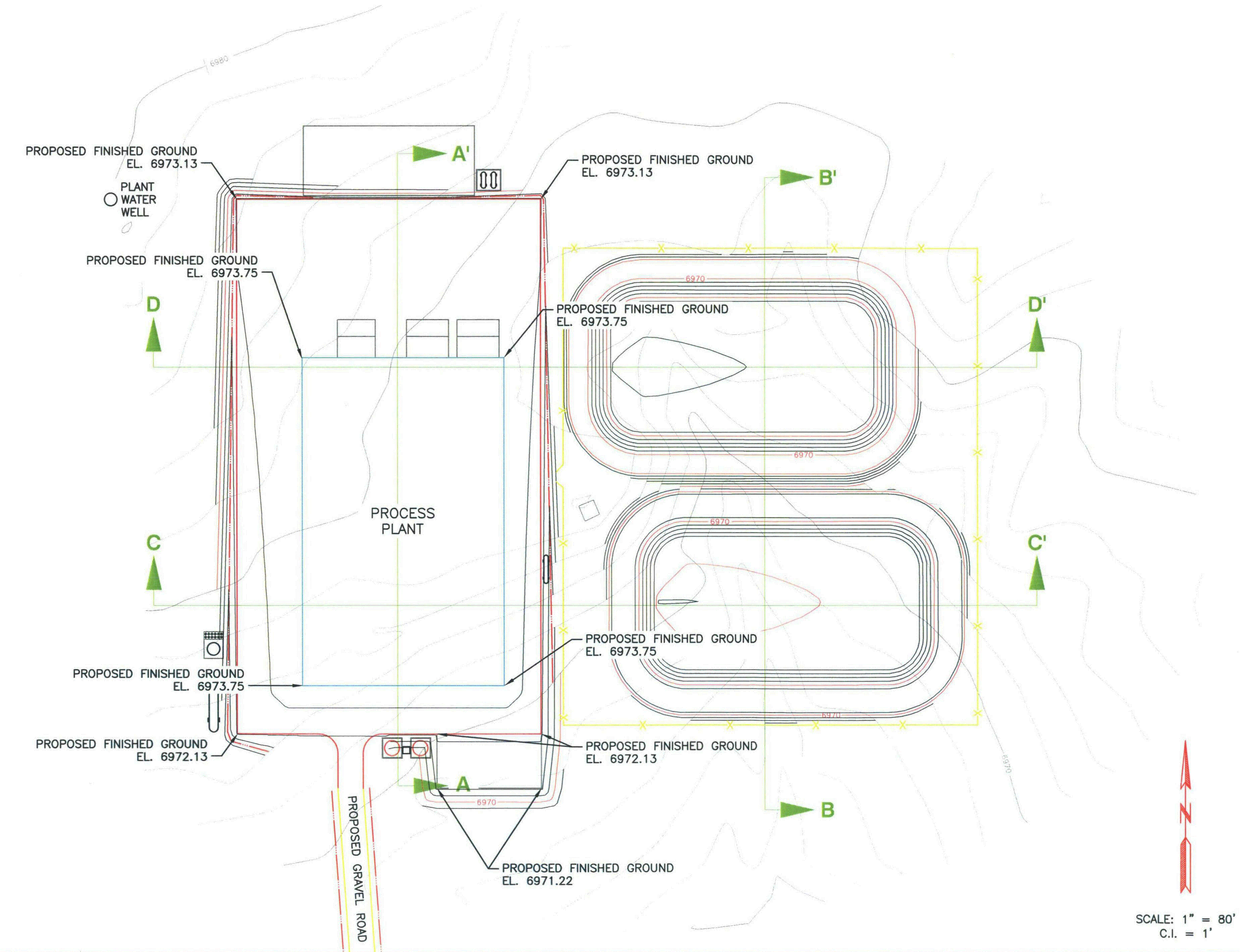
- DRAINAGE DITCH AND DIRECTION OF FLOW (FLOW)
- DRAINAGE FLOW DIRECTION

Professional Engineer (Civil)
DARRIN A. TROMBLE

REVISIONS	
Date	By

WWC ENGINEERING
6000 E. 2nd Street, Suite 1004
Casper, WY 82609
(307) 473-2707

Drawn By: | Checked By: | Date: | Scale:



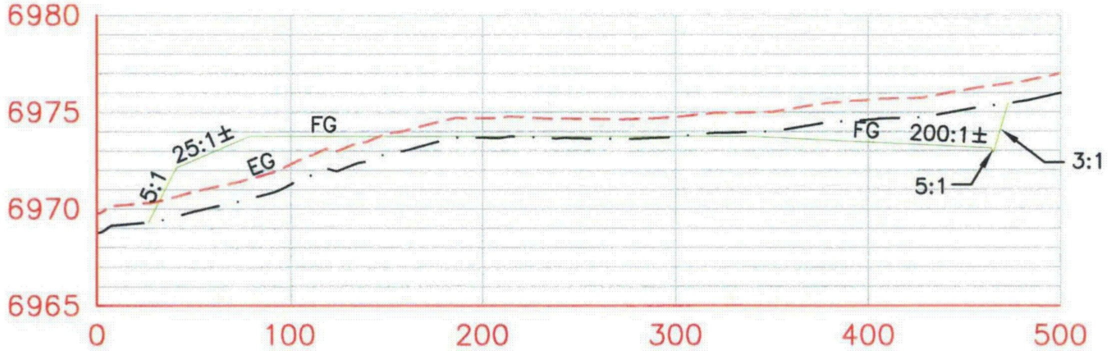
Professional Engineer (Civil)
DARRIN A. TROMBLE

REVISIONS

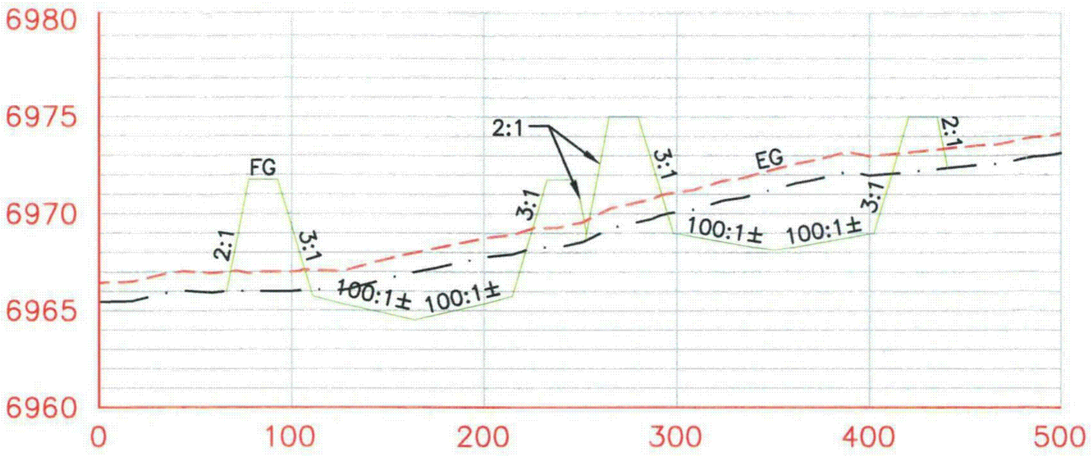
Date	By

WWC ENGINEERING
6000 E. 2nd Street, Suite 1004
Casper, WY 82609
(307) 473-2707

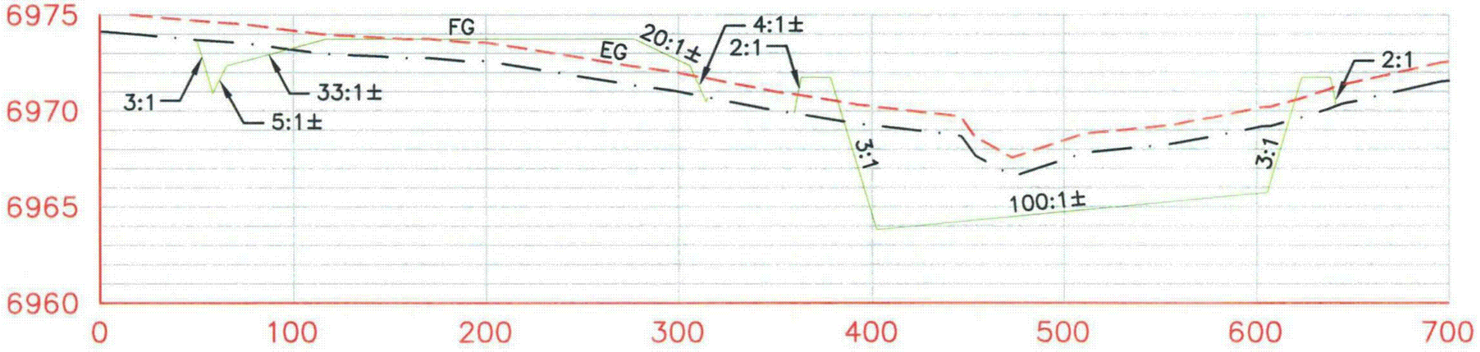
Drawn By: | Checked By: | Date: | Scale:



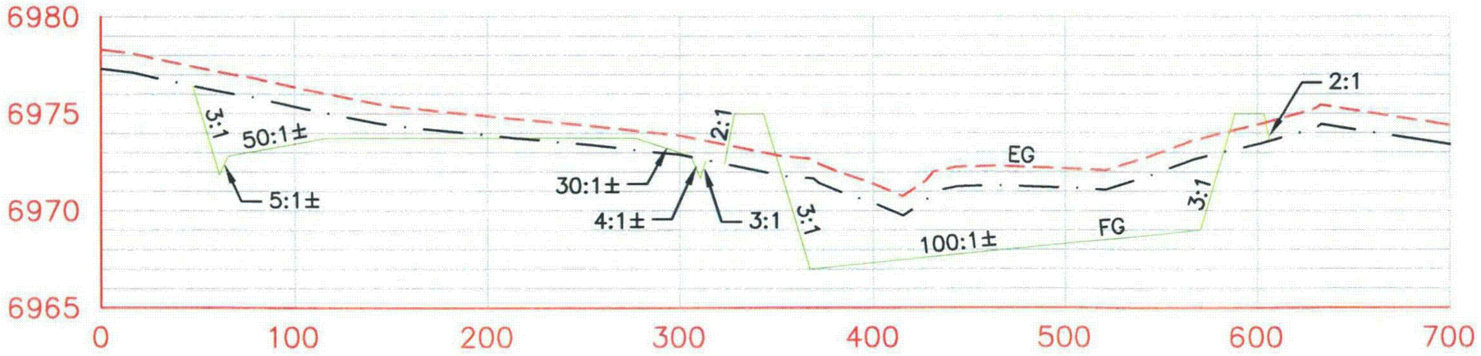
PROFILE A–A'



PROFILE B–B'



PROFILE C–C'



PROFILE D–D

LEGEND:

— — — — EXISTING GROUND SURFACE

— · — · — 1' TOPSOIL REMOVAL SURFACE

———— FINISHED GROUND SURFACE

Professional Engineer (Civil)
DARRIN A. TROMBLE

HORIZ. SCALE: 1" = 100'
VERT. SCALE: 1" = 10'

REVISIONS

Date	By

WWC ENGINEERING
6000 E. 2nd Street, Suite 1004
Casper, WY 82609
(307) 473-2707

Drawn By:	Checked By:	Date:	Scale:

Ponds 1 & 2 Reservoir Construction Drawings

Lost Creek ISR, LLC
Englewood, Colorado, USA

WESTERN STATES MINING CONSULTANTS, P.C.
6911 Casper Mountain Road • Casper, Wyoming 82601 • (307) 266-9117

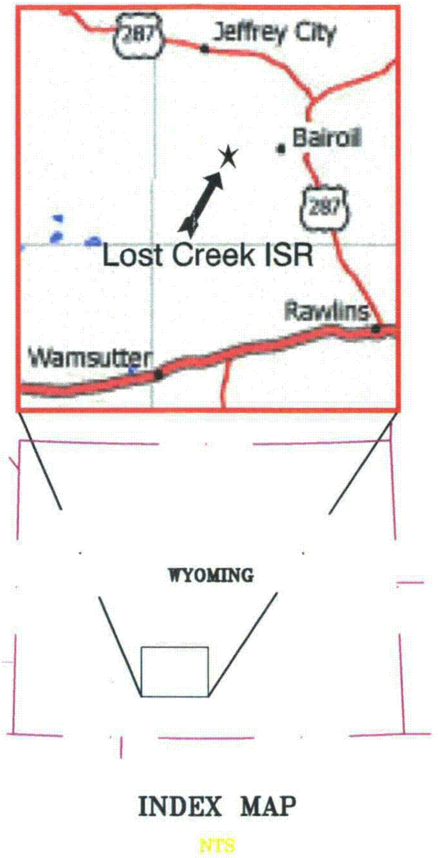
Project No. 0802

April 2008

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

INDEX OF DRAWINGS

Drawing No.	Title
0802.100	Index, Legend & General Notes
0802.100	Overall Site Plan
0802.101	Embamkment Plan
0802.103	Embankment Details
0802.104	Liner and Leak Detection Details



INDEX MAP

NTS

LEGEND

- Existing ground surface or bottom of excavation
- Groundwater table
- 6520 Existing grade elevation
- Slope
- 3:1 3 horizontal to 1 vertical slope
- 1 / 00802.000 Section number; Drawing No. where section is shown or called out
- W.S. Water surface

UNIFIED SOIL CLASSIFICATION SYSTEM

- Gravels; include GP, GM and GC
- Clean sands; include SW and Sp
- Clayey sands and silts; include SM, SC and ML
- Clays; include CL and CH
- Borrow Area

ABBREVIATIONS

PWPC	Process water collection pond	MH	Manhole
LCRS	Leachate collection and removal system	ID	Inside diameter
		OD	Outside diameter
CMP	Corrugated metal pipe	NFWE	No free water encountered
HDPE	High density polyethylene		
PVC	Polyvinyl Chloride	Nom.	Nominal
CPT	Corrugated polyethylene tubing	SDR	Standard dimensional ratio
NTS	Not to Scale		
Typ.	Typical		
El.	Elevation		
Req'd	Required		
Dia.	Diameter		
Sch.	Schedule		
℄	Center line		
Perf.	Perforated		

Lost Creek ISR, LLC
Englewood, Colorado, USA

Engineered By:
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Index, Legend and General Notes

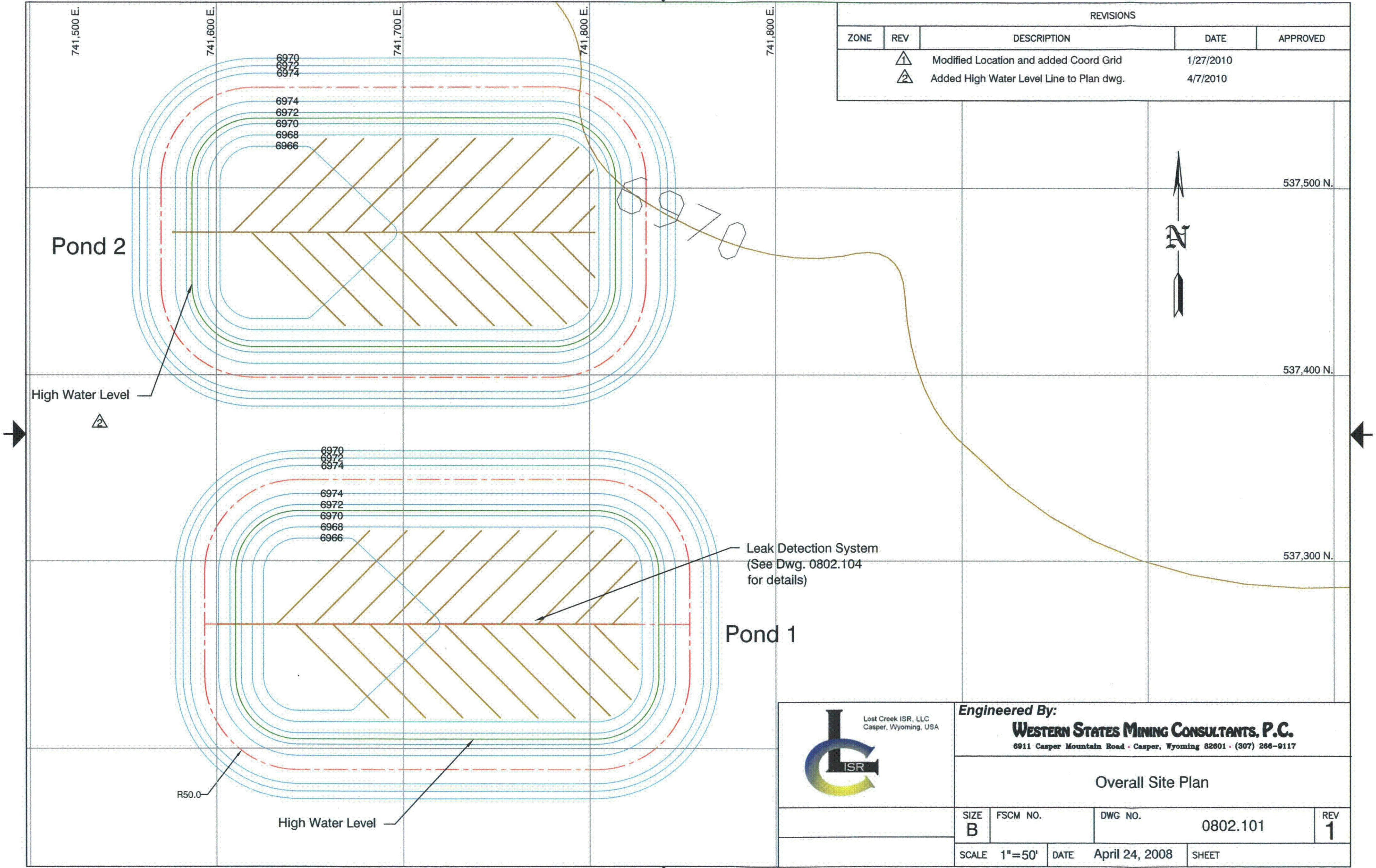
SIZE	FSCM NO.	DWG NO.	REV
B		0802.100	
SCALE	DATE April 24, 2008	SHEET	

FNAME

REVDATE

USER

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	1	Modified Location and added Coord Grid	1/27/2010	
	2	Added High Water Level Line to Plan dwg.	4/7/2010	



Leak Detection System
(See Dwg. 0802.104
for details)

Lost Creek ISR, LLC
Casper, Wyoming, USA

Engineered By:

WESTERN STATES MINING CONSULTANTS, P.C.

