REPORT

ENVIRONMENTAL ASSESSMENT

Horsethief Canyon Landfill Closure

Submitted To: USDA Forest Service
Jackson Ranger District
Bridger-Teton National Forest
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1.0 INTRODUCTION

Teton County submitted an application to the U.S. Forest Service (USFS), dated September 25, 2012, for authorization to re-shape and re-cap a landfill and to construct groundwater and landfill gas monitoring wells on National Forest System (NFS) lands managed by the Jackson Ranger District of the Bridger-Teton National Forest.

The Bridger-Teton National Forest has prepared this Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This EA discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives.

1.1 Background

The landfill property (Site) is located approximately seven miles south of the Town of Jackson along Highway 26/89/189/191, in an area known as Horsethief Canyon (Figure 1) and encompasses approximately 40.5 acres owned by Teton County in the SW1/4 of the NW1/4 of Section 27, Township 40 North, Range 116 West, in Teton County, Wyoming, and an adjacent 17.8-acre United States Forest Service (USFS) parcel to the east of the 40.5-acre parcel.

Municipal solid waste (MSW) was buried in the Horsethief Canyon Landfill (on both US Forest Service and Bureau of Land Management [BLM] properties) from the mid-1950s through 1989. (The BLM property is now owned by Teton County.) A soil cap (consisting of 18 inches of compacted soil beneath 6 inches of topsoil) and surface water control channels were placed on top of the landfill in 1989 and a trash transfer station and scale house were constructed on property owned by Teton County. Since that time, all landfill-bound trash was sent to a landfill in Sublette County, WY until July 2012 when Teton County began sending waste to a lined landfill in Bonneville County, ID. There is evidence from groundwater quality monitoring performed by Teton County (see Section 1.3, below, for more detail) that surface water has infiltrated the buried MSW and shallow groundwater at the site has been impacted.

1.2 Project Area

The project area consists of the 17.8-acre parcel of reclaimed landfill that now supports herbaceous vegetation consisting of a mix of introduced and native species (Figure 1).

Immediately to the east of the Forest Service portion of the landfill is coniferous forest stand consisting of a mix of Engelmann spruce, Douglas-fir, subalpine fir and limber pine. The property immediately to the south is reclaimed landfill which is managed by Teton County, including the transfer station and recycling. Highway 89 and a Wyoming DOT maintenance facility are located to the west.

1.3 Purpose and Need

The purpose of the project is to provide final closure of the landfill to meet the requirements of the Wyoming Department of Environmental Quality (WDEQ) (Wyoming Solid Waste Rules, Chapter 1, Section 2 (g and h) and Chapter 2, Section 7) as well as Bridger-Teton National Forest Plan water quality standards.

In 2008, quarterly groundwater testing by Teton County began on samples from four groundwater wells at the downgradient edge of the landfill. Methylene chloride was found to be slightly exceeding the Groundwater Protection Standard in 12 out of the past 14 sampling events in one of these wells. Methylene chloride is a volatile solvent that is mobile in subsurface environments and is often an indicator that other chemicals may follow. In addition, 15 other VOCs have been detected at concentrations below the Groundwater Protection Standard (See Section 3.3.1). The extent and degree of contamination is unknown at this time. A Nature and Extent of Contamination Study and Assessment of Corrective Measures is being prepared, to meet WDEQ requirements (Appendix B). The Proposed Action will also protect water quality for segments of the Snake River, classified as Wild and Scenic Rivers and downgradient consumptive use of water.

Because the concentration of methylene chloride exceeds the Groundwater Protection Standards, the WDEQ is requiring Teton County to put a new, more robust final cap on the landfill, including improved storm water controls, and apply for a final closure permit. Implementation of both of these requirements must be met by August 2017. Once capped, the site must remain undisturbed and monitored for at least 30 years post-closure. The intent in re-capping the landfill is to minimize the infiltration of surface water, and thus, reduce the production of leachate, and significantly reduce further impacts to groundwater, while providing a barrier to surface intrusion into the MSW.

1.4 Forest Plan Direction

The Forest Plan has assigned Desired Future Conditions (DFCs) for specific areas of land in the Bridger-Teton National Forest. These DFCs provide the emphasis and requirements used in project implementation to help achieve Forest Plan goals and objectives. The proposed action is located in Management Area 41 (Jackson Hole South; Forest Plan pg. 266 – 267; USFS 1990) and the DFC is DFC 12 Backcountry Big-Game Hunting, Dispersed Recreation, and Wildlife Security Areas. The theme for DFC 12 is: “An area managed for high-quality wildlife habitat and escape cover, big-game hunting opportunities, and dispersed recreation.”

Applicable prescriptions, standards, and guidelines include:

- Visual Quality Prescription – The visual quality objectives are retention and partial retention.
- Fisheries and Wildlife Prescription – Habitat will be managed to help meet the game populations, harvest levels, success, and recreation-day objectives, and to fully achieve the fish population, harvest levels, success, and recreation-day objectives identified by the Wyoming Game and Fish Department and agreed to by the Forest Service.
- Management Activity Guideline – All management activities should be concentrated to within the shortest period of time and to the smallest possible area.

The proposed actions meet all Forest-wide and DFC 12 standards and all other applicable Forest Plan direction (USFS 1990). Forest Plan objectives are discussed in more detail for each resource in Section 3.

1.5 Proposed Action

In order to meet the purpose and need, the Forest Service proposes to authorize Teton County to regrade MSW from a 5-acre area on Teton County property onto a portion of the existing landfill on adjacent NFS land, regrade the MSW on NFS land, construct a new cap on NFS land, and construct surface water channels on the landfill. The construction activities are expected to last approximately three years, with construction expected to begin 2014 or 2015 and be complete by 2016 or 2017. No construction is planned during the winter months. The project will comply with BTNF seasonal restrictions for winter wildlife range (See Section 1.6), with no construction from December 1 to April 30.

The cap will serve as a barrier to reduce the infiltration of precipitation into the MSW, reducing contact between water and the MSW, thus, reducing the production of leachate and reducing impacts to groundwater. The cap consists of a relatively impermeable geomembrane that will impede downward movement of precipitation into waste. It also includes a drainage layer on top of the geomembrane that will transmit water to the sides of the cover and to surface water channels. A permeable layer underneath the geomembrane will assist in conducting any landfill gas to the landfill gas vents that will be spaced across the cap.

Certain elements of this project occur on Teton County property and the Forest Service has no authority over those activities, but they are considered in the cumulative effects analyses.

Additional background and details of this proposal may be found in the draft report entitled "Teton County Landfill Closure Alternatives Evaluation" (Golder 2012a), included as Appendix A.

1.6 Decision Framework

Based on the environmental analysis and public input, the Forest Supervisor of the Bridger-Teton National Forest will decide whether or not to authorize re-shaping and re-capping of the landfill and construction of groundwater and landfill gas monitoring wells on NFS lands as described or implement an alternative or adjustment to the proposal.

1.6.1 Public Involvement

The proposal was first listed in the Forest Schedule of Proposed Actions in the 3rd quarter of 2013. The proposal was provided to the public and other agencies for comment via a scoping document dated May 13, 2013. A legal notice was published in the newspaper of record, Casper Star-Tribune, announcing a 30-day public comment period. The comment period lasted from May 18, 2013, to June 17, 2013. No comments were received during the comment period.

Pre-decisional Administrative Review

This project is subject to the objection process at 36 CFR 218 Subparts A and B. The Forest Service allows the public 45 days following a legal notice of draft decision to file an objection (36 CFR 218 Subparts A and B). Persons or organizations are eligible to object if they have submitted timely and specific written comments regarding the proposed project during a public comment period. Only those who submitted timely and specific written comments regarding the proposed project during a public comment period established by the responsible official are eligible to file an objection under 36 CFR 218.

Since no comments were received during the public comment period, no one is eligible to object. Therefore, there will not be a need for the 45-day objection-filing period.

1.6.2 Issues

Issues were developed based on internal discussions with the Forest Service resource specialists. No specific comments were received during the public comment period, so no issues were identified from public input.

The following is a list of issues and resource concerns identified during the scoping process:

- Noise, dust, and odor during earthwork activities
- Increased runoff potential
- Increased potential for sediment delivery to downgradient streams
- Increased potential for noxious weed invasion
- Air quality effects from exhaust emissions and fugitive dust
- Effects on wildlife and plants (including special status species) due to loss of habitat or noise
- Groundwater quality (possible beneficial effect)

The following potential issues were considered and eliminated from detailed evaluation:

- The Proposed Action area is not located in or near floodplains, wetlands, or municipal watersheds. This has been validated by map and site-review. The Proposed Action will not affect floodplains, wetlands or municipal watersheds.

- No Wildernesses, Wilderness Study Areas, National Recreation Areas, Research Natural Areas or Wild and Scenic Rivers will be affected by this action because the action is outside of these areas and will have no impacts to these areas.
- The Proposed Action is not located in an Inventoried Roadless Area. The landfill is adjacent to the Gros Ventre Inventoried Roadless Area, but is outside the boundary.
- A Class III Cultural Resources Survey was performed on the landfill in April 2012 (Schubert 2012). No historic or cultural sites were identified. The results were submitted to Wyoming State Historic Preservation Office (SHPO) and a concurrence letter from SHPO is in the project file. Therefore there will be no effects to cultural or historic resources. The project complies with: National Historic Preservation Act of 1966 (as amended), American Indian Religious Freedom Act of 1978, Archeological Resource Protection Act of 1980, and Executive Order 11593 (cultural resources).

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 Alternative 1 – Proposed Action

A detailed design for the proposed cap has not yet been developed. Therefore, the following discussion is for a typical landfill cap design with respect to materials and thickness of layers for the purpose of addressing the proposed alternative. The cap being proposed has been accepted conceptually by WDEQ as an acceptable closure cap design for sites that have had impacts to groundwater. The proposed action includes the following steps on NFS land:

- Remove topsoil from the area to be regraded and stockpile on adjacent, previously disturbed portions of the landfill for later use.
- Remove remaining soil cap and stockpile on previously disturbed land for later use.
- Move existing waste within the existing footprint of the landfill as necessary to match the final closure grading plan and use stockpiled soil as needed to develop foundation grading for cap.
- MSW would be removed from a 5-acre area on Teton County property and then used to regrade portions of the landfill on Teton County and USFS properties. Adding additional material and regrading is necessary in order to establish the appropriate grade for a successfully functioning cap.
- Place a final cap system that meets requirements of the Wyoming Department of Environmental Quality (WDEQ) (Wyoming Solid Waste Rules). The cap will include the following components (in order from the MSW upward):
  - Gas collection layer consisting of a 1-foot-thick layer of permeable material (sand, shredded tires, or a geosynthetic) and gas vents (6-inch-diameter perforated HDPE pipe), designed to collect and disperse landfill gas (methane and carbon dioxide), in order to prevent build-up of gasses beneath the cap. They will be spaced at approximately 200-ft centers, so approximately 19 wells are expected on the Forest Service portion of the cover.
  - A geosynthetic (plastic) liner to limit infiltration of precipitation into the MSW, reducing the production of leachate, and significantly reducing further impacts to groundwater.
  - Drainage layer, consisting of a 1-foot-thick layer of permeable material (sand, shredded tires, or geosynthetic), which will drain excess precipitation from the surface of the liner and help prevent infiltration through the liner while enhancing stability by preventing saturation of the soil cover.
  - 2-foot-thick vegetation support layer and topsoil (soil layer), consisting of clean soil and topsoil that was previously salvaged and stockpiled. The soil layer will protect the liner and promote the growth of vegetation by providing moisture and nutrients.
  - Revegetate the area by seeding with a mixture of Forest Service-approved, native, herbaceous species. The vegetation will help to prevent erosion of the soil layer and remove moisture.
- Control surface water by installing appropriately engineered (grass-lined or armored) channels along the east and southwest portions of the landfill perimeter to collect runoff from the final cap and convey it to the southwest boundary of the Site.
- Incorporate a revised groundwater and landfill gas monitoring program into post-closure activities. This is necessary because there is evidence that contaminants may have previously migrated from the MSW into groundwater and also since MSW will remain in place and continue to generate landfill gas.