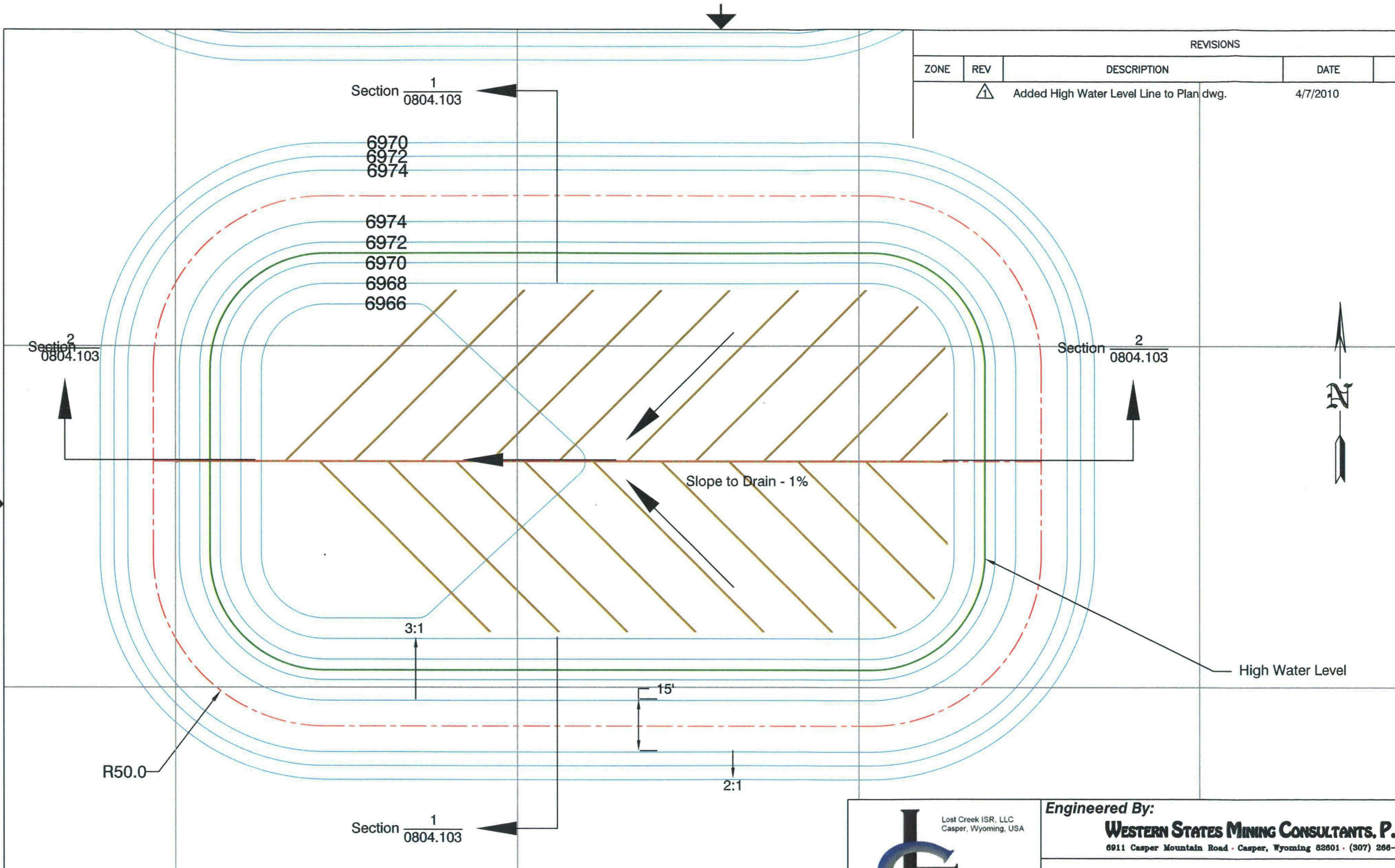
6911 Casper Mountain Road · Casper, Wyoming 82601 · (307) 266-9117

Overall Site Plan

SIZE	FSCM NO.	DWG NO.	REV
B		0802.101	1

SCALE 1"=50' DATE April 24, 2008 SHEET

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	⚠1	Added High Water Level Line to Plan dwg.	4/7/2010	



Lost Creek ISR, LLC
Casper, Wyoming, USA

ISR

Engineered By:

WESTERN STATES MINING CONSULTANTS, P.C.

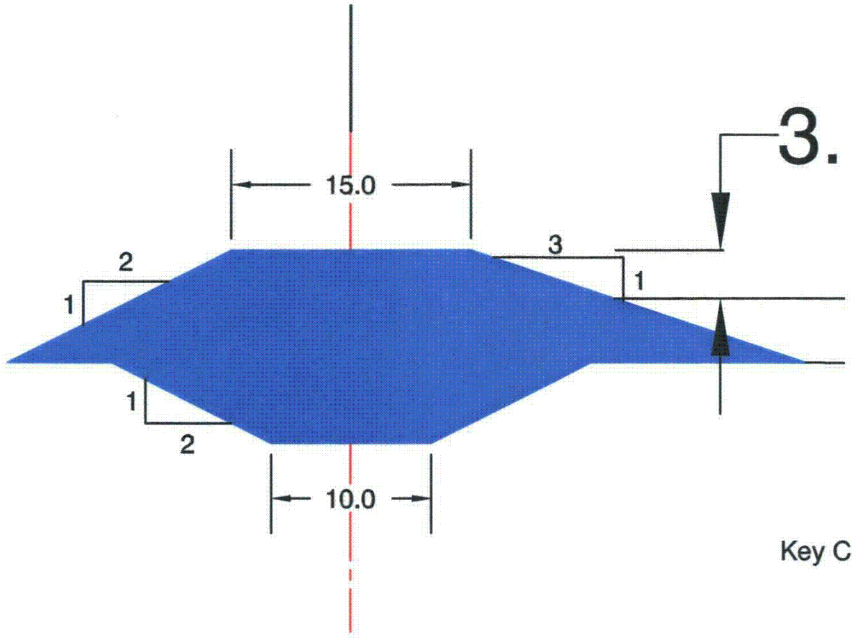
6911 Casper Mountain Road · Casper, Wyoming 82601 · (307) 266-9117

Embankment Plan

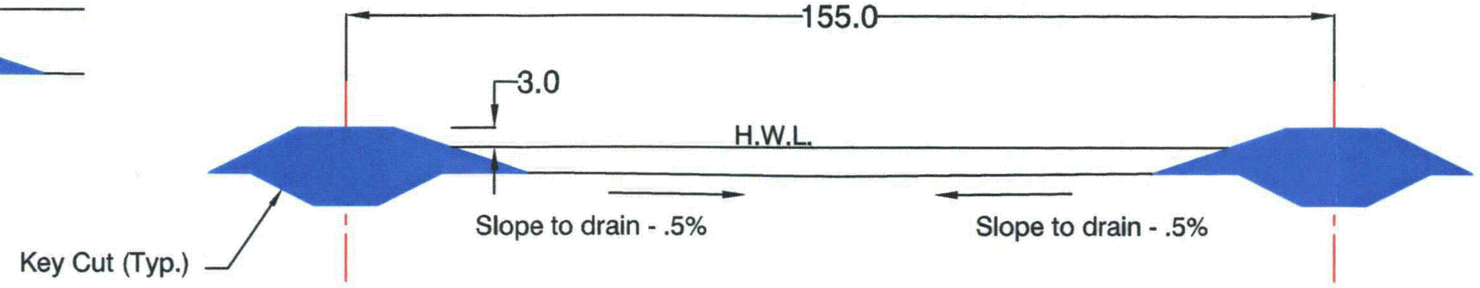
SIZE	FSCM NO.	DWG NO.	REV
B		0802.102	1

SCALE			
SCALE	1"=30'	April 24, 2008	SHEET

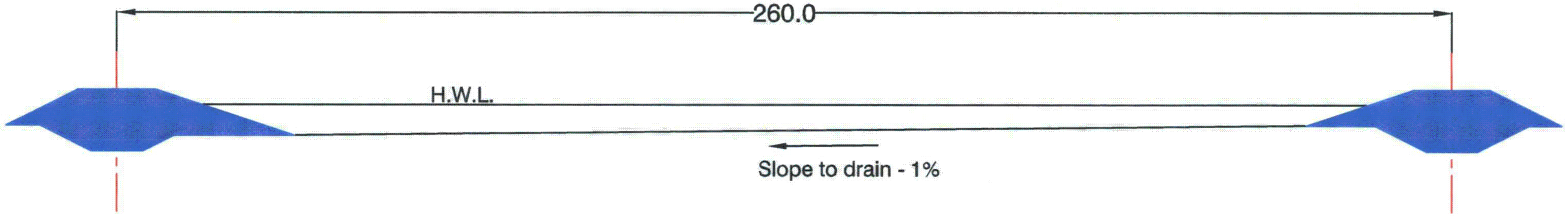
REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Embankment Detail
(Typ.)
NTS



Section $\frac{1}{0804.102}$



Section $\frac{2}{0804.102}$

FNAME

REVDATE

USER

Lost Creek ISR, LLC
Englewood, Colorado, USA

Engineered By:

Western States Mining Consultants, P.C.
6911 Casper Mountain Road · Casper, Wyoming 82601 · (307) 266-9117

Embankment Details

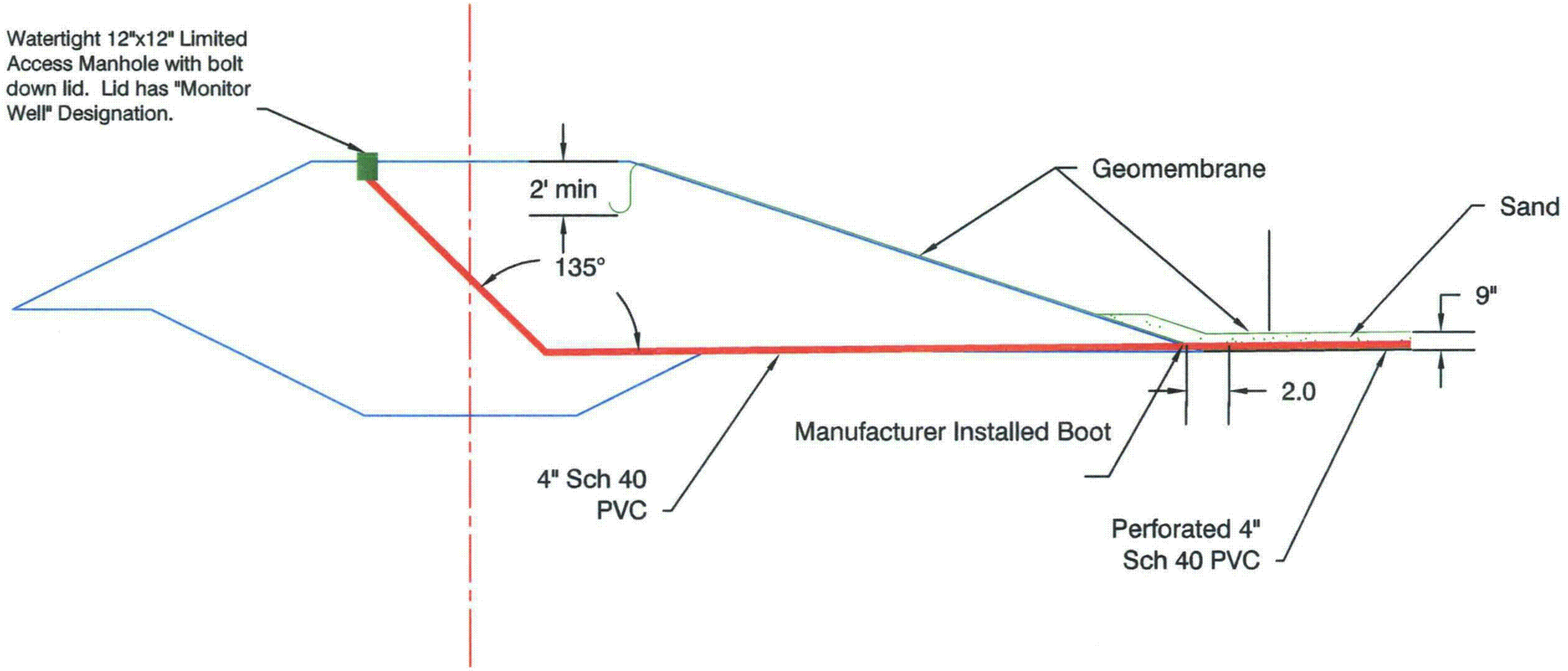
SIZE B
FSCM NO.
DWG NO. 0802.103
REV
SCALE 1"=30'
April 24, 2008
SHEET

FNAME

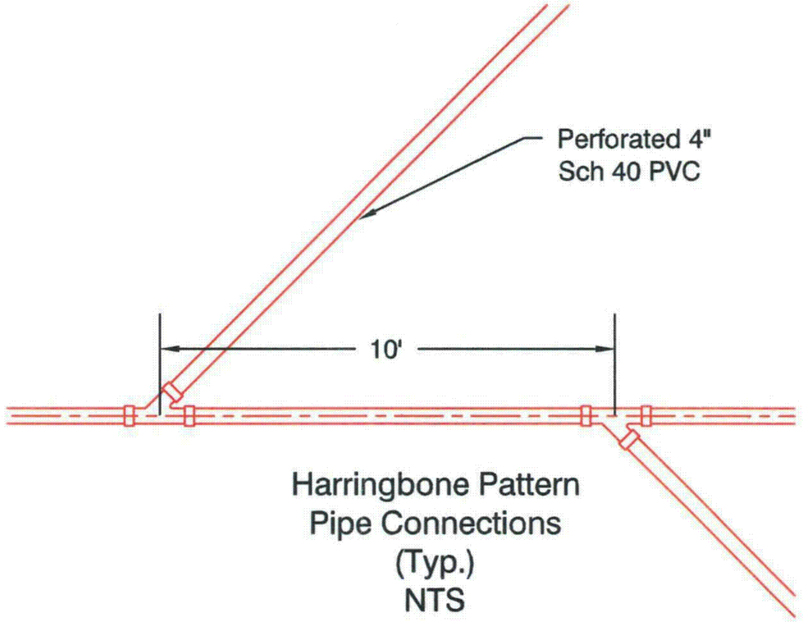
REVDATE

USER

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Double Geomembrane Liner
w/ Leak Detection
NTS



Harringbone Pattern
Pipe Connections
(Typ.)
NTS

Lost Creek ISR, LLC
Englewood, Colorado, USA

ISR

Engineered By:

WESTERN STATES MINING CONSULTANTS, P.C.
6911 Casper Mountain Road · Casper, Wyoming 82601 · (307) 266-9117

Leak Detection Details

SIZE	FSCM NO.	DWG NO.	REV
B		0802.104	
SCALE NTS		April 24, 2008	SHEET

Subsurface Exploration and Geotechnical Engineering Report

Prepared for:

Lost Creek ISR, LLC
5880 Enterprise Drive, Suite 500
Casper, WY 82601

Uranium Processing Plant Sweetwater County

September 8, 2008

13854-CX

Prepared by:

INBERG-MILLER ENGINEERS
1120 East "C" Street
Casper, WY 82601

INBERG-MILLER ENGINEERS

QUALITY SOLUTIONS THROUGH TEAMWORK

September 8, 2008 13854-CX

Mr. Steve Hatten
Lost Creek ISR, LLC
5880 Enterprise Drive, Suite 500
Casper, WY 82601

RE: SUBSURFACE EXPLORATION AND
GEOTECHNICAL ENGINEERING REPORT
URANIUM PROCESSING PLANT
SWEETWATER COUNTY, WYOMING

Dear Steve:

We are enclosing the original and two copies of our subsurface Exploration and Geotechnical Engineering report for the above-referenced project. The work described in this report has been completed per our Service Agreement and proposal (Appendix A) dated August 5, 2008.

It has been a pleasure participating in this project. We are available to provide additional services at your request. Services we could provide include:

- additional field exploration
- environmental assessment
- civil engineering
- plan and specification review
- surveying
- construction materials testing
- observation of excavations and earthwork

If you have any questions or comments, please contact us at 307-577-0806.

Sincerely,

INBERG-MILLER ENGINEERS

Ben Hauser E.I.T.
Geotechnical Engineer

BH:llm\13854-cx\13854-cx rpt

Enclosures as stated

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TABLE OF CONTENTS

Summary

Based on information obtained from our subsurface exploration and laboratory testing of recovered samples, it is our opinion that the site is suitable for construction of the proposed uranium processing plant, subject to considerations for site preparation and foundations as described in this report. Our field exploration included 12 test borings to depths ranging from 20 to 45 feet. Soils encountered included varying layers of sand and clay. Soils at anticipated shallow foundation depths were generally in a very dense or hard condition. Groundwater was not encountered within any of the test borings.

The proposed building can be supported on conventional, shallow spread, and continuous footings bearing on properly prepared and compacted native subgrades. Footings can be placed on firm, native soil subgrades that have been scarified, moisture conditioned, and compacted as described in the recommendations.

Scope of Services

The purpose of this study was to explore subsurface conditions at the site of the proposed uranium processing plant, and to provide geotechnical recommendations for design and construction. Specific recommendations and information are provided about foundation types, bearing capacity, groundwater conditions, earthwork, and other pertinent foundation and construction requirements.

Project Information

Project information was provided by Steve Hatten and Catherine Bull with Lost Creek ISR, LLC. It is our understanding the project will consist of constructing a new uranium processing plant and two containment ponds.

Detailed information on the structural loads was not available at the time this report was prepared. However, based on information provided, we assume that the proposed buildings will have low to moderate loads. These assumptions include maximum wall loads on the order of 3 kips per linear foot and maximum isolated columns loads on the order of 60 kips. In addition we understand there will be processing tanks with approximate loads of 100 kips. Some recommendations provided in this report will not be appropriate for buildings with loads in excess of those described above. Based on preliminary drawings provided to us we understand the project will include the construction of a main plant with approximate dimensions of 425 feet by 200 feet. In addition, the project will have two out buildings, one located at the north edge, and the other located at the southeast corner of the plant. We assume structural loads for these buildings will be similar to the main processing plant. Test borings were placed within the proposed footprint of each out building.

Grading plans were not provided to us at the time this report was prepared. We assume that some minor grading will be required for the proposed plant, and cut and fill depths will be less than 3 feet. If cuts and fills significantly in excess of these assumptions are planned for the proposed plant, we should be provided plans and the recommendations of this report should be reviewed for conformance with the planned site configuration. Cut and fill recommendations have not been provided for the proposed containment ponds.

Field Exploration

The fieldwork was performed using a Mobile B-57 truck-mounted drilling rig at the site from August 11 through August 15, 2008. Twelve test borings were advanced to depths of 20 to 45 feet. Drilling was performed using 4.25-inch inside diameter, hollow-stem augers. The augers act as a continuously advancing, steel casing. The method prevents test holes from caving in above the levels to be tested. Sampling tools are lowered inside the hollow-stem for testing into undisturbed soils.

Drilling and field sampling were performed according to the following standard specifications:

1. "Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling," ASTM D6151.
2. Sampling with a 2-inch O.D., split-barrel (split-spoon) sampler per ASTM D1586, "Penetration Test, and Split-Barrel Sampling of Soils." Ninety-eight such tests were performed. Standard penetration test blow counts were obtained by driving a 2.0-inch diameter split-spoon sampler into the soil using an automatic hammer that drops a 140-pound hammer a distance of 30 inches. The SPT N-value is the blow count for 12 inches of sampler penetration. N-values are correlated to soil relative density, hardness, strength and a variety of other parameters.

The soil samples were field classified by the geotechnical engineer, sealed in containers to prevent loss of moisture, and returned to our laboratory. A field log was prepared for each boring during drilling. The borings were located in the field by pacing from property corners.

Laboratory Testing Program

Upon return to the office, samples were classified visually in accordance with ASTM D2488. In order to better classify the recovered samples and determine their engineering properties, the following laboratory soil tests were performed:

		TESTS
1.	Moisture Content (ASTM D2216)	98
2.	Atterberg Limits (ASTM D4318)	7
3.	Sieve Analysis (#4 to #200) (ASTM C136 and C117)	13
4.	Water Soluble Sulfate	4

A Final Log for each boring was prepared containing the work method, samples recovered, and a description of soils encountered. The sieve analyses are presented graphically in Appendix C. All other test results are arrayed on the final logs bound into Appendix B.

Site Conditions

The site is located approximately 23 miles southwest of Bairoil, Wyoming. The site is vegetated with sparse native grass. The topography at the site slopes gently to the south. A Site Location Map, Site Observation Sheet, and Test Boring Location Plan in Appendix A describe the site in more detail.

Subsoil Conditions

The subsoil classified in the 12 test borings performed at the site consisted of varying layers of sand and clay over sedimentary bedrock. The following paragraphs represent only general subsoil conditions for the site due to the degree of variability within the subsoil. The final logs presented in Appendix B should be viewed for specific details about the subsoil conditions.

The topsoil consists of 0.5 to 2 feet of sandy clay. The organic content of the soils appears to be relatively low. Standard Penetration Test Blow counts (N-Values) indicate that the soils are in a stiff to hard condition.

Over the approximate interval of 2 to 4 feet, clayey sand and sandy clay was encountered. Laboratory testing indicates minus number 200 sieve fractions of 16.6 percent to 72.8 percent and plasticity indices of "non-plastic" to 18 percent indicating low to medium plasticity. Standard Penetration Test blow counts (N-values) indicate that the soil is in a medium dense to very dense condition in the case of the sand soils. The clay soil condition is hard.

Over the approximate interval of 4 feet to the extent of each boring, sedimentary bedrock was encountered. Laboratory testing indicates minus number 200 sieve fractions of 15.3 percent to 80 percent and plasticity indices of "non-plastic" to 14 percent indicating low to medium plasticity.

Based on the soil classification, the clayey sand has a low susceptibility for problematic settlement or heave under anticipated building loads. However, layers with high percentages of moderate plasticity clay may be subject to swell and heave if moisture becomes elevated.

Groundwater Conditions

Groundwater was not encountered in any of the test borings. Observations were made in each test boring at the completion of drilling and again prior to completion of the fieldwork. This information, along with cave-in depths of the drill holes, is recorded on the final logs in Appendix B. Test borings were backfilled at the completion of the fieldwork for practical and safety reasons, therefore no subsequent readings were performed.

Three permanent monitor wells were placed in the corners of the containment ponds. The fourth monitor well was not installed after exploration of the subsoil conditions at B-2 indicated that a suitable low permeability layer was not present. Installation records for the three monitor wells are presented graphically in Appendix B.

Recommendations

Earthwork

1. Prior to construction on the site, all vegetation and organic surface matter should be stripped from the surface. Based on the test borings, it appears that stripping depths of approximately 4 to 8 inches may be required.

2. Demolition of existing structures and utilities (if any) must include complete removal of below grade concrete and old fill.

3. After excavation to desired site grades (including any overexcavation required), and prior to placing fill or erection of forms for foundations and slabs, we recommend the site surface be compacted. This compaction densifies the native subgrade and soils loosened by excavation. This compaction effort should be performed in the presence of the geotechnical engineer so that soft or loose zones can be properly identified and improved. Alternatively, the geotechnical engineer can observe proof rolling with a heavily loaded wheeled vehicle. If loose or soft zones are encountered that do not improve with repeated compaction, they should be removed and replaced with properly compacted, approved fill, as described in Items 4 and 5 below.

4. Fill material requirements are provided in the following table:

Use	Fill Material
Beneath structures	Native clayey sand or Structural fill meeting Envelope A
Beneath Slabs/Pavement	
Bottom of slap/paved surface to 6 inches	Grading W aggregate base
Deeper than 6 inches below slab	Native clayey sand or Structural fill meeting Envelope A
Road and pavement subgrades	Scarified and compacted native soil
Trench backfill	Native clayey sand
General site fill in landscaped areas	Native clayey sand

Imported fill specifications are provided below:

Structural Fill Envelope A	
Sieve	Percent Finer
1.5″	100
#4	50-100
#8	30-90
#30	15-75
#50	10-60
#200	0-20
Liquid Limit < 40, PI < 15	

WYDOT Grading W Crushed Aggregate Base	
Sieve	Percent Finer
1.5″	100
1″	90-100
½″	60-85
#4	45-65
#8	33-53
#200	3-12
Liquid Limit < 25, PI < 3	

5. Engineered fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness and compacted at moisture contents ranging from 2 percent below to 2 percent above the optimum moisture content. The contractor's equipment and procedures should produce a uniformly mixed and compacted lift. In-place density and water content of each lift of fill materials should be tested and approved.

The following table is our recommended soil compaction requirement for earthwork. All compaction requirements are based on Standard Proctor maximum dry density (ASTM D698).

Native Subgrade	Minimum % Compaction
Scarified and compacted subgrade soils beneath footings, slabs-on-grade, pavement, and structural fill	95
Fill Soils	
Beneath foundations	95
Beneath slabs-on-grade	95
Beneath pavements	95
Embankments and backfill in non-structural areas	90

6. If construction takes place during cold weather, care should be taken to prevent construction on frozen soils. In addition, fill materials should not contain snow and/or ice and should not be placed in a frozen condition.

Foundations

The proposed structures can be supported on conventional continuous and spread footings bearing on well-prepared native soil. Site soils are generally in a hard or very dense condition and are considered adequate for support of shallow foundations.

1. Continuous strip or individual pad (spread) footings should bear on moisture conditioned, compacted, and tested, native site soil. Compaction should be performed as described in the *Earthwork* section above.

2. Spread footings for building columns and continuous footings for bearing walls should be designed for an allowable net bearing pressure of 1500 psf. The allowable net bearing pressure could potentially be increased if excavations reveal that footings will bear directly on the sandstone bedrock. This determination should be made by a qualified geotechnical engineer.
   - Shallow footing widths should be a minimum of 24 inches for individual pads and 18 inches for continuous footings.
   - The allowable net bearing pressure can be increased by one-third for short-term loads such as wind or seismic.
   - The above allowable bearing pressure is to be used with foundation reactions from dead and long-term live loads derived by working stress analyses.
   - "Net" bearing pressure is the difference in vertical pressure on an element of soil, at the bottom of the footing, between its pre-excavation condition and its completed project condition (including all live and dead structural loads). Generally, the weight of below-grade foundation concrete and below-grade fill are not considered a net structural load because the densities of these materials are similar to the density of the original soil they displace. Where site grades change between the time of foundation excavation and project completion, the weight of fill soil and/or excavated soil may need to be accounted for as part of the "net bearing capacity".

3. For frost protection and to provide containment for the bearing soils, exterior footings should extend to a minimum depth of 48 inches below finished exterior grade. Interior footings within heated areas of the building should extend to a minimum depth of 18 inches below the floor subgrade.

4. Settlement is often induced by saturation of the foundation subgrade. Therefore, provisions for adequate surface drainage should be made. Where differential settlement may be problematic, consideration should be given to design footing

dimensions and loads to produce equal settlement. This effort may include considerations of compressibility of native soil, thickness and compressibility of fill, and distribution of dead load. Total anticipated settlement and differential settlement based on the allowable bearing pressure and estimated footing sizes are presented below:

Footing Size	Estimated Total Settlement	Estimated Differential Settlement
Continuous or rectangular (*B<3 feet)	0.25 to 0.5 inch	< 0.5 inch
Rectangular or Circular (*3 feet < B < 10 feet)	0.5 to 1.0 inches	< 0.5 inch
Rectangular or Circular (*10 feet < B < 15 feet)	0.5 to 1.5 inches	< 0.5 inch

* B = least footing dimension or diameter

5. Footing subgrades should be observed by the geotechnical engineer prior to concrete placement, to identify suitable bearing materials, and to observe whether the foundation soils have been properly prepared prior to foundation construction. All loose or soft soils in the footing excavation should be removed from the foundation excavation prior to concrete placement. Footings should not be placed on either uncompacted native soil or uncompacted fill.

Lateral Earth Pressures

1. Lateral load parameters are provided in the following table. All of the parameters assume the structure and soils are above the water table. The following parameters do not include a factor of safety. A minimum factor of safety of 2.0 is recommended for horizontal loading.

	Native Clayey Sand	Grading A Fill
Active Lateral Soil Pressure – for structures that can deflect without restraint by other structures. (equivalent fluid unit weight, pcf)	35	40
At-Rest Lateral Soil Pressure - for structures that have significant restraint against deflection. (equivalent fluid unit weight, pcf)	55	60
Passive Lateral Soil Pressure – resistance of soil abutting a structure. (equivalent fluid unit weight, pcf)	480	400
Coefficient of Friction between foundation and underlying soil	0.6	0.5
Soil Density, wet soil (pcf)	130	135

2. Where possible, foundations should be backfilled and compacted evenly on all sides to prevent horizontal movement due to unbalanced pressure. Foundations walls should be adequately braced prior to backfilling. Fill placed against retaining walls or basement walls should be carefully compacted with appropriate equipment to prevent excessive lateral pressures that may displace or damage the structure.

3. Surcharge loads, on the uphill side of the wall, due to ground slope, soil stockpiles, equipment, and structures may significantly increase lateral forces on the wall and need to be fully evaluated, if applicable to this project, by the geotechnical engineer.

4. Drains should be installed behind retaining walls or other confined areas where surface seepage and percolation water can collect. Drains should be designed to prevent the build-up of hydrostatic pressures behind the retaining structures due to trapped water.

Slab-on-Grade

1. We recommend a minimum of 6 inches of properly compacted aggregate base (WYDOT Grading W) beneath the slab. This layer is intended as a leveling course and to reduce potential point loading due to inconsistencies in the natural subgrade or shrink-swell related movements. The aggregate base course will not provide an effective capillary break for moisture rise to the slab. Soil beneath the aggregate base can be properly prepared, native soil or structural fill prepared as described in the Site Preparation and Fill Section above.

2. The floor slabs should have an adequate number of joints to reduce cracking resulting from differential movement, shrinkage, and curing stresses. The floor slab should be considered "floating" and may move differentially with respect to the building and foundation supported equipment. Consequently, isolation joints should be placed between the floor, building walls, and foundation supported equipment.

3. Regardless of the pre-construction soil-moisture content, there is a potential for problematic infiltration of moisture upwards through the slab-on-grade floor. In this semi-arid climate, the moisture content of soil beneath buildings generally increases following construction. This is due to the reduction of evapotranspiration from the ground surface and the concentration of water around the building from irrigation and runoff from hard surfaces. Post-construction moisture infiltration through the slab may result in damage to

flooring materials or may support growth of mold or other biologic materials in areas of poor ventilation. Installation of a moisture barrier beneath the slab should be considered by the building design professionals in light of the long-term service requirements for the building.

General

1. The measured water-soluble sulfate content of 0-50 ppm for samples from test borings B-6, B-8, B-9, and B-11 at a depth of 2.5 feet indicates that the soils do not contain sufficient sulfates to be very reactive with cement. According to American Concrete Institute (ACI) and Portland Cement Association (PCA) guidelines, no special provisions for cement type or water/cementitious material ratio are required for sulfate resistance of portland cement concrete.

2. Rainwater discharge from the building roofs, parking, and drive areas should be directed toward collection points and disposed of away from the building and pavement in an adequate and efficient manner.

3. In order to promote drainage away from the building, we recommend that final exterior grades slope away from the building at a slope of 5 percent for a minimum distance of 10 feet.

4. In order to reduce the presence of moisture near the structure, landscaping adjacent to the building should utilize plants and vegetation that do not require much irrigation. Furthermore, sprinkler heads should not be placed closer than 10 feet from the structure.

5. In accordance with the International Building Code (IBC), 2003 Edition, Table 1615.1.1, we recommend site Class C for determination of design spectral response acceleration parameters per IBC. This class is based on Standard Penetration Resistance blow count numbers (N-values) per ASTM D1586 and the assumption that the subsurface soil conditions encountered in the test borings can be projected deeper into the earth to describe the average soil conditions for the top 100 feet. Class C describes the average soil properties for the top 100 feet as very dense soil and soft rock (Standard Penetration Test blow count, N > 50 or unconfined shear strength > 2,000 psf).

6. Inberg-Miller Engineers should review final plans and specifications in order to determine whether the intent of our recommendations has been properly implemented. In addition, we should be retained as the geotechnical engineer and construction materials testing agency to provide the following services:

a. Observe excavations to determine if subsurface conditions revealed are consistent with those discovered in the exploration.
b. Identify if the proper bearing stratum is exposed at proposed foundation excavation depths.
c. Observe that foundation excavations are properly prepared, cleaned, and dewatered prior to concrete placement.
d. Test compaction of subgrades and fills.
e. Perform field and laboratory testing of concrete and other materials as required by project specification and/or building code.
f. Observe drilled pier construction to identify suitable bearing strata and to observe pier construction including cleaning of pier bottoms and concrete placement.

Construction Considerations

No major difficulties are anticipated for conventional equipment during earthwork construction at the proposed site. We do not anticipate that groundwater will be encountered at the proposed foundation depths during construction. However, excavations should be protected from surface water run-off, whenever possible. Water accumulation within excavations should be promptly removed. If excavation bottoms become wet, excavation of soils beyond the minimum required depth may be necessary to provide a firm base for fill placement.

Excavations should be sloped, benched, shored, or made safe for entry by use of trench boxes as required by the standards of 29 CFR Part 1926. As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance equal to the slope height, from the crest of the slope. The contractor is solely responsible for designing and constructing stable excavations. Furthermore, the contractor's "responsible person" should continuously evaluate the soil exposed in the excavations, the geometry of the excavation slopes, and the protective equipment and procedures employed by his forces. For the sole purpose of project planning, we recommend that sandy clays and clayey sands be considered an OSHA Type B soil. Excavations, including utility trenches, extending to depths of greater than 20 feet are required to have side slopes, trench boxes, or shoring designed by a professional engineer.

Closure

This report has been prepared for the exclusive use of our client, Lost Creek ISR, LLC, for evaluation of the site, design, and construction planning purposes of the described project. All information referenced in the Table of Contents, as well as any future written documents that address comments or questions regarding this report, constitute the "entire report". Inberg-Miller Engineers' conclusions, opinions, and recommendations are based on the entire report. This report may contain insufficient information for applications other than those herein described. Our scope of services was specifically designed for and limited to the specific purpose of providing geotechnical recommendations for the design of the proposed Uranium Processing Plant. Consequently, this report may contain insufficient information for applications other than those herein described.