The cap will serve as a barrier to reduce the infiltration of precipitation into the MSW, reducing contact between water and the MSW, thus, reducing the production of leachate and reducing negative impacts to groundwater. The cap consists of a relatively impermeable geomembrane that will impede downward movement of precipitation into waste. It also includes a drainage layer on top of the geomembrane that will transmit water to the sides of the cover and to surface water channels. A permeable layer underneath the geomembrane will assist in conducting any landfill gas to the landfill gas vents that will be spaced across the cap.

Certain elements of this project would occur on Teton County property; therefore the Forest Service has no authority over those activities.

Additional background and details of this proposal may be found in the report entitled "Teton County Landfill Closure Alternatives Evaluation" (Golder 2012a) attached as Appendix A.

2.1.1 Required Design Features

Design criteria and best management practices (BMPs) are included in the proposed action to reduce potential effects to resources of concern. They include:

- Seasonal restrictions – winter wildlife range – All activities will be conducted outside of the December 1 to April 30, "no human activity" period for wildlife winter range.
- Sediment control BMPs, such as rock check dams, straw bales, and wattles will be installed in the channels. Silt fencing will be installed during earthwork activities.
- A sediment basin will be installed on the downgradient edge of the property to prevent increased sediment loading to the 303(d) section of Flat Creek across Highway 189.
- Bioengineering (cuttings, live stakes, and wattles) will be used to reestablish riparian vegetation along the constructed channels.
- There will be no staging or storage of materials or equipment within 150 feet of riparian areas in compliance with the Construction Staging Area Guideline and Wyoming BMP #4.
- Compliance with the Forest food storage order during operations will be specified in contract clauses for private companies involved in the project. Periodic site inspections to ensure compliance will occur. Personnel will receive training (oral instruction and brochures) on garbage and food storage regulations and protocols to be followed in the field and at any temporary camps used at night.
- Soil will be excavated and stockpiled from the project footprint prior to construction activities. Stockpiles will be protected from erosion.
- Regrading and cover reconstruction will be staged so that soil stockpiles will not be required for long periods of time. Salvaged soil will remain in stockpiles for no more than two months.
- If soil is stockpiled for more than two months, stockpiles will be vegetated to maintain soil productivity.
- Following regrading and reconstruction of the landfill cover, a seed mix specified by the Forest Service will be used to reseed the area. The seed mix will include, to the extent practical, native species that are adapted to the site.
- Before implementation, during operations and upon completion of the Proposed Action, a noxious weed control program will be implemented to control the presence and spread of noxious weed species. The weed control program will be conducted in conjunction with Teton County Weed and Pest District (TCWPD) to ensure proper timing for disturbance and control methods are applied for each species encountered in the project area.

- The potential to spread noxious weeds in seeds and propagules on construction equipment will be mitigated by washing equipment to remove seeds and propagules prior to entering or leaving the work area.
- Any mulch or straw bales utilized will be certified weed free.
- The proponent will be required to obtain coverage under the General Stormwater Discharge Permit for Large Construction Projects (WYR 10-0000). Compliance with the permit requires preparing and implementing a Stormwater Pollution Prevention Plan (SWPPP) and implementing best management practices (BMPs) designed to protect the exposed soil from erosion and control sediment discharge to receiving streams.
- WDEQ will require Teton County to prepare an Environmental Monitoring Plan, including surface water, groundwater and methane monitoring, as part of the landfill closure permit application.
- Areas that have exposed MSW as construction progresses will be within temporary berms, much like active MSW landfills, that will control stormwater runoff and prevent it from flowing from the exposed MSW area. This will be a requirement in the construction specifications.
- Prior to beginning construction, Teton County will be required to apply for a construction permit from the Wyoming DEQ Air Quality Division. Compliance with the permit requires use of Best Available Control Technology such as treatment of haul roads, stockpiles and active work areas with a dust suppressant, and vegetation of soil stockpiles.
- The SWPPP prepared to comply with the Construction Stormwater Discharge Permit requires secondary containment around bulk storage containers of petroleum products equal to the volume of the largest container, plus 10%.
- There will be a performance specification that no windblown MSW will be allowed to exit the construction area. Teton County will monitor full-time to make sure this requirement is met. The construction contractor will be required to provide a plan outlining what methods will be used to control windblown MSW until the MSW is covered with final cover material. MSW landfills employ a number of means to control windblown MSW, and as stated above, daily cover is a primary engineering control. Contractors will employ daily cover methods that allow relatively easy removal and reuse such as tarps that are sand-bagged. Litter fences can also be used to catch any MSW that is not dealt with by daily cover.
- If a migratory bird nest is discovered within the proposed action disturbance area prior to construction activities, full protection of any nest will be implemented under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703-712).

2.2 Alternative 2 – No Action

Under the No Action Alternative, the Forest Service would not authorize the re-shaping and re-capping of the landfill and construction of groundwater and landfill gas monitoring wells on NFS land. If the No Action Alternative were chosen, Teton County would still regrade and re-cap portions of the landfill on Teton county land, adjacent to the NFS land. The No Action Alternative would not meet the WDEQ requirement to construct a more robust cap on all portions of the landfill.

2.3 Alternatives Considered but not Analyzed in Detail

Several alternatives for handling the MSW were considered, but not carried forward for detailed analyses.

Excavating all MSW for disposal at another landfill was considered and rejected because there is no Teton County property suitable as an alternative disposal location, requiring the waste to be hauled to a site out of the county. This alternative would cause a large increase in traffic, when compared to the

proposed action, while not eliminating the need for long-term monitoring of the site. In addition, the haul cost would be prohibitive to the County.

Hauling a portion of the MSW to another site was considered and eliminated because it would require additional traffic while providing no additional benefit when compared to the proposed action.

2.4 Applicable Laws and Executive Orders

Shown below is a partial list of federal laws and executive orders pertaining to project-specific planning and environmental analysis on federal lands, in addition to NEPA. While most pertain to all federal lands, some of the laws are specific to Wyoming. Disclosures and findings required by these laws and orders are contained in Chapter 3 and the Decision Notice for this EA.

- National Forest Management Act (NFMA) of 1976 (as amended)
- National Historic Preservation Act of 1966 (as amended)
- American Indian Religious Freedom Act of 1978
- Archeological Resource Protection Act of 1980
- Executive Order 11593 (cultural resources)
- Endangered Species Act (ESA) of 1973 (as amended)
- Executive Order 13186 (Migratory Bird Treaty Act)
- Clean Air Act of 1970 (as amended)
- Clean Water Act of 1977 (as amended)
- Executive Order 11988 (floodplains)
- Executive Order 11990 (wetlands)
- Executive Order 12898 (environmental justice)

The Proposed Action complies with Executive order 11988 and Executive Order 11990. The Proposed Action area is not located in or near floodplains, wetlands or municipal watersheds. This has been validated by map and site-review. There are floodplains and wetland located downstream in the Flat Creek drainage. Required design criteria (see Section 2.1.1 and 3.3.2) and compliance with the Wyoming Stormwater Discharge permit will prevent effects to Flat Creek. The Proposed Action will not affect floodplains, wetlands or municipal watersheds.

A Class III Cultural Resources Survey was performed on the landfill in April 2012 (Schubert 2012). No historic or cultural sites were identified. The results were submitted to Wyoming State Historic Preservation Office (SHPO) and a concurrence letter from SHPO is in the project file. Therefore, there will be no effects to cultural or historic resources. The project complies with: National Historic Preservation Act of 1966 (as amended), American Indian Religious Freedom Act of 1978, and Archeological Resource Protection Act of 1980 and Executive Order 11593 (cultural resources).

A Biological Assessment and Evaluation (BAE) was prepared to evaluate compliance with the Endangered Species Act. The results are summarized in Section 3.2. It determined that there would be “no effect” or “may affect, not likely to adversely affect” for all federally listed species on the BTNF. The analysis was submitted to the US Fish and Wildlife Service (USFWS), Cody Field Office for concurrence. The project is consistent with standards and guidelines in the Northern Rockies Lynx Management Direction (USFS 2007) and its biological opinion (USFWS 2008a). The BAE and Concurrence letter are available in the project record. The Proposed action complies with the Endangered Species Act (ESA) of 1973 (as amended).

The Proposed action complies with Executive Order 13186 (Migratory Bird Treaty Act). Effects to migratory birds were evaluated in the BAE and in Section 3.2 of this EA.

Executive Order 12898 (environmental justice) directs agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. The project area population is 8% minority and 5.8% are considered low-income (EPA EJ View 2013). These numbers are below the Teton County averages of 15.9% and 8.2%, respectively. Therefore, this project would not affect any minority or low-income populations disproportionately. There are no residences in the project area.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Soils

3.1.1 Affected Environment

According to the Teton County, Wyoming, Grand Teton National Park Area; Soil Survey; (NRCS 2011), the soil is described as Map Unit 19 (Greyback-Thayne complex 10 to 20 percent slopes). The dominant soil is the Greyback gravelly loam. This soil is alluvium and/or glacio-fluvial deposits derived from igneous, metamorphic and sedimentary rock. The soil is described as somewhat excessively drained (Hydrologic Group B). The soil is rated as having moderate erosion resistance and is well-suited to rangeland vegetation.

After construction is complete and salvaged soil has been replaced, the potential exists for increased erosion while vegetation is reestablishing. The erosive loss is expected to be minor. Erosion will be reduced by design criteria, including surface roughening and application of mulch to protect the soil surface and reduce flow paths and velocity of surface runoff.

3.1.2 Environmental Consequences

3.1.2.1 Issue Indicators – Forest Plan Direction

Guidance related to soils, is included on pages 136 – 137 in the Forest Plan. Standards and Guidelines applicable to the Proposed Action include:

- Soil, Water, and Air Prescription – Activities are planned to protect the quality of the basic watershed resources of soil, water, and air.
- Sediment Control Standard – Sediment control will take into account drainage density, slope position and configuration, and subsurface flow conditions.
- On-Site Erosion Guideline – Project-caused on-site potential soil erosion should be reduced by 50 percent one year after disturbance and 95 percent five years after disturbance.
- Rehabilitation Standard – Rehabilitation plans will identify quantities of topsoil A and B horizons to be reserved for stockpiling prior to project initiation. Rehabilitation seed mixes or other plantings will be designed for each vegetation community type that meets the desired future condition.

Indicators to assess impacts to soil include:

- Loss of productivity
- Increased erosion

3.1.2.2 Spatial and Temporal Context

The direct, indirect and cumulative area for soil is the project area. Temporal effects were considered short term if less than ten years and long term if more than ten years into the past and future.

3.1.2.3 Alternative 1 – Proposed Action

Approximately 12 acres of existing soil will be disturbed by implementing the Proposed Action. The soil will be removed and stored in stockpiles located on adjacent portions of the landfill during construction. No loss of productivity is expected because the stockpiled soils will be protected from compaction and erosive loss will be minimized by maintaining stockpile slopes less than 3 Horizontal:1 Vertical and providing diversions to prevent upgradient run-on. Construction activities will be staged so that soil is

stockpiled for no more than two months. Although not expected, if soil remains in stockpiles for more than two months, stockpiles will be vegetated. The vegetation cover will maintain productivity by maintaining microbial communities needed for nutrient cycling.

The potential for loss of soil from erosion was evaluated using the Water Erosion Prediction Project model interface for Disturbed Forest and Range Runoff, Erosion and Sediment Delivery ("Disturbed WEPP") for the footprint of the Proposed Action to assess potential soil loss and sediment delivery to stream channels and riparian areas. Model inputs are described below. The inputs were defined to model the expected "worst case" condition, during the initial period after seeding, before vegetation has established. Documentation for the model is available at:

http://forest.moscowfsl.wsu.edu/fswepp/docs/distweppdoc.html

Parameters used for the analysis included the following:

- Climate: Temperature and precipitation data from the National Weather Service Climate Station at Jackson, WY.
- Soil texture and rock content: Teton County soil map unit descriptions were used to assign surface soil textures and rock content. The Greyback loam is a gravelly loam. Loam texture was used with 15% rock fragments.
- Treatments: A poor grass stand was used as the treatment to represent the first year after revegetation before vegetation reestablishes.
- Gradient and slope lengths: Slope gradients and lengths were taken from topographic maps. The steepest slope gradient proposed for the cover is 20%. The slope length was estimated at 200 feet. Slope length was estimated assuming that silt fence or straw wattles will be installed at 200-foot spacing.
- Cover: Cover was conservatively estimated as 60%. The cover value assumes that straw mulch will be placed and crimped in at a rate of 2 tons/acre. Normally crimped mulch at 2 tons/acre achieves approximately 90% cover.

Disturbed WEPP is most useful as a means to compare alternatives versus providing absolute amounts of soil erosion and sediment delivery. As acknowledged in model documentation, "[a]t best, any predicted runoff or erosion value, by any model, will be within only plus or minus 50 percent of the true value. Erosion rates are highly variable, and most models can predict only a single value. Replicated research has shown that observed values vary widely for identical plots, or the same plot from year to year" (http://forest.moscowfsl.wsu.edu/fswepp/docs/distweppdoc.html). Modeled amounts of sediment passing through the riparian buffers to channels are shown for the existing condition (no treatment) and for treatments; results are shown as average annual erosion rates over 10 years, although sediment delivery would not be as constant as implied by the term "average annual", but would instead depend on climate and other variables.

The model was run for a 10-year period. Model output is available in the project record. The disturbed WEPP results predict that no sediment would be eroded under current conditions. For the Year 1 following revegetation condition, the model predicts sediment loss of 0.017 tons/acre/yr.

As stated above, the relative increase in sediment delivery over current conditions is the key factor to note. The increase in sediment delivery to channels under the proposed action would not be measurable and would not have measurable adverse impacts to stream channels. Therefore, no measurable effects from regrading activities should occur if all of the required design features are implemented.

3.1.2.4 Alternative 2 – No Action

If the No Action Alternative is chosen, there will be no soil disturbance on Forest Service land and no changes to soil productivity or changes in erosion.

3.1.2.5 Cumulative Effects

Within this analysis area past, present and reasonably foreseeable future activities that have the potential to impact the plants and wildlife included in this analysis include:

- Recent U.S. Highway 189/191 reconstruction/improvements (FHWA/WYDOT)
- Squaw Creek Water District Test Well
- Teton County landfill reclamation

Each project incorporates mitigation measures, including soil salvage and revegetation, and erosion control BMPs that minimize effects to soil. Because no measureable effects are expected for the Proposed Action, no measureable cumulative effects are expected.

3.2 BIOLOGICAL RESOURCES

For the purposes of this document, the biological environment is made up of plants and wildlife. When combined with the physical environment, they interact to form an ecosystem. Natural processes, such as fire, succession, and disease alter habitats over time. The biological environment is discussed below in two subsections: vegetation (including wetlands and noxious weeds) and special status species (federally listed, FS-designated sensitive species, and management indicator species [MIS] of plants, wildlife, and fish).

3.2.1 Vegetation (including wetlands and Noxious weeds)

General impacts and disturbance to vegetation will be minimal during implementation of the Proposed Action due to previous site disturbance (existing landfill cover) and the generally small area of impact (17.8 acres) on USFS lands. Presently the vegetation consists primarily of cheatgrass *(Bromus tectorum*) and several noxious weed species including Common Mullein (*Verbascum thapsus*), Dalmatian toadflax (*Linaria dalmatica*), Diffuse knapweed (*Centaurea diffusa*), Houndstongue (*Cynoglossum officinale*), and Musk thistle (*Carduus nutans*). Implementation and future management of the vegetation on the existing footprint of the site has the potential to improve native plant composition, and provide decreased levels of non-native and invasive species. Overall impacts to vegetation have the potential to be beneficial and improve the current existing plant community.

3.2.1.1 Affected Environment

3.2.1.1.1 Wetlands/Riparian

The wetland and aquatic habitats assessment consisted of mapping potentially jurisdictional waters of the United States (U.S.), including wetlands, within the project site. Golder Associates gathered and evaluated all readily available information (including topographic, floodplain, and watershed maps, USFWS National Wetland Inventory [NWI] mapping, Natural Resources Conservation Service [NRCS] Soil Survey of the Teton County Area [NRCS 2013], and aerial photographs) to provide a general characterization of the waters of the U.S., including wetlands, within the project area. No wetland areas or jurisdictional waters of the U.S. were identified within the project area during initial literature review. During an on-site evaluation of the project area on April 19, 2013 (Figure 2), a short segment of intermittent or ephemeral channel was identified on the edge of the landfill. The Proposed Action does not impact any jurisdictional waters of the U.S. downstream of the project area and will not impact any waters or wetlands in vicinity of the project area. There are wetlands downstream of the proposed action, on Flat Creek. The required design criteria (Section 2.1.1) will prevent changes in sediment (See WEPP model results in Section 3.1.2) delivery or flow that would affect the wetlands.

3.2.1.1.2 Noxious Weeds

During the site visit on April 19, 2013, Golder Associates documented the presence of several noxious weed species present on the TCWPD Control Priorities List in the project area (TCWPD 2013). These species included Common Mullein (*Verbascum thapsus*), Dalmatian toadflax (*Linaria dalmatica*), Diffuse knapweed (*Centaurea diffusa*), Houndstongue (*Cynoglossum officinale*), and Musk thistle (*Carduus nutans*). Diffuse knapweed is declared a Priority 1 species by the TCWPD and is considered to be highly invasive. Priority 1 species pose the highest threat to native plant communities, and are known to render land unfit for wildlife and livestock grazing, reduce land value and recreation, and are found or were previously found in extremely low numbers in Teton County (TCWPD 2013). There is no tolerance for further spread of these species and there exists a goal of eradication during detection. Dalmatian toadflax and Houndstongue are Priority 3 species and there is no tolerance for further spread from their established locations. These species require control and maintenance of current infestations and aggressive control to areas otherwise free from these species (TCWPD 2013). Musk thistle and Common mullein are Priority 4 species. There is no tolerance for further spread of these species and control and maintenance of current infestations is required. These species are all located in the project area that will be disturbed during project implementation. Consequently, these species will be removed during project implementation. Before construction and upon completion of the Proposed Action, a noxious weed control program will be implemented to control the presence and spread of noxious weed species. The weed control program will be conducted in conjunction with TCWPD to ensure proper timing for disturbance and control methods are applied for each species encountered in the project area.

3.2.1.2 Environmental Consequences

3.2.1.2.1 Issue Indicators – Forest Plan Direction

The land and resource management goals and objectives for vegetation that are relative to the Proposed Action include:

- Goal 4.3(b) – Provide for diverse habitats to ensure viable populations of MIS.
- Goal 4.3(c) – Protect and rehabilitate riparian areas to retain and improve their value for fisheries, aquatic habitat, wildlife, and water quality.
- Goal 4.8(b) – Help control the spread of noxious weeds.
- Aspen Management Guideline – Aspen sites should be managed for aspen-type perpetuation. The loss of aspen stands due to old age, conifer encroachment, and possible overgrazing should be prevented. Priority areas for aspen treatment should be big-game winter ranges, calving areas, and stands where type loss or conversion is imminent.
- Noxious Weeds Control Standard – Effective management of noxious weeds will be accomplished by cooperating with the Wyoming Department of Agriculture and county weed control districts, using Integrated Pest Management techniques, following the procedures outlined in the Bridger-Teton Environmental Assessment for noxious weed control and appropriate technical guides. No toxic chemicals will be applied in a manner that will adversely affect non-target species.
- Intermountain Noxious Weed and Poisonous Plant Control Program Environmental Impact Statement.
- Forest and District level environmental assessments.
- Teton County Weed and Pest District noxious weed control management guidelines for species on Control Priorities List (TCWPD 2013).

The Forest-wide standards and guidelines for vegetation (Forest Plan, pages 122–133; USFS 1990) that apply to this project are described below:

- Streambank Vegetation Standard – Grass and shrub vegetation will be maintained within about 25 feet, plus 2 to 4 feet for each 1 percent side slope adjacent to live streams. Vegetation with greater stability provided by rooting structure will be planted during the revegetation of channel banks following the completion of construction.
- Construction Staging Area Guideline – Construction staging and equipment service areas will be located on level ground and at least 150 feet from riparian areas.

Issues may include:

- Effects on streambank vegetation
- New disturbed areas susceptible to noxious weed infestation
- Introduction of noxious weed species from construction equipment and imported construction materials
- Effects on Special Status Plant Species – Proposed, threatened, and endangered species; FS sensitive species; and management indicator species (MIS)

Indicators to assess impacts to wetlands will follow the National Forest Management Act of 1976, which provides direction for selecting MIS for forest planning and management. The BTNF has selected, where practical, MIS groups and guilds rather than individual specie for habitats with a high rate of being affected by management activities. These habitats include riparian, old-growth forest, aspen, mountain meadow, wetlands, and sagebrush (USFS 1990).

3.2.1.2.2 Spatial and Temporal Context

The direct, indirect and cumulative area for vegetation is the project area. Temporal effects were considered short term if less than ten years and long term if more than ten years into the past and future.

3.2.1.2.3 Alternative 1 – Proposed Action

3.2.1.2.3.1 Wetland/Riparian

No jurisdictional wetlands will be disturbed by the regrading and construction implemented during the Proposed Action. A short segment of riparian vegetation along an intermittent channel that was created by the construction of the landfill will be temporarily disturbed during construction of the new diversion channel. Revegetation of the diversion channel will include bioengineering methods to establish native woody and herbaceous riparian species as specified by the Forest Service personnel. There will be no staging or storage of materials or equipment within riparian areas in compliance with the Construction Staging Area Guideline (USFS 1990).