The scope of services for this project does not include any environmental or biological assessment of the site. If requested, we would be pleased to assist you with developing a scope of services for environmental assessment for the subject site. Wherever structures are in contact with soil, there is potential that soil moisture may penetrate the building and provide an opportunity for mold growth. While this report identifies soil moisture/groundwater conditions and may provide geotechnical recommendations for drainage and construction, the design of drains, water proof/resistant building elements, equipment to remove moisture from the building, or additional measures to prevent the growth of mold are beyond the scope of our geotechnical services. Implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent the growth of mold in or on the proposed building.

We appreciate participating in your project. We can offer services under a separate contract to provide civil or environment engineering services, review final plans and specifications, perform construction surveying, field and laboratory construction materials testing, and observe excavations, as may be required. Please call us at 307-577-0806 if you have any questions regarding this report.

Sincerely,

INBERG-MILLER ENGINEERS

Ben Hauser, E.I.T.
Geotechnical Engineer

BH:llm\13854-cx\13854-cx rpt

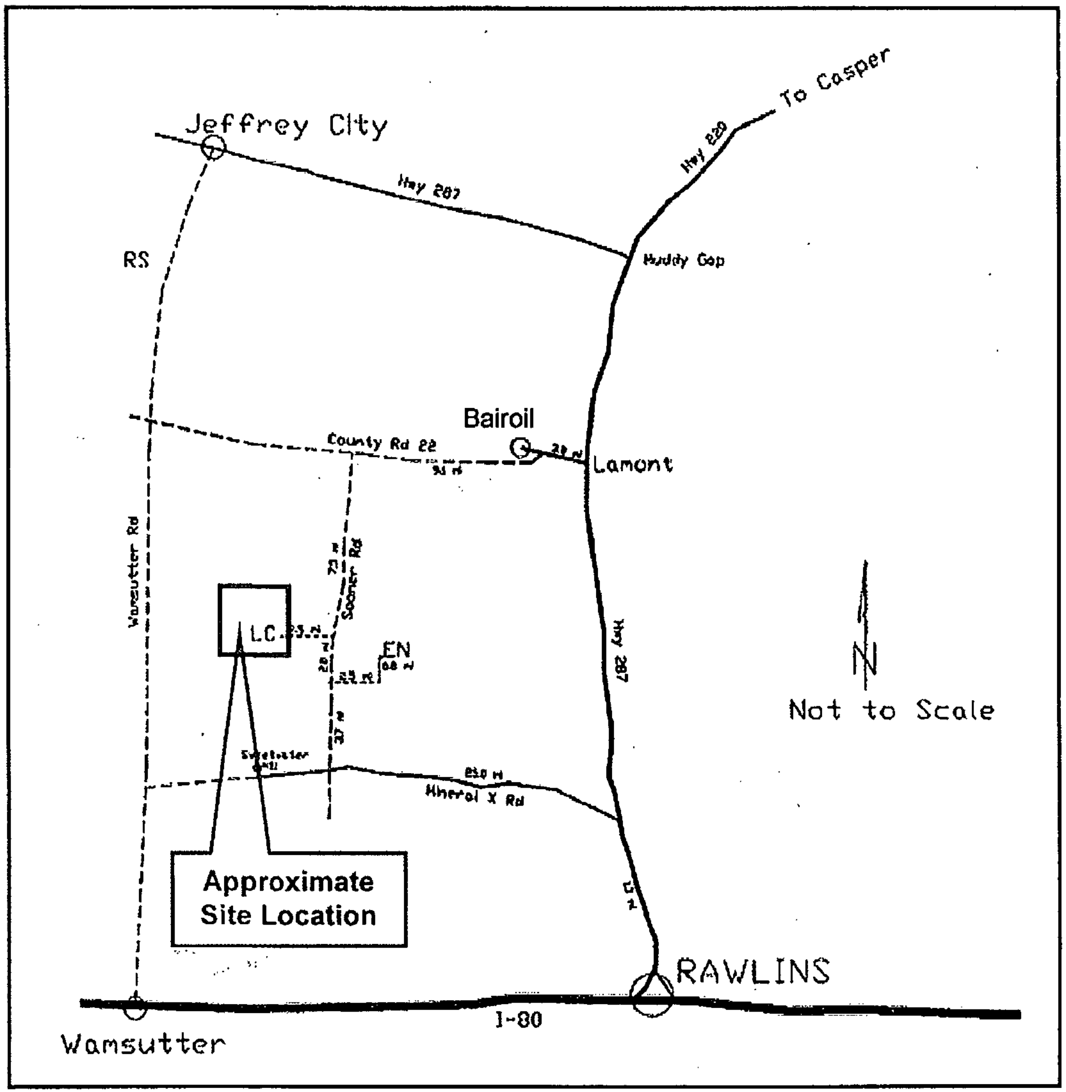
REVIEWED BY:

Glen M. Bobnick, P.E.
Geotechnical Engineer

GLEN M. BOBNICK
Date 9/8/08

Appendix A

Site Location Map

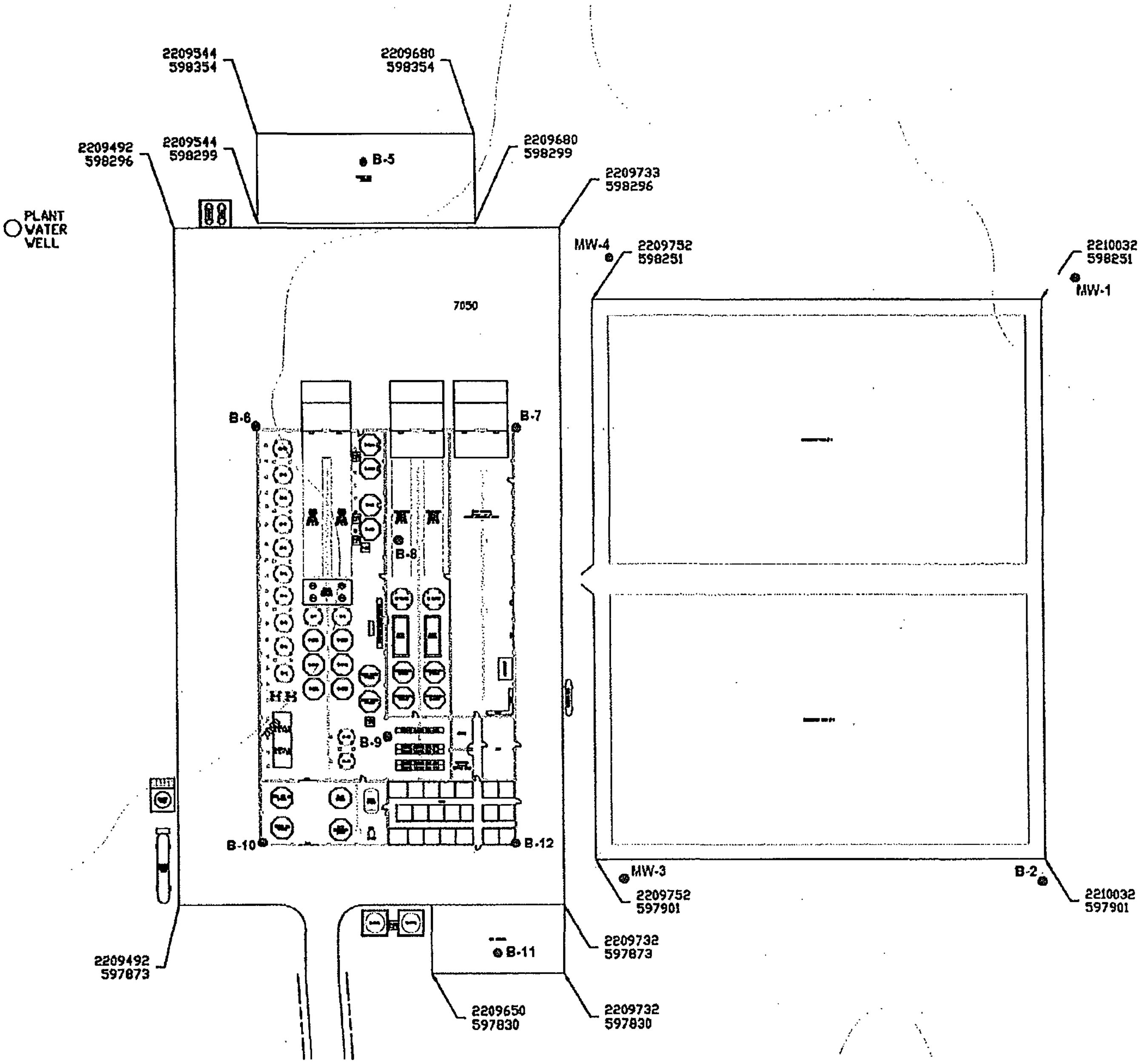


Source: Lost Creek ISR, LLC

Site Observations

1. Location of Site: *Approximately 23 miles SW of Bairoil WY*
2. City/Town: *n/a*
3. Slope of Ground Surface: *2%*
4. Downhill Direction: *south*
5. Est. Change of Surface Elevation: *5 to 6 feet*
6. Bodies of Water Nearby: *none*
7. Topsoil Type: *Sandy clay*
8. Vegetation: *Native grasses and shrubs*
9. Rock Outcrops: *None*
10. Est. Depth to Bedrock: *Unknown*
11. Artificial Fills: *None*
12. Type and Depth: n/a
13. Nearby Land Features: *None noted*
14. Present Site Improvements: *There are a few uranium exploration holes near the site*
15. Buried Utilities On Site: *None*
16. Nearby Buildings: *None*
17. Cond. of Nearby Foundations: n/a
18. Cond. of Nearby Streets/Walks: *N/A*
19. Buried Obstructions Encountered: *None*
20. History of Land Use: *BLM range land*
21. Existing Drainage Features: *None*
22. Overhead Utilities Crossing Site: *None*
23. Geologic Description of Site: *Basin lithology*
24. Remarks: *none*

Test Boring Location Plan



Test Boring by Inberg-Miller Engineers on August 11-15, 2008
Map Source: Lost Creek ISR, LLC

Appendix B

LOG OF TEST BORING NO. MW-1

Page 1 of 1

Project: Lost Creek Project

Job No.: 13854-CX

Location: 23 Miles SW of Bairoil, WY

Client: Lost Creek ISR, LLC

Surface El. (Ft):

Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	qp (TSF)	W (%)	γm γd (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 10	Stiff, dry, brown, sandy CLAY		14		2.9			
		2.5							
	SS-2 2.5-4.0 18	Dense to very dense, dry, reddish brown, clayey, fine SAND (sandstone)		40		9.0			
5	SS-3 5.0-6.5 8			50/5.5"		9.2			
	SS-4 7.5-9.0 5			50/5.5"		7.0			
10	SS-5 10.0-11.5 3	Grades to medium sand		50/4"		5.2			
15	SS-6 15.0-16.5 4			50/4"		7.0			- #200 = 24.0%
20	SS-7 20.0-21.5 2.5			50/3"		5.1			
		24.0							
25	SS-8 25.0-26.5 3	Hard, slightly moist, reddish tan, sandy CLAY (claystone)		50/4"		7.9			
30	SS-9 30.0-31.5 6	Grades olive	CL	50/4"		8.6		33 20 13	- #200 = 64.4%
		33.0							
35	SS-10 35.0-36.5 6	Very dense, moist, tan, clayey SAND (sandstone) 35.3		50/4"		10.5			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft)		none	
Time After Drilling	0.1		
Depth to Water (ft)	none		
Depth to Cave-In (ft)			

DRILLING AND SAMPLING NOTES

Date Begun 8/12/08 Comp. 8/13/08

Crew BH, BWH Rig Mobile B-57

Method: Hollow-Stem Auger

Termination Depth (ft) 35.3

LOG OF TEST BORING/PIT 13854-CX GINT.GPJ INB_MLLR.GDT 9/4/08

INBERG-MILLER ENGINEERS

LOG OF TEST BORING NO. B-2

Page 1 of 1

Project: Lost Creek Project
Job No.: 13854-CX
Location: 23 Miles SW of Bairoil, WY
Client: Lost Creek ISR, LLC
Surface El. (Ft):
Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	q_p (TSF)	W (%)	γ_m γ_d (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 5	Hard, dry, brown, sandy CLAY		32		3.5			
	SS-2 2.5-4.0 16	Grades tan		52		8.9			
		4.5							
5	SS-3 5.0-6.5 12	Very dense, dry, olive tan clayey SAND (sandstne)		50/4"		8.8			
	SS-4 7.5-9.0 4			50/5.5"		6.9			
10	SS-5 10.0-11.5 4			50/5"		7.1			
15	SS-6 15.0-16.5 3.5			50/4"		4.7			- #200 = 28.3%
20	SS-7 20.0-21.5 5.5	Grades less clayey		50/4"		6.4			
25	SS-8 25.0-26.5 5.5			50/4"		8.7			- #200 = 21.0%
30	SS-9 30.0-31.5 3.5			50/4"		7.9			
35	SS-10 35.0-36.5 4	35.3		50/4"		5.7			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft) none
Time After Drilling 0.1
Depth to Water (ft) none
Depth to Cave-In (ft) 21.5

DRILLING AND SAMPLING NOTES

Date Begun 8/14/08 Comp. 8/14/08
Crew BH, BWH, MEF Rig Mobile B-57
Method: Hollow-Stem Auger
Termination Depth (ft) 35.3

LOG OF TEST BORING/PIT 13854-CX GINT.GPJ INB_MLLR.GDT 9/9/08

INBERG-MILLER ENGINEERS

LOG OF TEST BORING NO. MW-3

Page 1 of 1

Project: Lost Creek Project
Job No.: 13854-CX
Location: 23 Miles SW of Bairoil, WY
Client: Lost Creek ISR, LLC
Surface El. (Ft):
Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	qp (TSF)	W (%)	γm γd (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 11	Medium dense, dry, tan, clayey, medium SAND		23		3.7			
	SS-2 2.5-4.0 10	Grades very dense		66		11.2			
5	SS-3 5.0-6.5 9			50/3"		3.5			- #200 = 16.6%
	SS-4 7.5-9.0 12	9.0		50/5.5"		4.7			
10	SS-5 10.0-11.5 14	Very dense, moist, light olive, clayey SAND (sandstone)	SM	50/5.5"		3.5		NP	- #200 = 15.3%
15	SS-6 15.0-16.5 5	Grades gray		50/5.5"		9.5			
20	SS-7 20.0-21.5 4	23.0		50/4"		8.9			
25	SS-8 25.0-26.5 3	Very dense, moist, light tan, clayey, medium SAND (sandstone)		50/4.5"		3.1			
30	SS-9 30.0-31.5 4			50/5"		5.1			- #200 = 17.3%
35	SS-10 35.0-36.5 5			50/5"		7.9			
40	SS-11 40.0-41.5 4			50/4.5"		8.2			
45	SS-12 45.0-46.5 2	45.2		50/2.5"		8.4			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft) none
Time After Drilling 0.1
Depth to Water (ft) none
Depth to Cave-In (ft)

DRILLING AND SAMPLING NOTES

Date Begun 8/11/08 Comp. 8/12/08
Crew BH, BWH Rig Mobile B-57
Method: Hollow-Stem Auger
Termination Depth (ft) 45.2

LOG OF TEST BORING/PIT 13854-CX GINT.GPJ INB_MLLR.GDT 9/4/08

INBERG-MILLER ENGINEERS

LOG OF TEST BORING NO. MW-4

Page 1 of 1

Project: Lost Creek Project
Job No.: 13854-CX
Location: 23 Miles SW of Bairoil, WY
Client: Lost Creek ISR, LLC
Surface El. (Ft):
Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	qp (TSF)	W (%)	γ_m γ_d (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 6	Very stiff, dry, light brown, sandy CLAY (		25		3.4			
		2.5							
	SS-2 2.5-4.0 14	Medium to very dense, dry, tan, clayey, medium SAND (sandstone)		21		6.6			
5	SS-3 5.0-6.5 10			50/5.5		3.9			
	SS-4 7.5-9.0 8			50/3"		5.9			
10	SS-5 10.0-11.5 6			50/6"		9.6			
15	SS-6 15.0-16.5 8			50/3"		10.9			- #200 = 20.5%
20	SS-7 20.0-21.5 3			50/4"		7.4			
		24.0							
25	SS-8 25.0-26.5 4	Hard, dry, light tan, sandy CLAY (claystone)	CL	50/4.5"		26.1		34 21 13	- #200 = 72.7%
30	SS-9 30.0-31.5 3			50/4"		9.8			
		33.0							
35	SS-10 35.0-36.5 3	Very dense, dry, tan, clayey SAND (sandstone) 35.3		50/4"					

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft) none
Time After Drilling 0.1
Depth to Water (ft) none
Depth to Cave-In (ft)

DRILLING AND SAMPLING NOTES

Date Begun 8/12/08 Comp. 8/12/08
Crew BH, BWH Rig Mobile B-57
Method: Hollow-Stem Auger
Termination Depth (ft) 35.3