3.2.1.2.3.2 Noxious Weeds

Noxious weeds are common on the landfill and on the surrounding area. The potential to spread noxious weeds in seeds and propagules on construction equipment will be mitigated by washing equipment to remove seeds and propagules prior to entering or leaving the work area. The regraded areas will provide conditions suitable for invasive species to establish, prior to establishment of native vegetation. Upon completion of the Proposed Action, a noxious weed control program will be implemented to control the presence and spread of noxious weed species. Seed mixes will be certified noxious weed-free in compliance with Wyoming law. Any mulch or straw bales utilized will be certified weed-free.

3.2.1.2.4 Alternative 2 – No Action

If the No Action Alternative is chosen, there will be no effect on vegetation, special status species or wetlands on Forest Service land.

3.2.1.2.5 Cumulative Effects

Within this analysis area past, present and reasonably foreseeable future activities that have the potential to impact the plants and wildlife included in this analysis include:

- Wildland fire
- Prescribed fire
- Recent U.S. Highway 189/191 reconstruction/improvements (FHWA/WYDOT)
- Squaw Creek Water District Test Well
- Teton County landfill reclamation

These projects will incorporate mitigation measures, including soil salvage and revegetation BMPs, which minimize effects to vegetation. Because no measureable effects are expected for the Proposed Action, no measureable cumulative effects are expected.

3.2.2 Migratory Birds

On January 10, 2001, President Clinton signed Executive Order 13186 (Federal Register, Vol. 66, No. 11, 2001) which outlines responsibilities of federal agencies to protect migratory birds under the *Migratory Bird Treaty Act* (16 U.S.C. 703-712). The Order requires each federal agency whose actions have, or are likely to have, a measurable negative effect on migratory bird populations to develop a Memorandum of Understanding (MOU) with USFWS. In December of 2008, a MOU between the USDA Forest Service (USFS) and the USFWS to Promote the Conservation of Migratory Birds was signed (USFS 2008a). Pursuant to the Executive Order and the MOU, the USFS shall ensure that environmental analyses of Federal actions required by NEPA evaluate the effects of actions and agency plans on migratory birds, with emphasis on: 1) species of management concern along with their priority habitats, and 2) species of conservation concern.

Species of management concern are identified in the Forest Plan (USFS 1990) as directed by the *National Forest Management Act* and its implementing regulations (36 CFR 219.19). Species of management concern on the BTNF include threatened and/or endangered species, sensitive species designated by the USFS Intermountain Regional Forester, and management indicator species (MIS) designated by the Forest Plan (USFS 1990). These species are also birds protected by the *Migratory Bird Treaty Act* (MBTA; 16 U.S.C. 703-712).

Birds of Conservation Concern are identified in the MOU between the USFS and the USFWS, and are defined in the MOU as those USFWS-listed migratory and non-migratory birds of the United States and its territories that are of conservation concern. The list is published and maintained by the USFWS, Division of Migratory Bird Management (USFWS 2008b). The current version of the list is available at http://www.fws.gov/migratorybirds. The BTNF is located within the Northern Rockies Bird Conservation Region (BCR 10).

The Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming (Orabona et al 2012) was used a guide to evaluate potential bird presence in the project area (Table 1). Of the twenty two bird species of conservation concern listed for BCR 10 (USFWS 2008b), five were not addressed further as Neo-tropical Migratory Birds (NTMB) due to lack of occurrence and lack of habitat. Seventeen were known or suspected to regularly occur in the Flat Creek Sub-Watershed. Three of these are addressed as Management Indicator or Sensitive species. The remaining fourteen BCR 10 species were not of management concern and were addressed as NTMB.

Table 1: Species in Bird Conservation Region 10 and their Occurrence in the Lower Flat Creek Sub-watershed

Species	Known or Likely Present in Flat Creek Sub-watershed?	General Habitat Description
Bald eagle (*Haliaeetus leucocephalus*)	Y	Please see section 3.2.3.2.2.1
Black rosy-finch (*Leucosticte atrata*)	Y	Alpine grasslands, alpine moss-lichen-forb, barren ground, fallow agricultural areas. A variety of habitats during the winter. Nests on the ground or on a cliff. Feeds on seeds, insects. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent cliff habitat, but no records of nesting.
Black swift (*Cypseloides niger*)	N	No observations in Wyoming (Orabona et. al. 2012)
Brewer's Sparrow (*Spizella pallida*)	Y	Please see section 3.2.3.2.2.1
Calliope hummingbird (*Stellula calliope*)	Y	Coniferous forests, woodland chaparral, mountain-foothills, shrublands, riparian shrub, mountain park-meadows, alpine grasslands. Uses many habitats during migration. Nests on a limb of a tree or on a conifer cone. Feeds on nectar, insects. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent forest habitat, but no records of nesting.
Cassin's finch (*Carpodacus cassinii*)	Y	Coniferous forests up to timberline, including burns. Lower habitats during the winter, especially urban areas. Nests in a conifer; nest is usually placed near the end of a large limb. Feeds on buds, berries, and conifer seeds. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent coniferous forest habitat, but no records of nesting.
Ferruginous hawk (*Buteo regalis*)	Y	Basin prairie shrublands and mountain foothills grasslands; rock outcrops; cottonwood-riparian. Nests on a rock outcrop, the ground, a bank, or in a tree. Feeds mostly on small mammals. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent rocky habitat, but no records of nesting.
Flammulated owl (*Otus flammeolus*)	Y	Montane forests, especially ponderosa pine. Nest in a tree cavity. Feeds primarily on insects; also a few arthropods. Rare in Wyoming. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent forest habitat, but no records of nesting. Not assumed to breed near analysis Area. (Orabona et. al. 2012)

Species	Known or Likely Present in Flat Creek Sub-watershed?	General Habitat Description
Lewis's woodpecker (*Melanerpes lewis*)	Y	Ponderosa pine savannah, pine-juniper, other coniferous forests, aspen, cottonwood-riparian, below 8,500 feet. Nests in a cavity in a dead or live tree or in a pole. Feeds on insects, nuts, and berries. Uncommon in Wyoming. Unlikely in the direct disturbance Analysis Area, due to lack of suitable habitat. Potential nesting habitat in adjacent coniferous forest habitat, but no records of nesting.
Loggerhead shrike (*Lanius ludovicianus*)	Y	Pine-juniper, woodland-chaparral, basin-prairie and mountain-foothills shrublands. Nest is usually hidden below the crown in the crotch or on a large branch of a deciduous tree or shrub. Feeds on insects, small vertebrates, carrion. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent pine-juniper habitat, but no records of nesting.
Long-billed curlew (*Numenius americanus*)	Y	Sagebrush-grasslands; mountain foothills, and wet-moist meadow grasslands; irrigated native meadows; with aquatic areas nearby. Uncommon in Wyoming. Nests on the grounds near water, sometimes in a moist hollow. Feeds on insects, aquatic invertebrates. Unlikely in the Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent shrub-grassland habitat, but no records of nesting.
McCown's longspur (*Ryhynchophanes mccownii*)	Y	Eastern great plains and great basin-foothills grasslands, basin-prairie shrublands, agricultural areas. Nests on the ground in shallow, natural or scraped depression. Feeds on seeds, insects. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Not assumed to breed near analysis Area. (Orabona et. al. 2012)
Olive-sided flycatcher (*Contopus cooperi*)	N	Coniferous forests from 8,000 feet to timberline, aspen-riparian. Nests often high in a conifer on a horizontal branch. Feeds exclusively on insects that can be caught in the air. Unlikely in the Analysis Area due to lack of suitable habitat. Analysis area is below 7,000 feet.
Peregrine falcon (*Falco peregrinus*)	Y	Please see section 3.2.3.2.2.1

Species	Known or Likely Present in Flat Creek Sub-watershed?	General Habitat Description
Sage sparrow (*Amphispiza belli*)	Y	Basin-prairie and mountain-foothills shrublands. Usually nests in or under a sagebrush. Feeds on insects, seeds. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent mountain-foothills shrublands habitat, but no records of nesting. Not assumed to breed near analysis Area. (Orabona et. al. 2012)
Sage thrasher (*Oreoscoptes montanus*)	Y	Basin-prairie and mountain-foothills shrublands. Nest is concealed in or beneath a sagebrush shrub. Feeds on insects, some fruit. Unlikely in the Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent mountain-foothills shrublands habitat, but no records of nesting.
Swainson's hawk (*Buteo swainsoni*)	Y	Most habitats below 9,000 feet with open areas for foraging. Nests in a tree, occasionally on a cliff. Feeds most on small mammals. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent coniferous forest habitat and rocky cliffs, but no records of nesting.
Upland sandpiper (*Bartramia longicauda*)	N	Eastern great plains grasslands, dry-land grass pastures. Nests in a depression on open ground, usually concealed by grass. Feeds on insects, terrestrial invertebrates, seeds. Unlikely in the Analysis Area during the breeding season. Unlikely in the Analysis Area due to lack of suitable nesting habitat. Not assumed to breed near analysis Area. (Orabona et. al. 2012)
White-headed woodpecker (*Picoides albolarvatus*)	Y	Coniferous forests from 4,000 to 9,000 feet. Feeds in insects, conifer seeds. Rare in Wyoming. Only historic records of occurrence near analysis Area. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent coniferous forest habitat, but no records of nesting.
Williamson's sapsucker (*Sphyrapicius thyroideus*)	Y	Coniferous forests, especially those that have burned. Also aspen. Nests in a cavity in an aspen, pine, or fir. Feeds on insects, tree sap. Unlikely in the direct disturbance Analysis Area during the breeding season due to lack of suitable nesting habitat. Potential nesting habitat in adjacent coniferous forest habitat, but no records of nesting.

Species	Known or Likely Present in Flat Creek Sub-watershed?	General Habitat Description
Willow flycatcher (*Empidonax minimus*)	N	Riparian shrub including willow, hawthorn, water birch, alder; below 9,000 feet. Nests in an upright or slanting fork in a shrub. Feeds primarily on insects, occasionally berries. Unlikely in the Analysis Area due to lack of suitable nesting habitat.
Yellow-billed cuckoo (*Coccyzus americanus)*	N	In the western U.S., yellow-billed cuckoo nest in open deciduous riparian woodlands (Orabona et al. 2012). There is no suitable habitat for this species within the project area (Orabona et al. 2012). There are no documented occurrences of this species within the project area (WYNDD 2013). Unlikely in the Analysis Area, due to lack of suitable nesting habitat.

Notes: Dark gray: species of conservation concern considered elsewhere; Light gray: carried forward for detailed analysis; No shading: species not carried forward because of species' rarity in the area or lack of suitable habitat in the Analysis Area.

3.2.2.1 Affected Environment

There are 17 species with analysis requirements that are known or suspected to regularly occur in the Analysis Area. All species were analyzed for the presence of their potential habitat in the analysis area. In addition, three of these (bald eagle, Brewer's sparrow, and peregrine falcon) are addressed as Management Indicator or Sensitive species (Section 3.2.3). Species with no highlight in Table 1 are considered not to be present in the Analysis Area or not present during the breeding season due to lack of suitable habitat. There are four species for which the Analysis Area does not contain suitable habitat. Those species with a dark gray highlight are addressed in Section 3.2.3. The analysis is summarized below.

3.2.2.2 Environmental Consequences

3.2.2.2.1 Issue Indicators – Forest Plan Direction

Species of management concern are identified in the Forest Plan (USFS 1990) as directed by the National Forest Management Act and its implementing regulations (36 CFR 219.19) but does not directly provide direction for NTMBs. These species are protected by the Migratory Bird Treaty Act (MBTA; 16 U.S.C. 703-712). Specific provisions in the statute include:

- Establishment of a Federal prohibition, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention . . . for the protection of migratory birds . . . or any part, nest, or egg of any such bird" (16 U.S.C. 703).