INBERG-MILLER ENGINEERS

LOG OF TEST BORING NO. B-5

Page 1 of 1

Project: Lost Creek Project Job No.: 13854-CX

Location: 23 Miles SW of Bairoil, WY Client: Lost Creek ISR, LLC

Surface El. (Ft): Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	qp (TSF)	W (%)	γm γd (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 3	Very stiff, dry, tan, sandy CLAY topsoil to 6 inches 2.0	SC	23		3.6		31 17 14	- #200 = 41.8%
	SS-2 2.5-4.0 14	Medium to very dense, dry, tan, clayey SAND		20		1.8			
5	SS-3 5.0-6.5 18	7.5		51		5.6			
	SS-4 7.5-9.0 6	Very dense, dry, tan, clayey SAND (sandstone)		50/6.5"		5.9			
10	SS-5 10.0-11.5 5			50/4"		6.9			
15	SS-6 15.0-16.5 4			50/4.5"		6.7			
20	SS-7 20.0-21.5 4	20.3		50/3"		8.0			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft) none

Time After Drilling 0.1

Depth to Water (ft)

Depth to Cave-In (ft) 11.0

DRILLING AND SAMPLING NOTES

Date Begun 8/13/08 Comp. 8/13/08

Crew BH, BWH Rig Mobile B-57

Method: Hollow-Stem Auger

Termination Depth (ft) 20.3

LOG OF TEST BORING NO. B-6

Page 1 of 1

Project: Lost Creek Project
Job No.: 13854-CX
Location: 23 Miles SW of Bairoil, WY
Client: Lost Creek ISR, LLC
Surface El. (Ft):
Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	q_p (TSF)	W (%)	γ_m γ_d (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 5	Very stiff, dry, tan, sandy CLAY 2.0		24		1.8			
	SS-2 2.5-4.0 18	Dense to very dense, dry, light tan, clayey SAND (sandstone)		36		10.5			wss = 0-50 ppm
5	SS-3 5.0-6.5 10			50/5.6"		5.6			
	SS-4 7.5-9.0 3			50/4.5"		5.7			
10	SS-5 10.0-11.5 3			50/3"		4.8			
15	SS-6 15.0-16.5 2			50/2.5"		3.9			
20	SS-7 20.0-21.5 2	20.3		50/2.5"		8.7			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft)		none	
Time After Drilling	0.1		
Depth to Water (ft)			
Depth to Cave-In (ft)	12.0		

DRILLING AND SAMPLING NOTES

Date Begun 8/12/08 Comp. 8/13/08
Crew BH, BWH Rig Mobile B-57
Method: Hollow-Stem Auger
Termination Depth (ft) 20.3

LOG OF TEST BORING/PIT 13854-CX GINT.GPJ INB_MLLR.GDT 9/4/08

INBERG-MILLER ENGINEERS

LOG OF TEST BORING NO. B-7

Page 1 of 1

Project: Lost Creek Project
Job No.: 13854-CX
Location: 23 Miles SW of Bairoil, WY
Client: Lost Creek ISR, LLC
Surface El. (Ft):
Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	q_p (TSF)	W (%)	γ_m γ_d (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 4	Very stiff, dry, brown, sandy CLAY		25		2.4			
		2.0							
	SS-2 2.5-4.0 18	Dense to very dense, dry, tan, clayey SAND (sandstone)		43		5.3			
5	SS-3 5.0-6.5 5			50/5.5"		5.0			
	SS-4 7.5-9.0 5			50/5.5"		4.6			
10	SS-5 10.0-11.5 6			50/6"		7.3			
15	SS-6 15.0-16.5 5			50/5"		8.8			
20	SS-7 20.0-21.5 3	20.3		50/3"		7.9			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft) none
Time After Drilling 0.1
Depth to Water (ft)
Depth to Cave-In (ft) 12.0

DRILLING AND SAMPLING NOTES

Date Begun 8/13/08 Comp. 8/13/08
Crew BH, BWH Rig Mobile B-57
Method: Hollow-Stem Auger
Termination Depth (ft) 20.3

LOG OF TEST BORING NO. B-8

Page 1 of 1

Project: Lost Creek Project
Job No.: 13854-CX
Location: 23 Miles SW of Bairoil, WY
Client: Lost Creek ISR, LLC
Surface El. (Ft):
Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	q_p (TSF)	W (%)	γ_m γ_d (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 6	Very stiff to hard, dry, brown, sandy CLAY		24		3.4			
	SS-2 2.5-4.0 4	Grades less sandy	CL	52		9.1		39 21 18	wss = 0-50 ppm - #200 = 72.8%
5	SS-3 5.0-6.5 6	Grades reddish		50/6"		6.8			
		7.0							
	SS-4 7.5-9.0 6	Very dense, dry, tan, clayey SAND (sandstone)		50/5"		7.5			
10	SS-5 10.0-11.5 6			50/5.5"		4.8			
15	SS-6 15.0-16.5 5			50/5"		7.9			
20	SS-7 20.0-21.5 4	20.3		50/4"		7.3			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft) none
Time After Drilling 0.1
Depth to Water (ft)
Depth to Cave-In (ft) 13.0

DRILLING AND SAMPLING NOTES

Date Begun 8/13/08 Comp. 8/13/08
Crew BH, BWH Rig Mobile B-57
Method: Hollow-Stem Auger
Termination Depth (ft) 20.3

INBERG-MILLER ENGINEERS

LOG OF TEST BORING NO. B-9

Page 1 of 1

Project: Lost Creek Project
Job No.: 13854-CX
Location: 23 Miles SW of Bairoil, WY
Client: Lost Creek ISR, LLC
Surface El. (Ft):
Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	q_p (TSF)	W (%)	γ_m γ_d (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 7	Very stiff, dry, brown, sandy CLAY 2.0		21		2.0			
	SS-2 2.5-4.0 4	Very dense, dry, tan, clayey SAND 4.5		51		1.9			wss = 0-50 ppm
5	SS-3 5.0-6.5 5	Hard, dry, light tan, sandy CLAY (claystone) 6.0		50/6"		9.5			
	SS-4 7.5-9.0 8	Very dense, dry, tan, clayey SAND (sandstone)	SM	50/6"		3.5		NP	- #200 = 26.9%
10	SS-5 10.0-11.5 5.5			50/6"		6.1			
15	SS-6 15.0-16.5 3			50/4"		5.1			
20	SS-7 20.0-21.5 3	20.3		50/4"		9.1			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft) none
Time After Drilling 0.1
Depth to Water (ft)
Depth to Cave-In (ft) 12.1

DRILLING AND SAMPLING NOTES

Date Begun 8/14/08 Comp. 8/14/08
Crew BH, BWH, MEF Rig Mobile B-57
Method: Hollow-Stem Auger
Termination Depth (ft) 20.3

INBERG-MILLER ENGINEERS

LOG OF TEST BORING NO. B-10

Page 1 of 1

Project: Lost Creek Project
Job No.: 13854-CX
Location: 23 Miles SW of Bairoil, WY
Client: Lost Creek ISR, LLC
Surface El. (Ft):
Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	q_p (TSF)	W (%)	γ_m γ_d (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 6	Very stiff to hard, dry, brown, sandy CLAY		29		2.0			
	SS-2 2.5-4.0 14			88		6.5			
5	SS-3 5.0-6.5 6			50/5"		7.3			
	SS-4 7.5-9.0 12	8.0 Very dense, dry, tan, clayey SAND (sandstone)		50/5.5"		5.7			
10	SS-5 10.0-11.5 6			50/6"		4.4			
15	SS-6 15.0-16.5 6			50/5"		8.3			
20	SS-7 20.0-21.5 2	20.3		50/3"		2.6			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft) none
Time After Drilling 0.1
Depth to Water (ft) none
Depth to Cave-In (ft) 12.2

DRILLING AND SAMPLING NOTES

Date Begun 8/14/08 Comp. 8/14/08
Crew BH, BWH, MEF Rig Mobile B-57
Method: Hollow-Stem Auger
Termination Depth (ft) 20.3

INBERG-MILLER ENGINEERS

LOG OF TEST BORING NO. B-11

Page 1 of 1

Project: Lost Creek Project

Job No.: 13854-CX

Location: 23 Miles SW of Bairoil, WY

Client: Lost Creek ISR, LLC

Surface El. (Ft):

Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	q_p (TSF)	W (%)	γ_m γ_d (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 14	Stiff, dry, brown, sandy CLAY 1.0		18		4.5			
	SS-2 2.5-4.0 10	Very dense, dry, tan, clayey SAND (sandstone)		50/5.5"		2.8			wss = 0-50 ppm
5	SS-3 5.0-6.5 4			50/5.5"		8.6			
	SS-4 7.5-9.0 4	9.0		50/5.5"		2.7			
10	SS-5 10.0-11.5 14	Hard, slightly moist, olive gray, sandy CLAY (claystone)	CL	91		10.7		36 22 14	- #200 = 80.2%
		14.5							
15	SS-6 15.0-16.5 3	Very dense, dry, light gray, clayey SAND (sandstone)		50/3"		7.0			
		18.5							
20	SS-7 20.0-21.5 3	Hard, slightly moist, olive gray, sandy CLAY (claystone) 20.3		50/4"		10.5			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft) none

Time After Drilling 0.1

Depth to Water (ft) none

Depth to Cave-In (ft) 11.5

DRILLING AND SAMPLING NOTES

Date Begun 8/15/08 Comp. 8/15/08

Crew BH, BWH Rig Mobile B-57

Method: Hollow-Stem Auger

Termination Depth (ft) 20.3

LOG OF TEST BORING NO. B-12

Page 1 of 1

Project: Lost Creek Project
Job No.: 13854-CX
Location: 23 Miles SW of Bairoil, WY
Client: Lost Creek ISR, LLC
Surface El. (Ft):
Benchmark/Datum (Ft):

Depth (ft)	SAMPLING TYPE - NO. DEPTH (ft) RECOVERY(in)	SOIL DESCRIPTION	USCS	N BLOWS PER Ft	qp (TSF)	W (%)	γm γd (PCF)	LL PL PI (%)	OTHER TESTS
0	SS-1 0.0-1.5 5	Very stiff, dry, brown, sandy CLAY topsoil 1.0		26		3.4			
	SS-2 2.5-4.0 15	Very dense, dry, light tan, clayey SAND (sandstone)		62		2.4			
5	SS-3 5.0-6.5 11			50/6"		2.5			
	SS-4 7.5-9.0 10			50/4"		4.6			
10	SS-5 10.0-11.5 5			50/5.5"		4.5			
15	SS-6 15.0-16.5 6	Grades very fine		50/5.5"		8.9			
20	SS-7 20.0-21.5 3	Grades reddish gray 20.3		50/3"		8.9			

WATER LEVEL OBSERVATIONS

Initial Occurrence While Drilling (ft)		none	
Time After Drilling	0.1		
Depth to Water (ft)	none		
Depth to Cave-In (ft)	12.0		

DRILLING AND SAMPLING NOTES

Date Begun 8/15/08
Comp. 8/15/08
Crew BH, BWH
Rig Mobile B-57
Method: Hollow-Stem Auger
Termination Depth (ft) 20.3

INBERG-MILLER ENGINEERS

MONITOR WELL INSTALLATION RECORD

PROJECT: Lost Creek Project
JOB NO.: 13854-CX
LOCATION: 23 Miles SW of Bairoil, WY
CLIENT: Lost Creek ISR, LLC
BORING NO.: MW-1
MONITOR WELL NO.: MW-1

CAP: locking steel

CASING
DIAMETER: 2.0 in.
MATERIAL: PVC
GAUGE: 40 SCH
FROM (A): ~+3.3 ft.
TO (J): 26.7 ft.

BLANK CASING
FROM (A): +3.3 ft.
TO (G): 16.7 ft.

FACTORY SLOTTED CASING (SCREEN)
SLOT SIZE: in.
FROM (G): 16.7 ft.
TO (H): 26.7 ft.

BLANK CASING
FROM (H): ft.
TO (J): ft.

PACKING
CONCRETE
FROM (B): +0.3 ft.
TO (C): 0.0 ft.

BENTONITE PLUG
FROM (C): ft.
TO (D): ft.

BACKFILL: Natural soil
FROM (D): 0.0 ft.
TO (E): 12.0 ft.

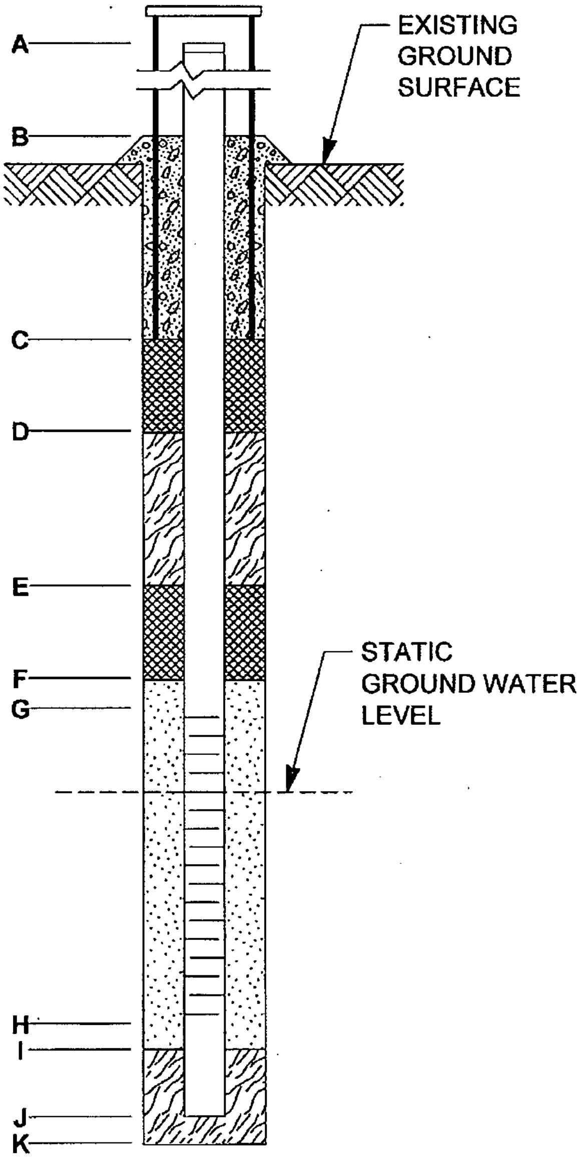
BENTONITE PLUG
FROM (E): 12.0 ft.
TO (F): 14.5 ft.

SAND: Sand
FROM (F): 14.5 ft.
TO (I): 26.7 ft.

NATURAL CAVE-IN
FROM (I): 26.7 ft.
TO (K): 35.3 ft.

ELEVATIONS
COMPLETION DATE: 8/15/08
SURFACE ELEV.: ft.
CASING ELEV.: ft.

POTENTIOMETRIC SURFACE
DATE: ft.
DATE: ft.
DATE: ft.



TOTAL COMPLETED CASING DEPTH (J): 26.7 ft.
TOTAL COMPLETED TEST BORING DEPTH (K): 35.3 ft.

NOTE: **Bentonite plug from 26.7 to 27.7 feet. All depths measured from existing ground surface.**

MONITOR WELL INSTALLATION RECORD

PROJECT: Lost Creek Project JOB NO.: 13854-CX
LOCATION: 23 Miles SW of Bairoil, WY CLIENT: Lost Creek ISR, LLC
BORING NO.: MW-3 MONITOR WELL NO.: MW-3

CAP: locking steel

CASING
DIAMETER: 2.0 in.
MATERIAL: PVC
GAUGE: 40 SCH
FROM (A): ~+2.5 ft.
TO (J): 19.95 ft.

BLANK CASING
FROM (A): +5.05 ft.
TO (G): 4.95 ft.

FACTORY SLOTTED CASING (SCREEN)
SLOT SIZE: in.
FROM (G): 4.95 ft.
TO (H): 19.95 ft.

BLANK CASING
FROM (H): ft.
TO (J): ft.

PACKING
CONCRETE
FROM (B): +0.3 ft.
TO (C): 0.0 ft.

BENTONITE PLUG
FROM (C): ft.
TO (D): ft.

BACKFILL: Natural soil
FROM (D): 0.0 ft.
TO (E): 1.75 ft.

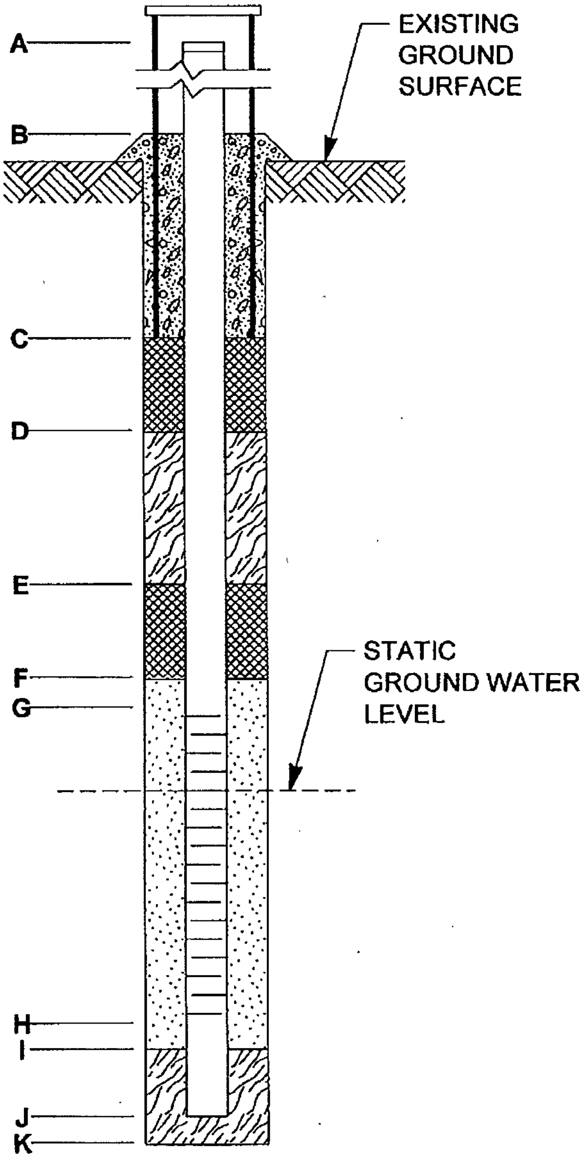
BENTONITE PLUG
FROM (E): 11.75 ft.
TO (F): 3.75 ft.