3.2.2.2.2 Spatial and Temporal Context

The direct effects analysis area is defined as the 17.8-acre NFS land disturbance footprint on the landfill. The indirect analysis area is the direct effects area plus an additional buffer for noise disturbance during construction activities, extending to Highway 89 approximately 0.25 miles southwest and 0.5 miles northwest up the canyon. The Lower Flat Creek sub-watershed is the watershed that encompassed the project area; this watershed is used as the cumulative effects analysis area. Temporal effects were considered short term if less than ten years and long term if more than ten years into the past and future.

The temporal boundary for cumulative effects is 5 years before present and 5 years following implementation of the project. The 5-year period covers the expected 3-year project implementation and 2 years for revegetation to establish.

3.2.2.2.3 Alternative 1 – Proposed Action

During project implementation, no loss of nests or adults is expected because the introduced and native grasses on the direct effects analysis area does not support quality nesting habitat and no increased potential for collisions with vehicles (machinery and haul trucks) are expected. If a migratory bird nest is discovered within the project area prior to construction activities, full protection of the nest will be implemented under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703-712). Therefore, there are no expected impacts from the Proposed Action to any migratory species. Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals.

There are a number of migratory birds that use the Bridger-Teton National Forest (BTNF) and adjacent areas as a thoroughfare during migration. There are no expected impacts from the Proposed Action to any migratory species. Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals.

3.2.2.2.4 Alternative 2 – No Action

Under the No Action Alternative, the Forest Service would not authorize re-shaping and re-capping of the landfill and construction of groundwater and landfill gas monitoring wells on NFS land. Thus, no direct or indirect effects to NTMB species would occur.

3.2.2.2.5 Cumulative Effects

Within this Analysis Area past, present and reasonably foreseeable future activities that have the potential to impact NTMB included in this analysis include:

- Wildland fire
- Prescribed fire
- Recent U.S. Highway 189/191 reconstruction/improvements (FHWA/WYDOT)
- Squaw Creek Water District Test Well
- Teton County landfill reclamation

Potential effects from these activities to NTMB species may include direct and indirect effects to species and their habitats. Construction activities in occupied habitats may directly harm species that are unable to avoid these activities. Increases in human activity and project vicinity to traffic volumes may also directly increase vehicle collisions with NTMB species. Species occurring in these project locales may also be indirectly affected by being displaced from these areas because of the increased human activity. Displacement may have severe effects on some species when sufficient suitable habitats are not available and/or when displacement occurs during high-stress periods, including winter.

Not all species will be affected equally by the activities listed above. Highly mobile species with large home ranges will be affected by activities at a much greater distance than relatively immobile species with small home ranges. The actions and effects described above can be both additive and interactive to each other and to the direct and indirect effects described for all alternatives. Because current management and mitigation is designed to eliminate or reduce negative cumulative impacts by protecting NTMB species from direct and indirect impacts, the cumulative effects to all species discussed in this analysis, under all alternatives, are expected to be minimal.

3.2.3 Special Status Species (Flora and Fauna)

The United States Department of Agriculture (USDA) Forest Service (Forest Service) established direction in the Forest Service Manual (FSM) 2670 to guide habitat management for proposed, endangered, threatened, and sensitive species (PETS). This document is prepared in accordance with FSM direction (2672.42) and the Code of Federal Regulations (CFR; 50 CFR 402). This document tiers directly to the Forest Plan (USFS 1990).

In accordance with the Endangered Species Act (ESA), its implementing regulations, and FSM 2671.4, the Bridger-Teton National Forest is required to request written concurrence from the USFWS concerning its actions that potentially affect listed and proposed species. Endangered, threatened, experimental, proposed, and candidate species are managed under the authority of the Federal Endangered Species Act and the National Forest Management Act (PL 94-588). Section 7 of the Endangered Species Act directs federal departments and agencies to ensure that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of listed and proposed species, or result in the destruction or adverse modification of designated critical habitats (16 USC 1536). A biological assessment/biological evaluation (Golder 2013) was prepared to evaluate the potential effects of the Horsethief Canyon Landfill Closure Project, Bridger-Teton National Forest, on listed species. It is based on the best data and scientific information currently available. A list of federally endangered, threatened, proposed, and candidate species which may occur within the Jackson Ranger District's area of management has been provided by the USFWS (USFWS; Sattelberg 2011).

To accomplish these objectives, the biological assessment/biological evaluation reviews the Proposed Action in sufficient detail to determine the level of effect that would occur to each federally listed and proposed species and their designated critical habitat. One of three possible determinations was chosen based on the best available scientific literature, a thorough analysis of the potential effects of the project, and the professional judgment of the biologist who completed the evaluation. The three possible determinations are as follows:

- No effect – A "no effect" determination means that there are absolutely no effects from the proposed action, positive or negative, to listed species. A "no effect" determination does not include effects that are insignificant (small in size), discountable (extremely unlikely to occur), or beneficial. "No effect" determinations do not require written concurrence from the Service unless the National Environmental Policy Act analysis is an Environmental Impact Statement.
- May affect, not likely to adversely affect – A "may affect, not likely to adversely affect" determination may be reached for a proposed action where all effects are beneficial, insignificant, or discountable. This conclusion is usually reached through the informal consultation process, and written concurrence from the Service exempts the proposed action from formal consultation. The federal action agency's written request for Service concurrence should accompany the biological assessment/biological evaluation.
- May affect, likely to adversely affect – A "may affect, likely to adversely affect" determination means that adverse effects cannot be avoided. Section 7 of the Endangered Species Act requires that the federal action agency request initiation of formal consultation with the Service when a "may affect, likely to adversely affect" determination is made. A written request for formal consultation should accompany the biological assessment/biological evaluation.

The Forest Service Region 4 sensitive species are species identified by the Regional Forester for which population viability is currently of concern, as evidenced by significant current or predicted downward trends in population numbers or density, or by significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (USFS 2005). The Forest Service has established direction in the FSM to guide habitat management for proposed, endangered, threatened, and sensitive plant and wildlife species. The direction establishes the process, objectives, and standards

for conducting a biological evaluation. This process ensures that these species receive full consideration in the decision making process.

To accomplish these objectives, the biological evaluation (Golder 2013) reviews the Alternative 1 (Proposed Action) in sufficient detail to determine the level of effect that would occur to each sensitive species evaluated. One of four possible determinations was chosen based on the best available scientific literature, a thorough analysis of the potential effects of the project, and the professional judgment of the biologist who completed the evaluation. The four possible determinations (from FSM 2674.42) are as follows:

- "No impacts" (NI) – where no impact is expected;
- "Beneficial effects" (BE) – where impacts are expected to be beneficial;
- "May impact individuals but is not likely to cause a trend to federal listing or loss of viability" (MAII) – where impacts are expected to be immeasurable or extremely unlikely; and "
- Likely to result in a trend to federal listing or loss of viability" (LRLV) – where impacts are expected to be detrimental and substantial.

Management indicator species (MIS) are selected "because their population changes are believed to indicate the effects of management activities" (36 CFR 219.19). Management indicators are "any species, group of species, or species habitat element selected to focus management attention for the purpose of resource production, population recovery, maintenance of population viability, or ecosystem diversity" (FSM 2605). Four types of MIS were identified in the Forest Plan; harvested species (fish and wildlife only), ecological indicator species, Forest Service sensitive species, and threatened and endangered species. For this report all the species listed by name in the forest plan as MIS will be addressed (including two species which are no longer considered sensitive) as well as those plants currently listed as R4 sensitive that are known or suspected to occur on the BTNF. Aspen (*Populus tremuloides*), an ecological indicator species for aspen habitat, will also be addressed.

3.2.3.1 Affected Environment

3.2.3.1.1 Species Evaluated (Flora)

There is one MIS with analysis requirements which are known to be present in or around the analysis area. In addition, seven other species with analysis requirements have potential habitat present in the analysis area with no known occurrences. All species were analyzed for the presence of their potential habitat in the project area. Species without potential habitat in the project area are considered to have a lack of suitable habitat and the activities will have "No impact" to those species. There are 13 species that meet the criteria for no impact because the analysis area does not contain their habitat and is outside their elevation envelope. The species carried forward in the analysis are listed below in Table 2 and Figure 3. The analysis is summarized below. The full biological evaluation is included in Golder (2013) and is available in the project record.

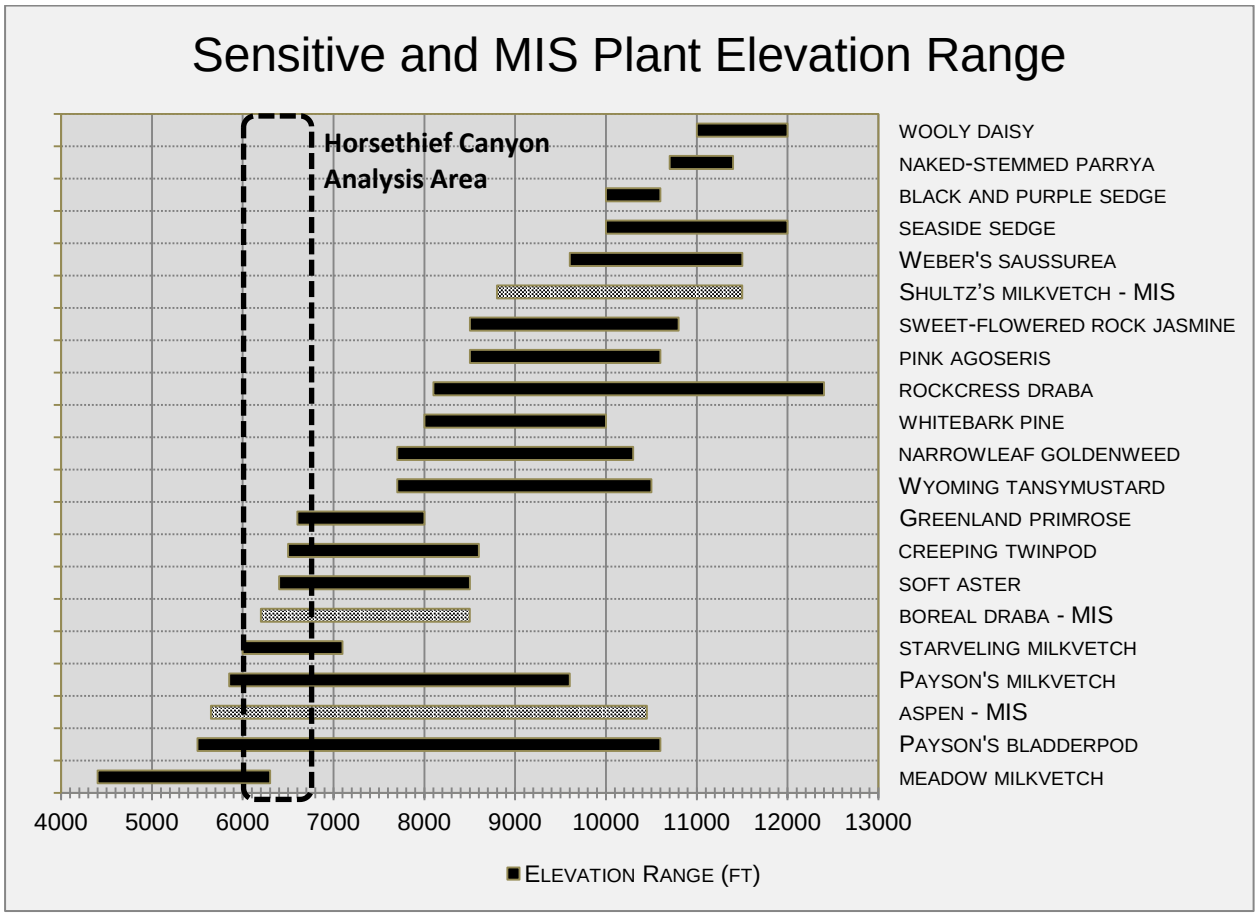
Table 2: Flora Species with Potential Habitat or Known Individuals Present in the Analysis Area