SAND: Sand
FROM (F): 3.75 ft.
TO (I): 19.95 ft.

NATURAL CAVE-IN
FROM (I): 19.95 ft.
TO (K): 45.2 ft.

ELEVATIONS
COMPLETION DATE: 8/14/08
SURFACE ELEV.: ft.
CASING ELEV.: ft.

POTENTIOMETRIC SURFACE
DATE: ft.
DATE: ft.
DATE: ft.



TOTAL COMPLETED CASING DEPTH (J): 19.95 ft.
TOTAL COMPLETED TEST BORING DEPTH (K): 45.2 ft.

NOTE: **Bentonite plug from 19.95 to 21.6 feet. All depths measured from existing ground surface.**

INBERG-MILLER ENGINEERS

MONITOR WELL INSTALLATION RECORD

PROJECT: Lost Creek Project
JOB NO.: 13854-CX
LOCATION: 23 Miles SW of Bairoil, WY
CLIENT: Lost Creek ISR, LLC
BORING NO.: MW-4
MONITOR WELL NO.: MW-4

CAP: locking steel

ELEVATIONS

COMPLETION DATE: 8/15/08
SURFACE ELEV.: ______ ft.
CASING ELEV.: ______ ft.

POTENTIOMETRIC SURFACE

DATE: ______ ______ ft.
DATE: ______ ______ ft.
DATE: ______ ______ ft.

CASING

DIAMETER: 2.0 in.
MATERIAL: PVC
GAUGE: 40 SCH
FROM (A): ~+2.5 ft.
TO (J): 23.8 ft.

BLANK CASING
FROM (A): +6.2 ft.
TO (G): 13.8 ft.

FACTORY SLOTTED CASING (SCREEN)
SLOT SIZE: ______ in.
FROM (G): 13.8 ft.
TO (H): 23.8 ft.

BLANK CASING
FROM (H): ______ ft.
TO (J): ______ ft.

PACKING

CONCRETE
FROM (B): +0.3 ft.
TO (C): 0.0 ft.

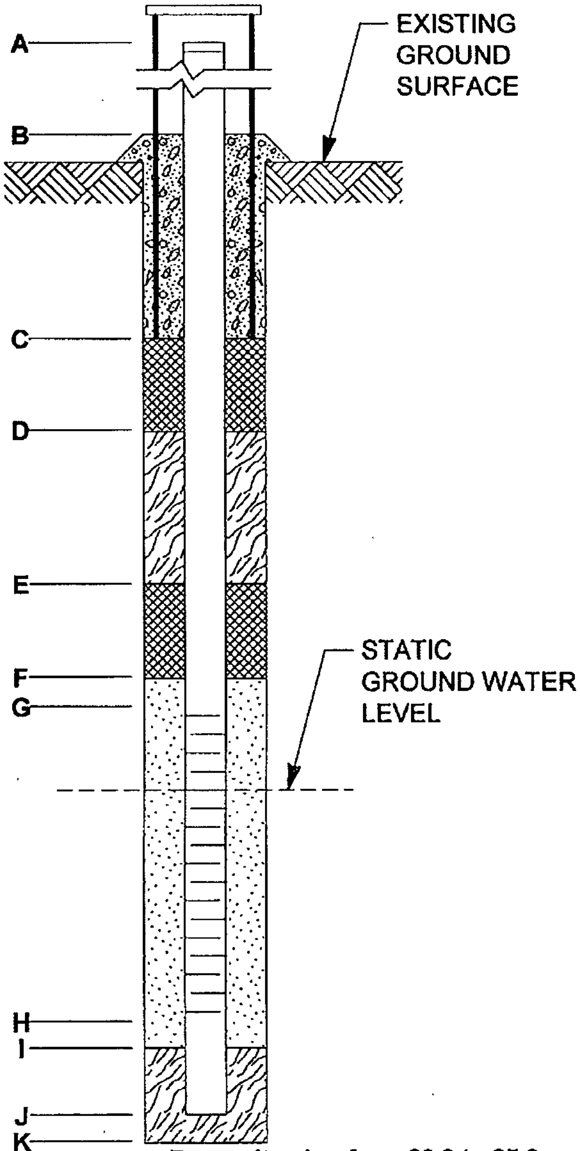
BENTONITE PLUG
FROM (C): ______ ft.
TO (D): ______ ft.

BACKFILL: Natural soil
FROM (D): 0.0 ft.
TO (E): 10.0 ft.

BENTONITE PLUG
FROM (E): 10.0 ft.
TO (F): 11.5 ft.

SAND: Sand
FROM (F): 11.5 ft.
TO (I): 23.8 ft.

NATURAL CAVE-IN
FROM (I): 23.8 ft.
TO (K): 35.3 ft.



TOTAL COMPLETED CASING DEPTH (J): 23.8 ft.
TOTAL COMPLETED TEST BORING DEPTH (K): 35.3 ft.

NOTE: **Bentonite plug from 23.8 to 25.6 feet. All depths measured from existing ground surface.**

INBERG-MILLER ENGINEERS

General Notes - Log of Test Boring/Test Pit

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction		Particle Size	U.S. Standard Sieve Size
Boulders		Larger than 12"	Larger than 12"
Cobbles		3" to 12"	3" to 12"
Gravel:	Coarse	3/4" to 3"	3/4" to 3"
	Fine	4.76mm to ¾"	#4 to ¾"
Sand:	Coarse	2.00mm to 4.76mm	#10 to #4
	Medium	0.42mm to 2.00mm	#40 to #10
	Fine	0.074mm to 0.42mm	#200 to #40
Silt		0.005mm to 0.074mm	Smaller than #200
Clay		Smaller than 0.005mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay

Relative Density

Term	"N" Value*
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Consistency

Term	q_u-tons/sq. ft.
Very Soft	0.0 to 0.25
Soft	0.25 to 0.5
Firm	0.5 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

*Note: The penetration number, N, is the summation of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140-pound weight falling 30", and is seated to a depth of 6" before commencing the standard penetration test.

DESCRIPTIVE ROCK CLASSIFICATION

Engineering Hardness Description of Rock
(not to be confused with MOH's scale for minerals)

Very Soft	Can be carved with a knife. Can be excavated readily with point of pick. Pieces one inch or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Medium Soft	Can be grooved or gouged 1/16-inch deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-inch-maximum size by hard blows of the point of a geologist's pick.
Medium Hard	Can be scratched with knife or pick. Gouges or grooves to ¼-inch deep. Can be excavated by hard blow of a geologist's pick. Hand specimens can be detached by moderate blow.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Very Hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.

NOMENCLATURE

Drilling and Sampling

SS - Split Barrel (spoon) Sampler

N - Standard Penetration Test Number, blows/foot*

ST - Thin-walled Tube (Shelby Tube) Sampler

DC - Thick-wall, ring lined, drive sampler

C - Coring

DP - Direct Push Sampler

CS - Continuous Sampler (used in conjunction with hollow stem auger drilling)

D Disturbed Sample (auger cuttings, air/wash rotary cuttings, backhoe, shovel, etc.)

Laboratory Tests

USCS - Unified Soil Classification System (soil type)

W - Water Content (%)

LL - Liquid Limit (%)

PL - Plastic Limit (%)

PI - Plasticity Index (LL-PL) (%)

q_u - Unconfined Strength, TSF

q_p - Penetrometer Reading (estimate of unconfined strength), TSF

γ_m - Moist Unit Weight, PCF

γ_d - Dry Unit Weight, PCF

WSS - Water Soluble Sulfate (%)

Φ - Angle of Internal Friction (degrees)

c - Soil Cohesion, TSF

SG - Specific gravity of soil solids

S - Degree of Saturation (%)

e - Void Ratio

n - Porosity

k - Permeability (cm/sec)

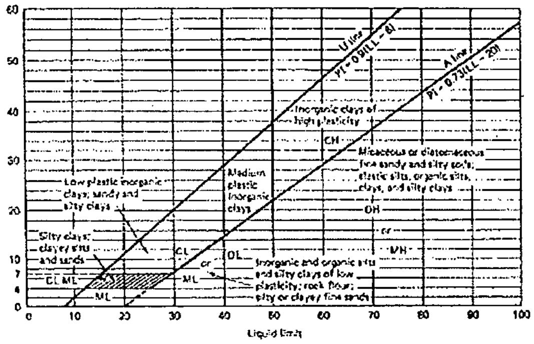
Water Level Measurement

▼ - Water Level at Time Shown

Note: Water level measurements shown on the boring logs represent conditions at the time indicated, and may not reflect static levels, especially in cohesive soils. The available water level information is given at the bottom of each log.

Classification of Soils for Engineering Purposes

ASTM Designation: D2487-69 and D2488-69
(Unified Soil Classification System)

<table>
<tr><th colspan="3">Major Divisions</th><th colspan="2">Group Symbols</th><th>Typical Names</th><th colspan="4">Laboratory Classification Criteria</th></tr>
<tr><td rowspan="8">Coarse-Grained Soils (More than half of material is larger than No. 200 sieve size)</td><td rowspan="5">Gravels (More than half of coarse fraction is larger than No. 4 sieve size)</td><td rowspan="2">Clean Gravels (Little or no fines)</td><td colspan="2">GW</td><td>Well graded gravels, gravel-sand mixtures, little or no fines</td><td rowspan="10">Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:
Less than 5 %
More than 12%
5 to 12 %</td><td rowspan="10">GW,GP, SW, SP
GM, GC, SM, SC
Borderline cases requiring dual symbols[b]</td><td colspan="2">$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10}xD_{60}}$ between 1 & 3</td></tr>
<tr><td colspan="2">GP</td><td>Poorly Graded gravels, gravel-sand mixtures, little or no fines</td><td colspan="2">Not meeting all gradation requirements for GW</td></tr>
<tr><td rowspan="3">Gravels w/ Fines (Appreciable amount of fines)</td><td rowspan="2">GM[a]</td><td>d</td><td rowspan="2">Silty gravels, gravel-sand-silt mixtures</td><td rowspan="2">Atterberg limits below "A" line or P.I. less than 4</td><td rowspan="3">Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols</td></tr>
<tr><td>u</td></tr>
<tr><td colspan="2">GC</td><td>Clayey gravels, gravel-sand-clay mixtures</td><td>Atterberg limits below "A" line or P.I. greater than 7</td></tr>
<tr><td rowspan="5">Sands (More than half of coarse fraction is smaller than No. 4 sieve size)</td><td rowspan="2">Clean Sands (Little or no fines)</td><td colspan="2">SW</td><td>Well-graded sands, gravelly sands, little or no fines</td><td colspan="2">$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10}xD_{60}}$ between 1 & 3</td></tr>
<tr><td colspan="2">SP</td><td>Poorly graded sands, gravelly sands, little or no fines</td><td colspan="2">Not meeting all gradation requirements for SW</td></tr>
<tr><td rowspan="3">Sands w/ Fines (Appreciable amount of fines)</td><td rowspan="2">SM[a]</td><td>d</td><td rowspan="2">Silty sands, sand-silt mixtures</td><td rowspan="2">Atterberg limits above "A" line or P.I. less than 4</td><td rowspan="3">Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols</td></tr>
<tr><td>u</td></tr>
<tr><td colspan="2">SC</td><td>Clayey sands, sand-clay mixtures</td><td>Atterberg limits above "A" line or P.I. greater than 7</td></tr>
<tr><td rowspan="7">Fine-Grained Soils (More than half material is smaller than No. 200 sieve size)</td><td colspan="2" rowspan="3">Silts and Clays (Liquid limit less than 50)</td><td colspan="2">ML</td><td>Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity</td><td colspan="4" rowspan="7">Plasticity Chart
</td></tr>
<tr><td colspan="2">CL</td><td>Inorganic clays of low to medium plasticity, gravelly, clays, sandy clays, silty clays, lean clays</td></tr>
<tr><td colspan="2">OL</td><td>Organic silts and organic silty clays of low plasticity</td></tr>
<tr><td colspan="2" rowspan="3">Silts and Clays (Liquid limit greater than 50)</td><td colspan="2">MH</td><td>Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts</td></tr>
<tr><td colspan="2">CH</td><td>Inorganic clays of high plasticity, fat clays</td></tr>
<tr><td colspan="2">OH</td><td>Organic clays of medium to high plasticity, organic silts</td></tr>
<tr><td colspan="2">Highly Organic Soils</td><td colspan="2">P_t</td><td>Peat and other highly organic soils</td></tr>
</table>

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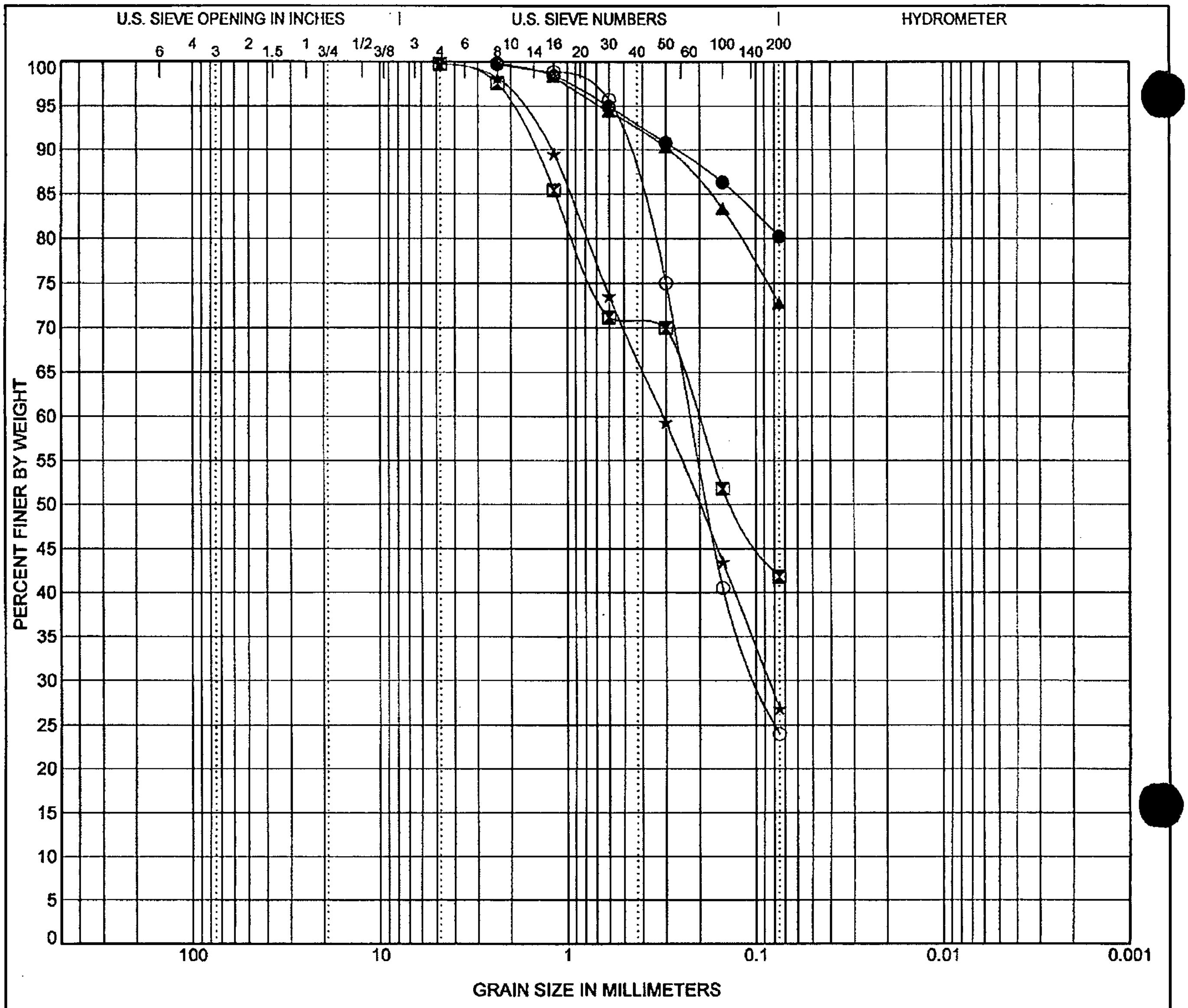
[a] Division of GM and SM groups into subdivision of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

Appendix C



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

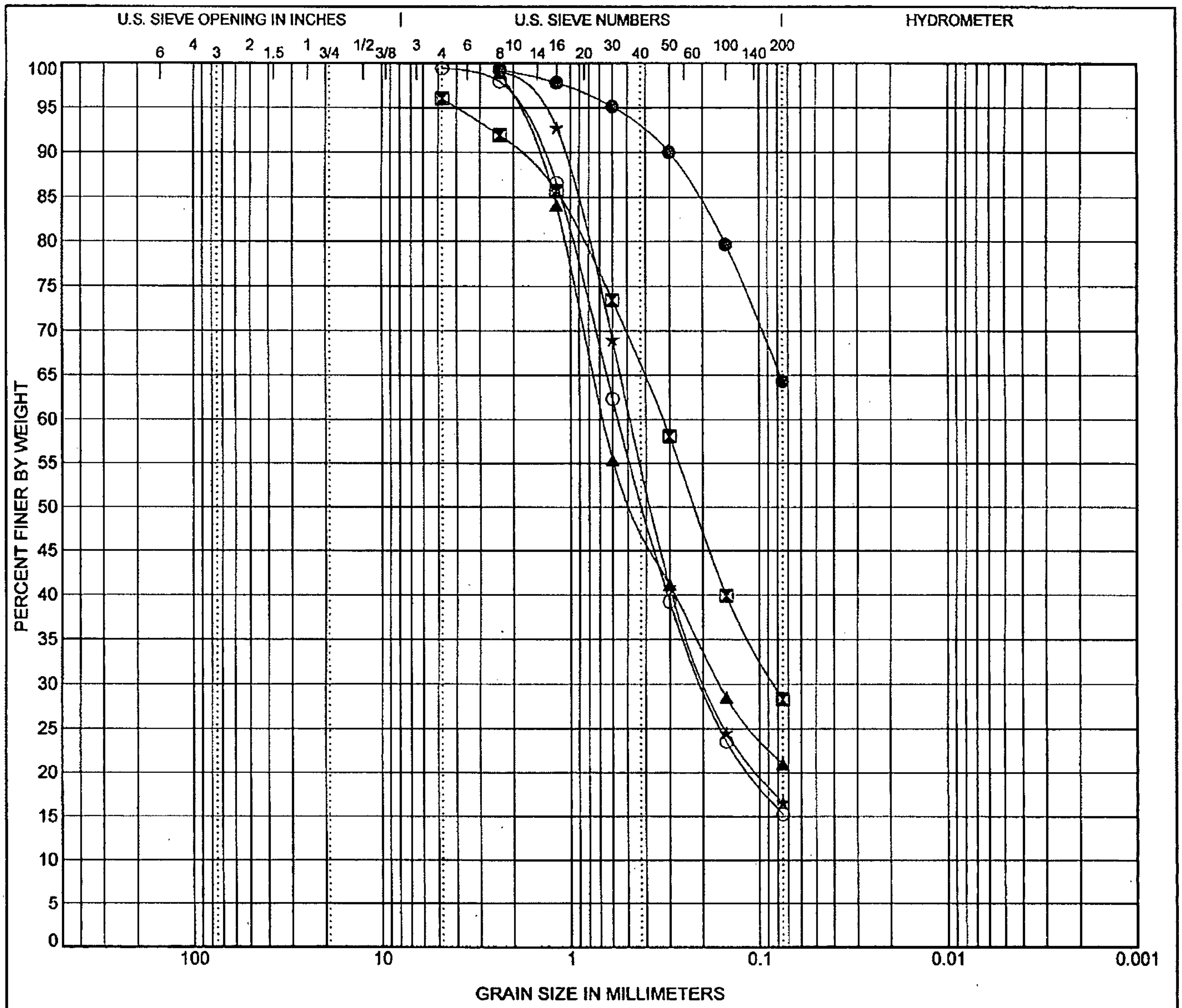
Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	**B-11**	**10.0**	**LEAN CLAY with SAND(CL)**	**36**	**22**	**14**		
☒	**B-5**	**0.0**	**CLAYEY SAND(SC)**	**31**	**17**	**14**		
▲	**B-8**	**2.5**	**LEAN CLAY with SAND(CL)**	**39**	**21**	**18**		
★	**B-9**	**7.5**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
⊙	**MW-1**	**15.0**						

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-11**	**10.0**	**2.36**				**0.0**	**19.6**	**80.2**	
☒	**B-5**	**0.0**	**4.75**	**0.205**			**0.0**	**57.9**	**41.8**	
▲	**B-8**	**2.5**	**1.18**				**0.0**	**25.5**	**72.8**	
★	**B-9**	**7.5**	**4.75**	**0.31**	**0.085**		**0.0**	**72.9**	**26.9**	
⊙	**MW-1**	**15.0**	**2.36**	**0.222**	**0.096**		**0.0**	**75.7**	**24.0**	

PROJECT: Lost Creek Project
JOB NO.: 13854-CX
CLIENT: Lost Creek ISR, LLC
TEST METHOD: ASTM D422

PARTICLE SIZE ANALYSES

INBERG-MILLER ENGINEERS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

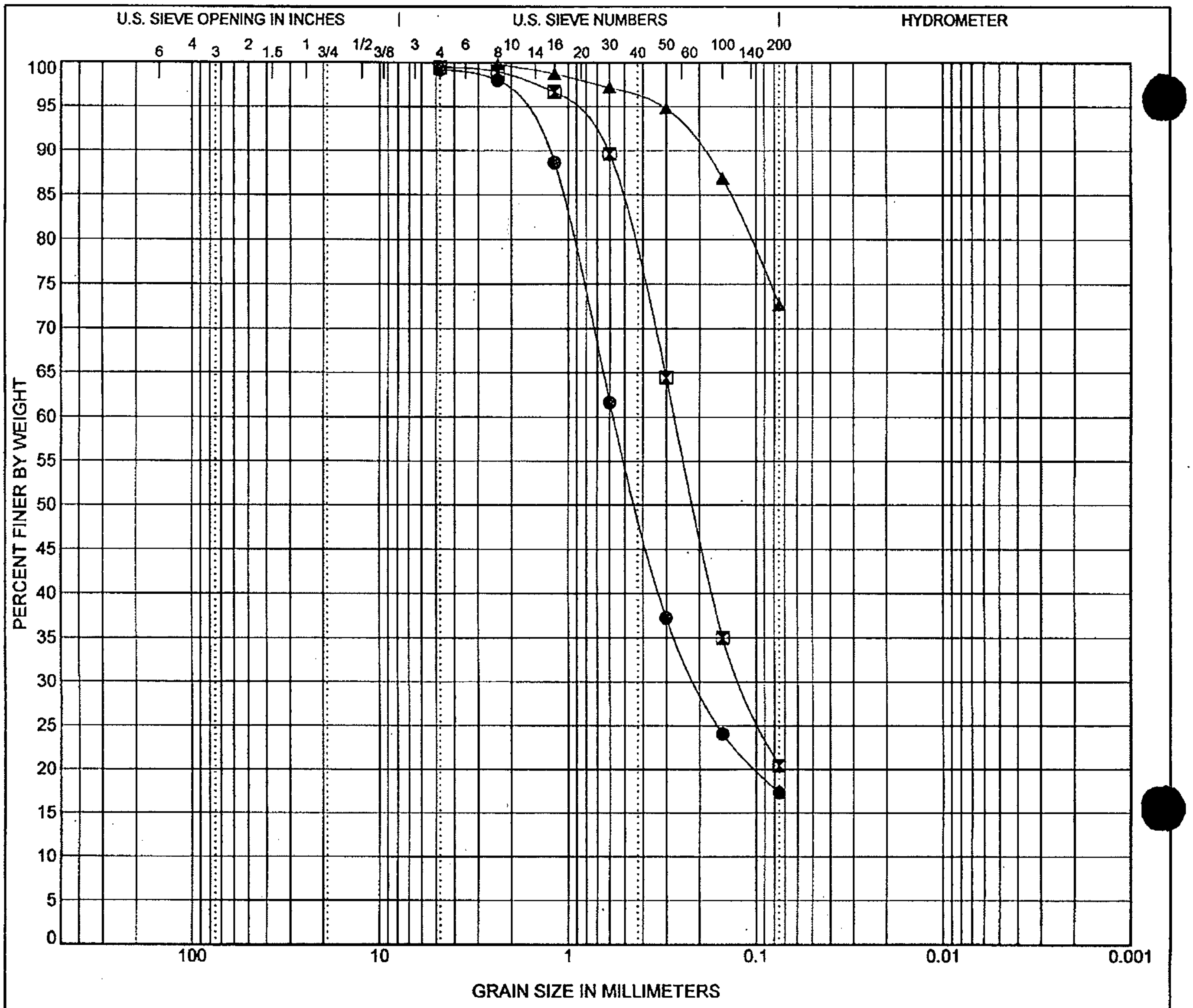
Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	**MW-1**	**30.0**	**SANDY LEAN CLAY(CL)**	**33**	**20**	**13**		
⊠	**MW-2**	**15.0**						
▲	**MW-2**	**25.0**						
★	**MW-3**	**5.0**						
⊙	**MW-3**	**10.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**MW-1**	**30.0**	**2.36**				**0.0**	**34.9**	**64.4**	
⊠	**MW-2**	**15.0**	**4.75**	**0.327**	**0.083**		**0.0**	**67.7**	**28.3**	
▲	**MW-2**	**25.0**	**2.36**	**0.67**	**0.163**		**0.0**	**77.9**	**21.0**	
★	**MW-3**	**5.0**	**2.36**	**0.48**	**0.189**		**0.0**	**82.5**	**16.6**	
⊙	**MW-3**	**10.0**	**4.75**	**0.559**	**0.199**		**0.0**	**84.2**	**15.3**	

PROJECT: Lost Creek Project
JOB NO.: 13854-CX
CLIENT: Lost Creek ISR, LLC
TEST METHOD: ASTM D422

PARTICLE SIZE ANALYSES

INBERG-MILLER ENGINEERS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**MW-3**	**30.0**						
☒	**MW-4**	**15.0**						
▲	**MW-4**	**25.0**	**LEAN CLAY with SAND(CL)**	**34**	**21**	**13**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**MW-3**	**30.0**	**4.75**	**0.572**	**0.205**		**0.0**	**81.9**	**17.3**	
☒	**MW-4**	**15.0**	**4.75**	**0.27**	**0.118**		**0.0**	**79.0**	**20.5**	
▲	**MW-4**	**25.0**	**2.36**				**0.0**	**27.1**	**72.7**	

PROJECT: Lost Creek Project
JOB NO.: 13854-CX
CLIENT: Lost Creek ISR, LLC
TEST METHOD: ASTM D422

PARTICLE SIZE ANALYSES

INBERG-MILLER ENGINEERS

Appendix D

Limitations and Use of This Report

This report has been prepared by Inberg-Miller Engineers, hereinafter referred to as "IME", to evaluate this property for the intended use described herein. If any changes of the facility are planned with respect to the design vertical position or horizontal location as outlined herein, we recommend that the changes be reviewed, and the conclusions and recommendations of this report be modified in writing by IME.

The analyses and recommendations submitted in this report are our opinions based on the data obtained, and subsurface conditions noted from the field exploration. The locations of the exploration are illustrated on the accompanying map and diagram. Any variations that may occur between, beyond, or below the depths of test borings or test pits, are not presented in this report because these areas were not specifically explored. Excavations during the construction phases may reveal variations from subsurface conditions identified in our exploration. The nature and extent of such variations may not become evident until excavation and construction begins. If variations appear evident during construction, we advise a re-evaluation of the recommendations in this report. After performing additional on-site observations, we can provide an addendum to our recommendations noting the characteristics of any variations.

IME is responsible for the conclusions and opinions contained in this report based on the supplied data relative only to the specific project and location outlined in this report. If conclusions or recommendations are made by others, IME should be given an opportunity to review and comment on such conclusions or recommendations in writing, prior to the completion of the project design phase.

It is recommended that IME be provided the opportunity to review final designs, plans, and specifications using the conclusions of this report, in order to determine whether any change in concept may have any effect on the validity of the recommendations contained in this document. If IME is accorded the privilege of this review, IME can assist in avoiding misinterpretation or misapplication of these recommendations if changes have been made as compared with IME's understanding of either the project or design content. Review of the final design, plans, and specifications will be noted in writing by IME upon client's request, and will become a part of this report.

Standards are referenced by designated letters/numbers in several locations within this report. These standards were identified for the sole purpose of informing the reader what test methods were followed by IME during the execution of IME's scope of services. Anyone who reads, references, or relies on this report for any purpose whatsoever is hereby advised that IME has applied professional judgment in determining the extent to which IME complied with any given standard identified in this report or any other instrument of IME's professional service. Unless otherwise indicated, such compliance referred to as "general compliance," *specifically excluded consideration of any standard listed as a reference* in the text of those standards IME has cited. Questions about general compliance – i.e., which elements of a cited standard were followed and to what extent, should be directed to IME.

Limitations and Use of This Report, Continued

IME has performed exploration, laboratory, and engineering services sufficient to provide geotechnical information that is adequate for either the preliminary planning or the design phase of the project, as stated herein. IME's scope of services was developed and agreed to specifically for this purpose. Consequently, this report may be insufficient for other purposes. For example, this report may be insufficient for the contractor or his subcontractors to prepare an accurate bid for the construction phase of the project. The client, owner, potential contractors, and subcontractors are advised that it is specifically the contractor and subcontractor's obligation and responsibility during the bidding process to collect whatever additional information they deem necessary to prepare an accurate bid. The contractor's and subcontractor's bid should include selection of personnel, equipment, bits, etc. that are necessary to complete the project according to the project specifications, on schedule, within budget, and without change orders resulting from unforeseen geologic conditions.

Variations in soil conditions may be encountered during construction. To permit correlation between soil data in this report and the actual soil conditions encountered during construction, we recommend that IME be retained to perform construction observations of the earthwork and foundation phases of the work. It is recommended that IME be retained to observe all areas where fills are to be placed, and test and approve each class of fill material to be used according to the recommendations for compacted fill presented in this report. IME can provide specific assistance in evaluating construction compliance with the design concepts, specifications, or recommendations if IME has been retained to perform continuous on-site observations and materials testing during construction.

The presence of IME's field representative, if such services are requested by the client, will be for the sole purpose of providing record observations and field materials testing. We recommend the contractor be solely responsible for supervision, management, or direction of the actual work of the contractor, his employees, or agents. The contractor for this project should be so advised. The contractor should also be informed that neither the presence of our field representative or the observation and testing by our firm shall excuse him in any way for defects discovered in his work. It is understood that IME will not be responsible for job or site safety on this project.

This report has been prepared in accordance with generally accepted geotechnical engineering practices, and makes no warranties, either expressed or implied. The services performed by IME in preparing this report have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, express or implied, and no warranty or guarantee is included or intended in this report. The report has not been prepared for other uses or parties other than those specifically named, or for uses or applications other than those enumerated herein. The report may contain insufficient or inaccurate information for other purposes, applications, building sites, or other uses.

Sample and Data Collection Information

Field-sampling techniques were employed in this exploration to obtain the data presented in the Final Logs and Report generally in accordance with ASTM D420, D1452, D1586 (where applicable), and D1587 (where applicable).

The drilling method utilized in most test borings is a dry-process, machine rotary auger type that advances hollow steel pipe surrounded by attached steel auger flights in 5-foot lengths. This method creates a continuously cased test hole that prevents the boring from caving in above each level of substrata to be tested. Sampling tools were lowered inside the hollow shaft for testing in the undisturbed soils below the lead auger. In some test borings, as appropriate to advance to the desired depth, air or wash rotary drilling methods were utilized. Air or wash rotary drilling methods allow for the extraction of rock core samples.

Samples were brought to the surface, examined by an IME field representative, and sealed in containers (or sealed in the tubes) to prevent a significant loss of moisture. They were returned to our laboratory for final classification per ASTM D2487 methods. Some samples were subjected to field or laboratory tests as described in the text of this report.

Groundwater observations were made with cloth-tape measurements in the open drill holes by IME field personnel at the times and dates stated on the Final Logs. Recorded groundwater levels may not reflect equilibrium groundwater conditions due to relatively low permeability of some soils. It must also be noted that fluctuations may occur in the groundwater level due to variations in precipitation, temperature, nearby site improvements, nearby drainage features, underdrainage, wells, severity of winter frosts, overburden weights, and the permeability of the subsoil. Because variations may be expected, final designs and construction planning should allow for the need to temporarily or permanently dewater excavations or subsoil.

A Final Log of each test pit or boring was prepared by IME. Each Final Log contains IME's interpretation of field conditions or changes in substrata between recovered samples based on the field data received, along with the laboratory test data obtained following the field work or on subsequent site observations. The final logs were prepared by assembling and analyzing field and laboratory data. Therefore, the Final Logs contain both factual and interpretive information. IME's opinions are based on the Final Logs.

The Final Logs list boring methods, sampling methods, approximate depths sampled, amounts of recovery in sampling tools (where applicable), indications of the presence of subsoil types, and groundwater observations and measurements. Results of some laboratory tests are arrayed on the Final Logs at the appropriate depths below grade. The horizontal lines on the Final Logs designate the interface between successive layers (strata) and represent approximate boundaries. The transition between strata may be gradual.

We caution that the Final Logs alone do not constitute the report, and as such they should not be excerpted from the other appendix exhibits or from any of the written text. Without the written report, it is possible to misinterpret the meaning of the information reported on the Final Logs. If the report is reproduced for reference purposes, the entire numbered report and appendix exhibits should be bound together as a separate document, or as a section of a specification booklet, including all drawings, maps, etc.

Pocket penetration tests taken in the field, or on samples examined in the laboratory are listed on the Final Logs in a column marked "q_p". These tests were performed only to approximate unconfined strength and consistency when making comparisons between successive layers of cohesive soil. It is not recommended that the listed values be used to determine allowable bearing capacities. Bearing capacities of soil is determined by IME using test methods as described in the text of the report.

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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Design Report

Ponds 1 &2

Submitted to:

Lost Creek ISR, LLC
5880 Enterprise Dr., Suite 200
Casper, WY 82609

Prepared by:

Western States Mining Consultants, P.C
6911 Casper Mountain Road
Casper, WY 82601

January, 2009
Project Number: 00802

TABLE OF CONTENTS

Design Report
Ponds 1 & 2

1.0 Introduction

Western States Mining Consultants, P.C. (WSMC) has complete the design of a two evaporation ponds at the Lost Creek ISR project in Carbon County, Wyoming. Both ponds are identical and are adjacent to one another

Both ponds are approximately 155 feet wide and 260 feet long and have a capacity of approximately 2.3 acre-ft each.

Included in this design report are the following:

- Stability analyses of the embankment,
- Freeboard calculations,
- Slope protection recommendations, and the
- Geotechnical Report.