Name	Habitat Description	Species Type	Known Occurrences in Project Area?	Habitat in Analysis Area (Elevation Range from 6,000-6,600 ft)?	Likelihood of Effects from Proposed and No Action?
Aspen (*Populus tremuloides*)	Aspen can be found throughout the Bridger-Teton. It occurs in pure stands, or mixed with subalpine fir, lodgepole pine, Douglas-fir, whitebark pine, or Engelmann spruce. In lower elevations, it forms a mosaic with shrublands.	BTNF MIS	Yes	Yes – The forested habitat of this species is present in the analysis area	Low – There are no expected impacts from the Proposed Action to the species. No aspen will be removed under the Proposed Action.
Boreal draba (*Draba borealis*)	Known in Wyoming from the southwestern Absaroka, western Wind River, Gros Ventre, Salt and Wyoming ranges, Jackson Hole and the Yellowstone Plateau. North-facing limestone, dolomite or volcanic slopes, cliffs and riparian areas from 6200-8500 (Fertig 1999).	BTNF MIS	No	No – both the riparian and rocky portions of this species' habitat is not present in the analysis area	Low – There are no expected impacts from the Proposed Action to the species. The project area is located between 6,091 and 6,537 feet in elevation, but does not include species specific habitat. There are no documented occurrences of the species within the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Creeping twinpod (*Physaria integrifolia var. monticola*)	Found on barren, rocky, calcareous hills and slopes at 6,500 to 8,600 feet elevation (Fertig et al. 1994).	USFS R4 Sensitive	No	No – the barren and rocky habitat of this species is not present within the analysis area	Low – There are no expected impacts from the Proposed Action to the species. The project area is located between 6,091 and 6,537 feet elevation. There is rocky habitat adjacent to the project, but no rocky habitat will be disturbed. There are no documented occurrences of the species within the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.

Name	Habitat Description	Species Type	Known Occurrences in Project Area?	Habitat in Analysis Area (Elevation Range from 6,000-6,600 ft)?	Likelihood of Effects from Proposed and No Action?
Greenland primrose (*Primula egalikensis*)	This species is found in wet meadows along streams and calcareous montane bogs from 6600 to 8000 ft (Fertig et al. 1994).	USFS R4 Sensitive	No	No – the wet meadow habitat of this species is not present within the analysis area	Low – The project area is located between 6,091 and 6,537 feet in elevation, and does not include species specific habitat. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Payson's bladderpod (*Lesquerella paysonii*)	This species is endemic to the carbonate mountain ranges of west-central Wyoming, eastern Idaho, and southwestern Montana. It is found on rocky, sparsely-vegetated slopes, often calcareous substrates at elevations of 5,500 to 10,600 feet (Heidel 2008a).	USFS R4 Sensitive	No	No – the barren and rocky habitat of this species is not present within the analysis area	Low – The project area is located between 6,091 and 6,537 feet elevation. There is rocky habitat adjacent to the project, but no rocky habitat will be disturbed. There are no documented occurrences of the species within the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Payson's milkvetch (*Astragalus paysonii*)	This species occurs primarily in disturbed areas on sandy soils that have a low cover of forbs and grasses at elevations of 5,850 to 9,600 feet (Heidel 2008b)	USFS R4 Sensitive	No	No – the forested and disturbed habitat of this species is not present in the analysis area	Low – The project area is located between 6,091 and 6,537 feet in elevation, but does not include species specific habitat. There are no documented occurrences of the species within the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Soft aster (*Symphyotrichum molle*)	In Wyoming, this species has been found in the Big Horn Mountains and Hoback Canyon. It prefers sagebrush grasslands and mountain meadows in calcareous soils at 6,400 to 8,500 feet elevation (Fertig et al. 1994).	USFS R4 Sensitive	No	No – the shrubland habitat of this species is not present in the analysis area	Low – The project area is located between 6,091 and 6,537 feet in elevation, but does not include species specific habitat. There are no documented occurrences of the species within the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.

Name	Habitat Description	Species Type	Known Occurrences in Project Area?	Habitat in Analysis Area (Elevation Range from 6,000-6,600 ft)?	Likelihood of Effects from Proposed and No Action?
Starveling milkvetch (*Astragalus jejunus var. jejunusl*)	This species is found on dry barren ridges and bluffs of shale and stone, clay or cobblestones at 6,000 to 7,100 feet elevation (Fertig et al. 1994).	USFS R4 Sensitive	No	No – the barren and rocky habitat of this species is not present within the analysis area	Low – The project area is located between 6,091 and 6,537 feet in elevation, but does not include species specific habitat. There are no documented occurrences of the species within the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.

Figure 3: The Known Elevation Range of Sensitive and MIS Plants on the BTNF



Note: The elevation range of the analysis area is 6,000–6,600 feet as shown in black dashes.

3.2.3.1.2 Species Evaluated (Fauna)

There are eight species with analysis requirements that are known to be present in or around the analysis area. In addition, three other species with analysis requirements have potential habitat present in the analysis area with no known occurrences. All species were analyzed for the presence of their potential habitat in the analysis area. Species without potential habitat in the project area are considered to have a lack of suitable habitat and the activities will have "No Impact" to those species. There are 17 species which meet the criteria for No Impact because the analysis area does not contain their habitat and is outside their elevation envelope. The species carried forward in the analysis are listed below in Table 3. A list of species that were not carried forward in the analysis is provided in Table 4. The analysis is summarized below. The full biological evaluation is included in Golder (2013).

Table 3: Fauna Species with Potential Habitat or Known Individuals Present in the Analysis Area

Name	Habitat Description	Species Type	Known Occurrences in Analysis Area?	Likelihood of Effects from Proposed and No Action?
Mammals				
Canada lynx (*Lynx canadensis*)	This species dens in forests with large woody debris, such as downed logs and windfalls, to provide denning sites with security and thermal cover for kittens.	USFWS ESA Threatened	No	None – There are no expected impacts from the Proposed Action to the species. There currently are no known lynx, including natal dens, in the project area. Surveys for tracks of pine marten and other carnivores have occurred on the Bridger-Teton National Forest since 2010, including the vicinity of the project area, but no lynx have been detected.
Gray wolf (*Canis lupus*)	The Gray wolf prefers coniferous forests, mountain-foothills shrublands and grasslands.	USFS R4 Sensitive	Yes	Minor – There are no expected impacts from the Proposed Action to the species. Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals.
Grizzly bear (*Ursus arctos horribilus*)	The species occupies a variety of habitats throughout their range. They are highly adaptable and are capable of exploiting different landscapes given their omnivorous generalist lifestyle and overall adaptability and intelligence Occupied Grizzly bear habitat in the lower 48 states is characterized by extensive forest cover often interspersed with grasslands and meadows.	USFWS ESA Threatened; USFS R4 Sensitive; BTNF MIS	No	None – There are no expected impacts from the Proposed Action to the species. There are no known Grizzly bears in the project area (WYNDD 2013). Grizzly bears occur nearby within portions of the Teton Mountain Range, about 1.12 miles northwest of the project area and throughout the Bridger-Teton National Forest and Grand Teton National Park to the north and east of the project area, approximately 11 miles distance.
Elk (*Cervus elaphus nelsoni*)	Perhaps the best combination of habitat for elk is mosaics of aspen, oakbrush, and mountain shrub, which provide optimal forage and cover. Aspen is also commonly located in proximity to conifer habitats. Spruce-fir forests with intermingled aspen stands are another example of prime elk habitat. The spruce-fir forest provides cover and the aspen understory provides a source of quality forage.	BTNF MIS	Yes	Minor – There are no expected impacts from the Proposed Action to the species. Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals. Timing stipulations (see Section 3.2.3.2.1), will limit disturbance.

Name	Habitat Description	Species Type	Known Occurrences in Analysis Area?	Likelihood of Effects from Proposed and No Action?
Moose (*Alces alces shirasi*)	The moose lives in forested areas where there is snow cover in the winter and nearby lakes, bogs, swamps, streams and ponds. The moose's large size makes survival in warm climates difficult, and they have difficulty when temperatures rise above 80 degrees Fahrenheit.	BTNF MIS	Yes	Minor – There are no expected impacts from the Proposed Action to the species. Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals. Timing stipulations (see Section 3.2.3.2.1), will limit disturbance.
Pronghorn (*Antilocapra americana*)	The pronghorn lives in grasslands, brushlands and deserts. The pronghorn lives in herds that change in size depending on the season. In the summer, females and their young will gather in bands of less than a dozen individuals. Young males less than two years old form bachelor herds. Breeding males establish individual territories. In the winter, the herd will include males and females and can include hundreds of pronghorns. The pronghorn migrates from a summer feeding ground to a winter feeding ground.	BTNF MIS	No	None – There are no expected impacts from the Proposed Action to the species, because neither individuals nor their habitat are present in the analysis area
Mule deer (*Odocoileus hemionus*)	Depending on the season and eco-region, mule deer can be found between various zones ranging from the highest forests of the Rocky Mountains to the low desert floors of Sonora, Mexico. While mule deer occupy almost all types of habitat within their range, they seem to prefer arid, open areas and rocky hillsides.	BTNF MIS	Yes	Minor – There are no expected impacts from the Proposed Action to the species. Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals.

Name	Habitat Description	Species Type	Known Occurrences in Analysis Area?	Likelihood of Effects from Proposed and No Action?
Birds				
American peregrine falcon (*Falco peregrinus anatum*)	Most often, breeding pairs utilize habitats containing cliffs and almost always nest near water. Generally utilize open habitats for foraging. Many artificial habitats like towers, bridges and buildings are also utilized by the species.	USFS R4 Sensitive	Yes	Minor – There are no expected impacts from the Proposed Action to the species. There have been documented Peregrine falcon nesting sites within a one-mile buffer of the project area (Patla 2013a), but there are no documented occurrences of Peregrine falcon in the project area (WYNDD 2013). Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals.
Bald eagle (*Haliaeetus leucocephalus*)	The species generally nests near coastlines, rivers, large lakes or streams that support an adequate food supply. They often nest in mature or old-growth trees; snags (dead trees); cliffs; rock promontories; rarely on the ground; and with increasing frequency on human-made structures such as power poles and communication towers.	USFS R4 Sensitive	Yes	Minor – There are no expected impacts from the Proposed Action to the species. There have not been documented nesting sites within a one-mile buffer of the project area in over 30 years, and there are a total of 11 documented occurrences of Bald eagles within a one-mile buffer of the project area since 1979 (WYNDD 2013). Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals.
Brewer's sparrow (*Spizella breweri)*	The Brewer's sparrow prefers basin-prairie and mountain-foothills shrublands, especially sagebrush and woodland-chaparral (Orabona et al. 2012).	BTNF MIS	Yes	Minor – There are no expected impacts from the Proposed Action to the species, because there is no suitable habitat in the analysis area. There are 52 documented occurrences of this species in a one-mile radius of the project area (WYNDD 2013). Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals.