2.0 Stability Analysis and Settlement

Stability Analysis

Slope stability analyses were performed on embankment cross-section determined to be the most critical. Embankment slopes are 3:1 (h:v) for the upstream slope and 2:1 (h:v) for the downstream slope.

The material properties for the slope stability analyses were obtained from historical values used in similar projects and compared to drilling logs. They are presented in Table 1, Material Properties.

Table 1
Material Properties

Material Type	Cohesion (pcf)	Friction Angle	Unit Weight (pcf)
Fill Material	300	15	115
Native Soils	300	15	110
Bedrock	600	30	150

The computer program STABR was used to generate the slope stability analyses. The program uses the Modified Bishop Method developed by LeFebvre in 1971 to determine minimum factors of safety. Specific input requirements of the program include material properties (listed above), . surface profiles and phreatic surface profiles. Analyses were performed for both the upstream slope and downstream slope at Station 25+00 of the Phase 2 modification. The analyses included both the static and psuedostatic cases. A static safety factor of 1.5 and a psuedostatic safety factor of 1.0 is considered stable for earth filled dams. Results of the analyses are shown in Table 2, Stability Analyses.

Table 2
Stability Analyses - Station 25+00

Slope	Static	Psuedostatic
Downstream	2.128	2.575

All input data and output results of these analyses are included as Appendix 1 to this report.

Settlement Analysis

The foundations of the ponds will be a very dense clayey sandstone. The bearing strength of this material is about 10 kips (20,000 lbs/ft^2). The ponds are designed to have a maximum water depth of approximately 6 feet. This will apply approximately 374.4 lbs/ft^2. Therefore settlement of the pond is not anticipated with these water volumes.

3.0 Freeboard

The design freeboard must be of sufficient height above the maximum design water level to impound water when it rises above the design water level under the combined action of:

- waves,
- run-up, and
- wind-tide.

Wave height and wind-tide depend on the reservoir configuration; run-up is a function of the steepness and roughness of the design dike slope, the wave length and wave period (Linsley and Franzini, 1964)

The following assumptions were made in calculating the wind-tide, wave height, and run-up for Pond 1 Reservoir:

- Wind Velocity, Vw = 80 mph
- Fetch (length of water surface in miles), F = 0.05 miles
- Average depth of pond, d = 6 feet

The following calculations wre based the above assumptions:

Wind Tide (Zs)

$Zs = Vw^2F/1400d = 80^2 \times 0.05/(1400 \times 6) = 0.038\ feet$

Wave Height (Zw)

Significant wave height (13% exceeding) , Zw

$Zw = 0.034\ Vw^{1.06}F^{0.47} = 0.034 \times 80^{1.06} \times 0.038^{0.41} = 0.932\ feet$

Design

Design wave height (4% exceeding) , Z'

$Z' = 1.67\ Zw = 1.67 \times 0.932 = 1.55\ feet$

Run-up

Assume 3:1 slope (moderately smooth slope)

Wave Period (tw)

$tw = 0.46\ Vw^{0.44}F^{0.28} = 0.46 \times 80^{0.44} \times .05^{0.28} = 1.37$

Wave length (lw)

$lw = 5.12\ tw^2 = 9.57$

$Zw = 0.07$ *(from Linsley and Franzini, pg 167)*

Run-up, $Zr/Zw = 1.2$ *(Interpolated)*

$Zr = 1.2 \times 0.932 = 1.12\ feet$

Freeboard

Freeboard = Wind-tide + wave height (<4%) = run-up

$= Zs + Z' + Zr = 0.04 + 1.55 + 1.12 = 2.71$

Use 3 feet

4.0 Slope Protection

Upstream Slope Protection - The upstream slopes of earth filled dams must be protected against destructive wave action. The liner will provide all the required slope protection. No other measures are anticipated for these facilities.

Downstream Slope Protection - The downstream slope of the embankment will covered with topsoil and vegetation.

5.0 Geotechnical Report

The geotechnical report prepared by Inberg-Miller Engineers. The report in its entirety is shown as Appendix B of this report. Inberg-Miller drilled 12 borings. Boring B2 is the closest to the proposed pond location and that is the one used for the aforementioned analyses.

Liquifaction Potential

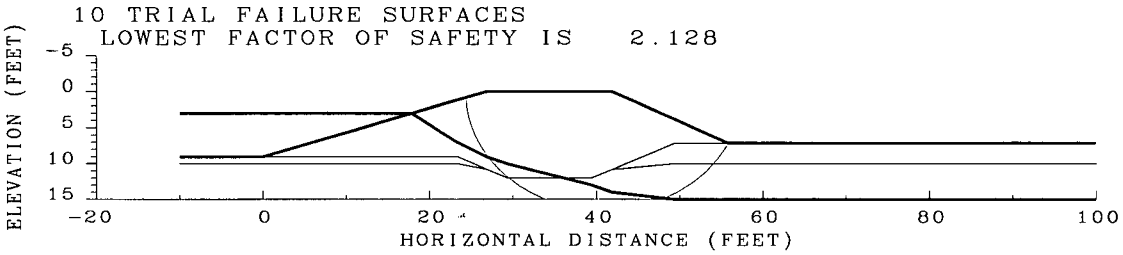
The liquifaction potential appears to be low for the surrounding the ponds, used for pond construction and the foundation of the ponds for the following reasons:

- The fines in the soils are greater than 15 percent, typically in the 25 - 30% range.
- The soils in the area are typically very dry. Usually less then 10%.
- The soil penetration resistance is high. Typical blowcounts of greater than 50 blows per foot.

Appendix A

Input file - Typical Cross-section Downstream - Static Case

```
Typ XS DS s  2:1
0 0 11 4 1 0  0.0 0.0
55.9    0       5
55.9    7
-10     9       9       9       9       9       10      40
0       9       9       9       9       9       10      40
17.9    3       3       3       3       9       10      40
23.4    1.19    1.19    1.19    1.19    9       10      40
26.9    0       0       0       0       10.8    10.8    40
29.4    0       0       0       0       12      12      40
39.4    0       0       0       0       12      12      40
41.9    0       0       0       0       10.8    10.8    40
49.4    3.8     3.8     3.8     3.8     7.1     10      40
55.9    7.1     7.1     7.1     7.1     7.1     10      40
100     7.1     7.1     7.1     7.1     7.1     10      40
 1   300   15   115
 2   300  15   110
 3   600   30   150
-10     3
0       3
17.9    3
23.4    7
26.9    9
29.4    10
39.4    13
41.9    14
49.4    15
55.9    15
100     15
 0
```



Typ XS DS s 2:1

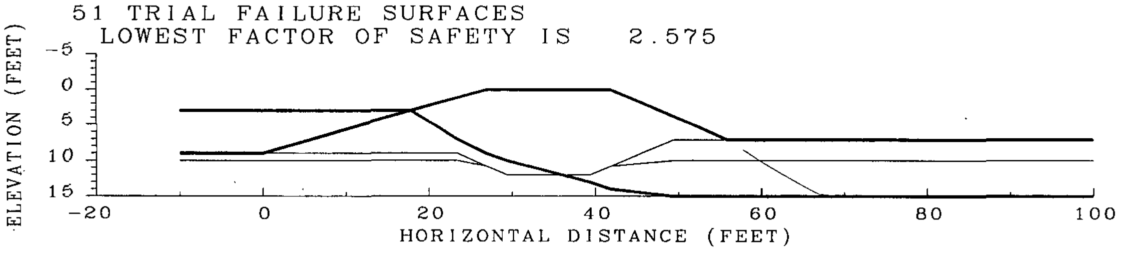
Output file - Typical Cross-section Downstream - Static Case

```
Typ XS DS s  2:1

CONTROL DATA

   NUMBER OF SPECIFIED CENTERS              0
   NUMBER OF DEPTH LIMITING TANGENTS           0
   NUMBER OF VERTICAL SECTIONS             11
   NUMBER OF SOIL LAYER BOUNDARIES            4
   NUMBER OF PORE PRESSURE LINES            1
   NUMBER OF POINTS DEFINING COHESION PROFILE  0

SEISMIC COEFFICIENT S1,S2  =  .00  .00


SEARCH STARTS AT CENTER (  55.9,    .0),WITH FINAL GRID OF  5.0


ALL CIRCLES PASS THROUGH THE POINT (  55.9,   7.0)


GEOMETRY

   SECTIONS   -10.0    .0  17.9  23.4  26.9  29.4  39.4  41.9  49.4  55.9 100.0

   T. CRACKS    9.0   9.0   3.0   1.2    .0    .0    .0    .0   3.8   7.1   7.1
   W IN CRACK   9.0   9.0   3.0   1.2    .0    .0    .0    .0   3.8   7.1   7.1
   BOUNDARY 1   9.0   9.0   3.0   1.2    .0    .0    .0    .0   3.8   7.1   7.1
   BOUNDARY 2   9.0   9.0   3.0   1.2    .0    .0    .0    .0   3.8   7.1   7.1
   BOUNDARY 3   9.0   9.0   9.0   9.0  10.8  12.0  12.0  10.8   7.1   7.1   7.1
   BOUNDARY 4  10.0  10.0  10.0  10.0  10.8  12.0  12.0  10.8  10.0  10.0  10.0


SOIL PROPERTIES

   LAYER       COHESION  FRICTIOH ANGLE    DENSITY
    1        300.0        15.0       115.0
    2        300.0        15.0       110.0
    3        600.0        30.0       150.0


PORE PRESSURE DATA

   COORDINATES OF EQUI-PRESSURE LINES

   SECTIONS  -10.0    .0  17.9  23.4  26.9  29.4  39.4  41.9  49.4  55.9 100.0
   LINE 1     3.0   3.0   3.0   7.0   9.0  10.0  13.0  14.0  15.0  15.0  15.0
```

```
 VALUES OF PRESSURE ON EQUI-PRESSURE LINES

 LINE   PRESSURE
  1       .0



NUMBER  TANGENT  RADIUS  (X) CENTER  (Y) CENTER   FS(BISHOP)  FS(OMS)

   1    7.0    7.0     55.9      .0    15.215   15.199
   2   12.2   12.2      65.9      .0        **********
                                  BISHOPS SOLU. DID NOT CONVERGE IN  21 ITERATIONS
   3   12.2   12.2      45.9      .0           2.582
                                  BISHOPS SOLU. DID NOT CONVERGE IN  21 ITERATIONS
   4   21.2   21.2      35.9      .0     3.046    2.103
   5    9.7   19.7      45.9   -10.0      6.012    5.764
   6    8.6    8.6     50.9       .0    6.506    6.276
   7   16.6   16.6      40.9      .0     2.128    1.491
   8   21.2   21.2      35.9      .0     3.046    2.103
   9   14.2   19.2      40.9    -5.0     2.577    2.128
  10    18.3   23.3      35.9    -5.0      3.126    2.467
  11    10.6   15.6      45.9    -5.0      4.459    4.115

F.S. MINIMUM= 2.128 FOR THE CIRCLE OF CENTER (  40.9,    .0)
```

Input file - Typical Cross-section Downstream - Psuedostatic Case

```
Typ XS DS p  2:1
0 0 11 4 1 0  0.1 0.1
55.9   0      5
55.9   7
-10    9      9      9      9      9      10     40
0      9      9      9      9      9      10     40
17.9   3      3      3      3      9      10     40
23.4   1.19   1.19   1.19   1.19   9      10     40
26.9   0      0      0      0      10.8   10.8   40
29.4   0      0      0      0      12     12     40
39.4   0      0      0      0      12     12     40
41.9   0      0      0      0      10.8   10.8   40
49.4   3.8    3.8    3.8    3.8    7.1    10     40
55.9   7.1    7.1    7.1    7.1    7.1    10     40
100    7.1    7.1    7.1    7.1    7.1    10     40
 1  300   15   115
 2  300  15   110
 3  600   30   150
-10    3
0      3
17.9   3
23.4   7
26.9   9
29.4   10
39.4   13
41.9   14
49.4   15
55.9   15
100    15
 0
```



Typ XS DS p 2:1

Output file - Typical Cross-section Downstream - Psuedostatic Case

```
        BISHOP MODIFIED,LEFEBVRE 1971


 Typ XS DS p  2:1


 CONTROL DATA

    NUMBER OF SPECIFIED CENTERS              0
    NUMBER OF DEPTH LIMITING TANGENTS          0
    NUMBER OF VERTICAL SECTIONS             11
    NUMBER OF SOIL LAYER BOUNDARIES            4
    NUMBER OF PORE PRESSURE LINES            1
    NUMBER OF POINTS DEFINING COHESION PROFILE  0

 SEISMIC COEFFICIENT S1,S2  =  .10  .10


 SEARCH STARTS AT CENTER (  55.9,    .0),WITH FINAL GRID OF  5.0


 ALL CIRCLES PASS THROUGH THE POINT (  55.9,   7.0)


 GEOMETRY

    SECTIONS    -10.0     .0   17.9   23.4   26.9   29.4   39.4   41.9   49.4   55.9  100.0

    T. CRACKS     9.0    9.0    3.0    1.2     .0     .0     .0     .0    3.8    7.1    7.1
    W IN CRACK    9.0    9.0    3.0    1.2     .0     .0     .0     .0    3.8    7.1    7.1
    BOUNDARY 1    9.0    9.0    3.0    1.2     .0     .0     .0     .0    3.8    7.1    7.1
    BOUNDARY 2    9.0    9.0    3.0    1.2     .0     .0     .0     .0    3.8    7.1    7.1
    BOUNDARY 3    9.0    9.0    9.0    9.0   10.8   12.0   12.0   10.8    7.1    7.1    7.1
    BOUNDARY 4   10.0   10.0   10.0   10.0   10.8   12.0   12.0   10.8   10.0   10.0   10.0


 SOIL PROPERTIES

    LAYER      COHESION  FRICTI0H ANGLE    DENSITY
     1       300.0      15.0      115.0
     2       300.0      15.0      110.0
     3       600.0      30.0      150.0


 PORE PRESSURE DATA

    COORDINATES OF EQUI-PRESSURE LINES

    SECTIONS  -10.0     .0   17.9   23.4   26.9   29.4   39.4   41.9   49.4   55.9  100.0
    LINE 1      3.0    3.0    3.0    7.0    9.0   10.0   13.0   14.0   15.0   15.0   15.0
```

VALUES OF PRESSURE ON EQUI-PRESSURE LINES

LINE	PRESSURE
1	.0

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	7.0	7.0	55.9	.0	12.687	12.698
2	12.2	12.2	65.9	.0	10.898	9.991
3	21.2	21.2	75.9	.0	5.028	4.003
4	30.8	30.8	85.9	.0	4.820	3.434
5	35.7	35.7	90.9	.0	6.443	4.733
6	35.1	30.1	85.9	5.0	7.458	4.513
7	26.0	26.0	80.9	.0	4.413	3.240
8	30.1	25.1	80.9	5.0	6.795	3.780
9	21.2	21.2	75.9	.0	5.028	4.003
10	22.7	27.7	80.9	-5.0	3.741	3.020
11	27.3	32.3	85.9	-5.0	3.794	2.912
12	18.3	23.3	75.9	-5.0	4.667	4.014
13	20.2	30.2	80.9	-10.0	3.545	3.043
14	24.5	34.5	85.9	-10.0	3.330	2.708
15	28.9	38.9	90.9	-10.0	3.649	2.871
16	27.3	32.3	85.9	-5.0	3.794	2.912
17	22.2	37.2	85.9	-15.0	3.141	2.678
18	26.3	41.3	90.9	-15.0	3.213	2.629
19	18.3	33.3	80.9	-15.0	3.590	3.218
20	20.4	40.4	85.9	-20.0	3.111	2.752
21	24.2	44.2	90.9	-20.0	2.998	2.543
22	28.3	48.3	95.9	-20.0	3.224	2.650
23	26.3	41.3	90.9	-15.0	3.213	2.629
24	22.4	47.4	90.9	-25.0	2.913	2.549
25	26.2	51.2	95.9	-25.0	2.968	2.509
26	18.9	43.9	85.9	-25.0	3.180	2.894
27	20.9	50.9	90.9	-30.0	2.910	2.613
28	24.5	54.5	95.9	-30.0	2.836	2.460
29	28.3	58.3	100.9	-30.0	3.004	2.533
30	26.2	51.2	95.9	-25.0	2.968	2.509
31	23.0	58.0	95.9	-35.0	2.782	2.469
32	26.6	61.6	100.9	-35.0	2.827	2.435
33	19.7	54.7	90.9	-35.0	2.964	2.717
34	21.7	61.7	95.9	-40.0	2.780	2.515
35	25.1	65.1	100.9	-40.0	2.730	2.398
36	28.6	68.6	105.9	-40.0	2.863	2.452
37	26.6	61.6	100.9	-35.0	2.827	2.435
38	23.8	68.8	100.9	-45.0	2.686	2.402
39	27.1	72.1	105.9	-45.0	2.726	2.375
40	20.6	65.6	95.9	-45.0	2.816	2.591
41	22.6	72.6	100.9	-50.0	2.679	2.434
42	25.8	75.8	105.9	-50.0	2.647	2.343
43	29.2	79.2	110.9	-50.0	2.757	2.386

44	27.1	72.1	105.9	-45.0	2.726	2.375
45	24.6	79.6	105.9	-55.0	2.606	2.341
46	27.9	82.9	110.9	-55.0	2.645	2.321
47	21.6	76.6	100.9	-55.0	2.701	2.488
48	23.6	83.6	105.9	-60.0	2.594	2.362
49	26.7	86.7	110.9	-60.0	2.575	2.290
50	29.9	89.9	115.9	-60.0	2.672	2.327
51	27.9	82.9	110.9	-55.0	2.645	2.321

Appendix B

Western
States
Mining
Consultants, P.C.

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