Name	Habitat Description	Species Type	Known Occurrences in Analysis Area?	Likelihood of Effects from Proposed and No Action?
Golden eagle (*Aquila chrysaetos*)	The Golden eagle inhabits open country from barren areas to open coniferous forests. They are primarily in hilly and mountainous regions, but also in rugged deserts, on the plains, and in tundra. The Golden eagle prefers cliffs and large trees with large horizontal branches for roosting and perching.	None	Yes	Minor – There are no expected impacts from the Proposed Action to the species. There have not been documented nesting sites within a one-mile buffer of the project area (WYNDD 2013). Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals.
Trumpeter swan (*Cygnus buccinator*)	Landscape-scale habitat characteristics associated with Trumpeter Swan breeding and growth and maintenance of Trumpeter Swan flocks have not been quantified. At the local scale, Trumpeter Swans are restricted to shallow, freshwater marshes, ponds, lakes, and occasionally slow-moving rivers (Slater 2006).	USFS R4 Sensitive	Yes	Minor – There are no expected impacts from the Proposed Action to the species. There are no known active Trumpeter swan nests in the project area. There have been three occurrences in the project area between 1980 and 1987, and three known occurrences within a one-mile buffer of the project area since 2003 (WYNDD 2013). Individuals foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals.
Amphibians				
Columbia spotted frog (*Rana luteiventris*)	Columbia spotted frogs inhabit riparian areas associated with a variety of vegetation communities, including coniferous or mixed forests, grasslands, and sage-juniper brush-lands. Elevation range for the species is reported up to nearly 10,000 feet. Because both breeding and over-wintering occur at aquatic sites, populations are typically located in the general vicinity of ponds, lakes, springs, and/or streams (Patla and Keinath 2005).	USFS R4 Sensitive	No	Minor – There are no expected impacts from the Proposed Action to the species. There are no known occurrences of Columbia spotted frogs in the project area (WYNDD 2013).

Table 4: Fauna Species without Potential Habitat or No Known Individuals Present in the Analysis Area

Common Name	Scientific Name	Status	Detailed Information
Mammals			
Bighorn sheep	*Ovis canadensis canadensis*	USFS R4 Sensitive; BTNF MIS	Bighorn sheep are found in open, steep, mountainous terrain with cliffs, rock outcrops, and canyons (Orabona et al. 2012). Such habitat is lacking in the direct project area, but present in the indirect analysis area. There are no documented occurrences of this species within the project area (WYNDD 2013). The project area does lay within the Bighorn Seasonal Range Boundaries as well as Bighorn Hunt areas/Herd units, although specific habitat within the project area does not exist. Therefore, based on this information, all alternatives in this proposed project will have “no impact” on this species.
Fisher	*Martes pennanti*	USFS R4 Sensitive	The fisher prefers coniferous forests with continuous closed canopy cover (Orabona et al. 2012). The fisher feeds on small birds, snowshoe hare, red and flying squirrels, mice, voles, shrews, porcupines, and carrion such as deer carcasses. The fisher is classified as rare in Wyoming and has been observed in the same region as the project area, but because of the mobility of the species, breeding cannot be assumed (Orabona et al. 2012). There are no documented occurrences of this species within the project area (Wyoming Natural Diversity Database [WYNDD] 2013). WYNDD only contains one record of a fisher in the Bridger-Teton National forest in 1989. Therefore, based on this information, all alternatives in this proposed project will have “no impact” on this species.
North American wolverine	*Gulo gulo luscus*	Proposed Threatened	In North America, wolverines occur within a wide variety of alpine, boreal, and arctic habitats, including boreal forest, tundra, and montane forests throughout much of Alaska and Canada. They do not appear to specialize on specific vegetation or physical habitat attributes, but instead select areas that are cold and receive enough winter precipitation to reliably maintain deep persistent snow late into the warm season (Copeland et al. 2010). This species' requirement for cold, snowy conditions means that, in the southern portion its range where ambient temperatures are warmest (like Wyoming). Wolverines occur principally at high (> 8,000 feet) elevations (Inman et al. 2007, Murphy et al. 2011). There are no documented occurrences of this species within or near the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” on this species.
American martin	*Martes Americana origins*	BTNF MIS	The species is found primarily in mature, northern forests. These animals are closely associated with lodgepole pine, Douglas fir, spruce, and mixed hardwood forests (Ellis 1999). There are no documented occurrences of this species within or near the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” on this species.
Pronghorn	*Antilocapra americana*	BTNF MIS	The pronghorn lives in grasslands, brushlands and deserts. The pronghorn lives in herds that change in size depending on the season. In the summer, females and their young will gather in bands of less than a dozen individuals. Young males less than two years old form bachelor herds. Breeding males establish individual territories. In the winter, the herd will include males and females and can include hundreds of pronghorns. The pronghorn migrates from a summer feeding ground to a winter feeding ground. There are no expected impacts from the Proposed Action to the species, because neither individuals nor their habitat are present in the analysis area

Common Name	Scientific Name	Status	Detailed Information
Spotted bat	*Eurderma maculatum*	USFS R4 Sensitive	This species roosts in rock crevices and cliffs, and is associated with juniper shrublands and desert sagebrush-grasslands of north central Wyoming (Orabona et al. 2012). There are no documented occurrences of this species within the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” on this species.
Townsend's big-eared bat	*Corynorhinus townsendii*	USFS R4 Sensitive	This species inhabits deciduous forests, dry coniferous forests, prairie and mountain foothills shrublands, desert grasslands, and pinyon-juniper habitat types (Orabona et al. 2012). Townsend’s big-eared bats roost near entrances to mines and caves that may also be used for hibernation. Tree cavities may occasionally be used for roosting (Orabona et al. 2012). No suitable hibernating habitat or preferred roosting habitats are known to exist within the project area, and there are no documented occurrences of this species within the project area (WYNDD 2013). Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Birds			
Boreal owl	*Aegolius funereus*	USFS R4 Sensitive	The Boreal owl is a secondary cavity nester that generally associates with mature conifer and mixed conifer/deciduous forest with scattered openings, especially spruce-fir, lodgepole line, and aspen (Orabona et al. 2012). There are no documented occurrences of this species in the project area (WYNDD 2013). There is no suitable habitat in the project area. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Common loon	*Gavia immer*	USFS R4 Sensitive	The common loon inhabits lake above 6,000 feet elevation. It feeds on fish and aquatic invertebrates (Orabona et al. 2012). There are no documented occurrences of this species in the project area (WYNDD 2013). There is no suitable habitat in the project area. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Flammulated owl	*Otus flammeolus*	USFS R4 Sensitive	The project area does not include ponderosa pine, the preferred nesting habitat for Flammulated Owls. There are no known occurrences of this species (WYNDD 2013) and no suitable habitat within the project area. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Great gray owl	*Strix nebulosa*	USFS R4 Sensitive	In Wyoming, Great Gray Owls almost exclusively inhabit mixed conifer forests near small openings, including lodgepole pine, Douglas-fir, and quaking aspen. They often nest in broken-topped snags or stick nests of other raptor species. During winter, Great Gray Owls may roost in low-elevation cottonwood groves (Orabona et al. 2012). There is one documented occurrence of this species in 1979 within the project area (WYNDD 2013), although there is no suitable habitat within the project area. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Greater sage-grouse	*Centrocercus urophasianus*	USFWS ESA Candidate; USFS R4 Sensitive	The Greater sage-grouse prefer basing-prairie and mountain-foothills shrublands, wet-moist meadows, alfalfa, and irrigated native meadows (Orabona et al. 2012). There is one documented occurrence of 11 individuals within the project area in 1991 (WYNDD 2013), although there is no suitable habitat within the project area. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.

Common Name	Scientific Name	Status	Detailed Information
Harlequin duck	*Histrionicus histrionicus*	USFS R4 Sensitive	The Harlequin duck require low gradient streams with woody debris and dense, shrubby riparian areas (Orabona et al. 2012). There are no documented occurrences of this species in the project area (WYNDD 2013). There is no suitable habitat in the project area. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Northern goshawk	*Accipiter gentilis*	USFS R4 Sensitive	Northern Goshawks are a forest habitat generalist. Hunting often occurs in open forests, along forest and shrubland ecotones, and in riparian zones. Northern goshawks tend to select stand with relatively large diameter trees and high canopy closure for nesting (Orabona et al. 2012). There are no known occurrences of this species (WYNDD 2013) and no suitable habitat within the project area. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Three-toed woodpecker	*Picoides dorsalis*	USFS R4 Sensitive	The Three-toed woodpecker typically inhabits mature and old growth coniferous forest, primarily above 2,700 m (8,900 ft) in eastern and central Wyoming but is found also at slightly lower elevations in the western part of the state (Orabona et al. 2012). The species is strongly associated with mature forests that include snags or dying trees, or forests that have recently burned and/or are infested with scolytid beetles, particularly spruce beetle. There are no known occurrences of this species (WYNDD 2013) and no suitable habitat within the project area. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Whooping crane	*Grus americana*	USFWS ESA Endangered	The Whooping crane prefers wet-moist measure grasslands, sedge meadows, irrigated native and introduced meadows, small grains, and marshes (Orabona et al. 2012). There are no documented occurrences of this species in the project area (WYNDD 2013). There is no suitable habitat in the project area. Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Yellow-billed cuckoo	*Coccyzus americanus*	USFS R4 Sensitive	In the western U.S., yellow-billed cuckoo nest in open deciduous riparian woodlands (Orabona et al. 2012). There is no suitable habitat for this species within the project area (Orabona et al. 2012). There are no documented occurrences of this species within the project area (WYNDD 2013).Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Amphibians			
Boreal toad	*Bufo boreas*	USFS R4 Sensitive	The Boreal toad used a wide range of habitats, including wetlands, forests, woodlands, sagebrush, floodplains, and meadows. They primarily use wetland habitats but can be found in upland when dispersing between breeding sites. They are usually found at elevations between 7,500 and 12,000 feet. There is no suitable habitat for this species within or near the project area. There are no documented occurrences of this species within the project area (WYNDD 2013).Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.
Columbia spotted frog	*Rana luteiventris*	USFS R4 Sensitive	Columbia spotted frogs inhabit riparian areas associated with a variety of vegetation communities, including coniferous or mixed forests, grasslands, and sage-juniper brush-lands. Elevation range for the species is reported up to nearly 10,000 feet. Because both breeding and over-wintering occur at aquatic sites, populations are typically located in the general vicinity of ponds, lakes, springs, and/or streams (Patla and Keinath 2005). There are no documented occurrences of this species within the project area (WYNDD 2013).Therefore, based on this information, all alternatives in this proposed project will have “no impact” to this species.

3.2.3.2 Environmental Consequences

3.2.3.2.1 Issue Indicators – Forest Plan Direction

The Forest Service Region 4 sensitive species are species identified by the Regional Forester for which population viability is currently of concern, as evidenced by significant current or predicted downward trends in population numbers or density, or by significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (USFS 2005). The Forest Service has established direction in the FSM 2670 to guide habitat management for proposed, endangered, threatened, and sensitive (PETS) plant and wildlife species. This evaluation is prepared in accordance with FSM direction (2672.42) and the Code of Federal Regulations (CFR; 50 CFR 402). The direction establishes the process, objectives, and standards for conducting a biological evaluation. This process ensures that these species receive full consideration in the decision making process.

Indicators to assess impacts to PETS species are outlined on pages 123–127 of the Forest Plan (USFS 1990) and in FSM 2672.41 and include:

- Goal 3.3 – Sensitive species are prevented from becoming a federally listed Threatened species in Wyoming.
- Goal 3.3(a) – Protect National Forest Service Intermountain Region Sensitive plant and animal species and provide suitable and adequate amounts of habitat to ensure that activities do not cause (1) long-term or further decline in population numbers or habitats supporting these populations and, (2) trends towards federal listing.
- Aspen Management Guideline – Aspen sites should be managed for aspen-type perpetuation. The loss of aspen stands due to old age, conifer encroachment, and possible overgrazing should be prevented. Priority areas for aspen treatment should be big-game winter ranges, calving areas, and stands where type loss or conversion is imminent.
- FSM 2672.41 Objectives:
  - Ensure that the Forest Service actions do no contribute to loss of viability of any native or desired non-native plant or animal species;
  - Ensure that activities do not cause the status of any species to move toward federal listing; and
  - Incorporate concerns for sensitive species throughout the planning process, reducing negative impacts to species and enhancing opportunities for mitigation.

Management indicator species (MIS) are selected "because their population changes are believed to indicate the effects of management activities" (36 CFR 219.19). Management indicators are "any species, group of species, or species habitat element selected to focus management attention for the purpose of resource production, population recovery, maintenance of population viability, or ecosystem diversity" (FSM 2605). Four types of MIS were identified in the Forest Plan; harvested species (fish and wildlife only), ecological indicator species, Forest Service sensitive species, and threatened and endangered species. The Regional Forester's sensitive species list has changed since the Bridger-Teton identified sensitive species as MIS. The description of impacts to MIS does not follow the guidance in FSM 2672.42 and will be presented as two different thresholds for significance. For aspen the threshold for significance is non-compliance with the Aspen Management Guideline (AMG; USFS 1990).

The land and resource management goals and objectives for elk and mule deer that are relative to the Proposed Action include:

- Jackson Elk Herd Crucial Winter Range Stipulation – This particular no surface occupancy (NSO) stipulation is intended to be used as a means of providing continued viability of the Jackson Hole elk herd population, protection of its crucial winter range

habitat in the Jackson Hole, Wyoming, area, and as a means to prevent its harassment while the elk occupy the range.

- Application of the Time-Limitation Stipulations for the Project of the Jackson Elk Herd and its Crucial Winter Range – No surface use is allowed from December 1 to April 30.
- Elk Calving Area Standard – Human activity and disturbance will be restricted in elk calving areas from May 15 to June 30 if elk are present in the area. Fences in elk calving areas will be designed so they do not create movement barriers to elk calves. Timing-limitation stipulations will be applied to elk calving areas.
- Big-Game Winter Range Standard – Human activity and disturbance in crucial big game winter range will be restricted from December 1 to April 30 if big game are present in the area. Stipulations restricting oil and gas development will be applied to crucial big game winter range as identified and agreed upon by the Forest Service and Wyoming Game and Fish Department.
- Big-Game Habitat Guideline:
  - Elk Calving Area – maintain about 30 percent of the brush/grassland – rangeland type – in a brush/forb type, emphasizing maintenance of the aspen or conifer/brush ecotones
  - Elk Winter Range – maintain about 50 percent of the brush/grassland in a brush type with about 30 percent in a mature age class
  - Mule Deer Winter Ranges – maintain about 75 percent of the brush/grassland – rangeland type – should be maintained in a brush type with about 55 percent in a mature age class
- Pronghorn Migration Corridor Forest Plan Amendment – All project, activities, and infrastructure authorized in the designated Pronghorn Migration Corridor will be designed, times and/or location to allow continued successful migration of the pronghorn that summer in Jackson Hole and winter in the Green River basin.

3.2.3.2.2 Spatial and Temporal Context

The effects analysis area for this project are the areas of potential habitat for any of the sensitive or MIS species *which have effects* in the present analysis within the project area. American Peregrine falcon, Canada Lynx (including designated critical habitat), Columbia spotted frog, Grizzly bear and Trumpeter Swan are the only special status species with potential effects from the Proposed Action; aspen is an MIS which have potential effects. This potential habitat includes the current landfill cap and fringe areas near the cap boundary. The temporal boundary for this analysis is 10 years into the past and future.

3.2.3.2.3 Alternative 1 – Proposed Action- Direct and Indirect Effects

American Peregrine Falcon – Sensitive

Peregrine falcons are known to occur in and around the project area (Patla 2013a). Peregrine falcons are not expected to be directly harmed under implementation of the Proposed Action due to timing stipulations what would be implemented near active Peregrine falcon nests, if any were discovered:

> *Human activities will be restricted within 0.5 mile of occupied eyries between March 1 and July 31 or July 1 to September 15 for hack sites, depending upon the height of the nesting cliff (USFS 1990).*

Individual Peregrine falcons foraging in the project area could be disturbed by noise associated with implementation of the Propose Action; however, these effects would be temporary and would affect few individuals. In the slight chance that Peregrine falcons were to use the project area for nesting, implementation of the Proposed Action may indirectly affect Peregrine falcons by temporarily altering a small amount of suitable foraging habitat in the project area. The Proposed Action does not pose potential

for the species to becoming federally listed and no long-term decline in population are expected from the temporary disturbance of the Proposed Action. Collective, long-term disturbance would affect less than one percent of the available Peregrine falcon nesting and foraging habitat in the analysis area. The detailed biological evaluation for this species is presented in Golder (2013).

Aspen – MIS

Aspen are a preferred browse for elk and other wild ungulates. As such, there are potential direct effects from browsing and physical damage to individuals located within the project area. Similar to whitebark pine, aspen is also in decline due in part to fire suppression in the past. The Proposed Action does not intend to cause physical damage to any individuals located in the project area, and not contradict the AMG detailed in the Forest Plan which states "Aspen sites should be managed for aspen-type perpetuation. The loss of aspen stands due to old age, conifer encroachment, and possible overgrazing should be prevented. Priority areas for aspen treatment should be big-game winter ranges, calving areas, and stands where type loss or conversion is imminent" (USFS 1990). The Proposed Action does not pose potential to change the population of aspen on the forest, so it will comply with the Aspen Management Guideline.

Bald Eagle – Sensitive

The number of Bald eagle pairs nesting in Wyoming has been steadily increasing since 1990 (WGFD 2011). There are no known active Bald eagle nests in the project area (WYNDD 2013). However, the South Park Wildlife Habitat Management Area is in close proximity to the project area, with a small foothills portion located immediately adjacent to Teton County property to the south. The area between Wilson and Hoback Junction supports 13 active nests which have over 90% occupancy on a yearly basis (Patla 2013c). These nests are located along an approximate one-mile stretch of the Snake River to the west of the project area and have produced 2 offspring in both 2012 and 2013 (Patla 2013c). Bald eagles have been observed flying over Horsethief Canyon in the spring and summer and may forage along the forest edges in the project area (Patla 2013a). There have not been documented nesting sites within a one-mile buffer of the project area in over 30 years, and there are a total of 11 documented occurrences of Bald eagles within a one-mile buffer of the project area since 1979 (WYNDD 2013).

Bald eagles are not expected to be directly harmed under implementation of the Proposed Action due to timing stipulations what would be implemented near active Bald eagle nests, if any were discovered:

> *No activity potentially disruptive to nesting eagles from February 1 to August 15 (or until two weeks after young are fledged) within 1/4 mile of active nests (*Greater Yellowstone Bald Eagle Working Group 1996*).*

Individual Bald eagles foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals. In the slight chance that Bald eagles were to use lands adjacent the project area for nesting, implementation of the Proposed Action may indirectly affect Bald eagles by temporarily altering a small amount of suitable foraging habitat in the project area during project implementation. Collective, long-term disturbance would affect an insignificant amount of the available Bald eagle foraging habitat in and near the project area. This is based on the relationship between the adjacent 1200-acre South Park Wildlife Habitat Management Area and surrounding area and the 17.8-acre project area that could be used for foraging.

Brewer's sparrow – MIS

There are 52 documented occurrences of this species in a one-mile radius of the project area (WYNDD 2013). This species is an ecological indicator for sagebrush habitat. It is also a sagebrush-obligate, meaning; it is restricted to sagebrush habitats during the breeding season and perhaps year-round. It is a common summer resident in the Analysis Area.

The Rocky Mountain Bird Observatory (RMBO; http://rmbo.org/v3/avian/ExploretheData.aspx) provides data for breeding bird surveys conducted in the Rocky Mountain Region. For 2010 and 2011, the number of Brewer's sparrows estimated on the BTNF was 13,180 and 16,780 individuals, respectively. Brewer's sparrows were detected on two transects on the BTNF in 2010 and 2011. On one transect, RMBO estimated the Brewer's sparrow density increased from 0.92 birds per km^2 in 2010 to 1.16 in 2011. On the other transect, estimate density increased from 4.34 birds per km^2 in 2010 to 5.52 in 2011.

Individual Brewer's sparrows foraging in the project area could be disturbed by noise associated with implementation of the Proposed Action; however, these effects would be temporary and would affect few individuals. Implementation of the Proposed Action may indirectly affect Brewer's sparrows by temporarily altering a small amount of suitable foraging habitat in the project area. The Proposed Action does not pose potential for the species to becoming federally listed and no long-term decline in population are expected from the temporary disturbance of the Proposed Action. Collective, long-term disturbance would affect less than one percent of the available Brewer's sparrow habitat in the Analysis Area.

Population and habitat objectives for this MIS have not been established by the Wyoming Game and Fish Department or the Bridger-Teton National Forest. Using the current estimated amount of sagebrush habitat in the Analysis Area as a threshold, Golder evaluated the contribution of the direct and indirect effects relative to the cumulative actions and inferred the effects of the Proposed Action on the species at the National Forest scale.

The amount of sagebrush habitat expected from implementation of the Proposed Action would not change in the Analysis Area, and particularly on the reclaimed landfill cap. Because Brewer's sparrows are sagebrush obligates, there would be no change in habitat or trends for this species' population that will result from the Proposed Action.

Canada Lynx (Including Canada Lynx Critical Habitat) – Threatened

Canada lynx are not known to occur in the project area (WYNDD 2013); however, the Proposed Action occurs within Designated Critical Lynx Habitat identified for the 9,500 mi^2 Greater Yellowstone (#5) Unit and the Flat Creek Lynx Analysis Unit (LAU; Figure 5). The important components of Critical Lynx Habitat, as defined by the USFWS (74 FR 8616), include (1) the presence of snowshoe hares and their preferred habitat conditions, (2) winter snow conditions that are generally deep and fluffy for extended periods of time; (3) sites for denning that have abundant coarse woody debris, such as downed trees and root wads; and (4) matrix habitat (e.g., hardwood forest, dry forest, non-forest, or other habitat types that do not support snowshoe hares) that occurs between patches of boreal forest.

Implementation of the Proposed Action will reduce horizontal cover at ground level initially, but this effect will be temporary with revegetation during project completion. This effect is insignificant because disturbance is temporary and revegetation of the project area mapped as lynx critical habitat will be completed to restore horizontal groundcover immediately following ground disturbance activities. The project area offers little to no habitat for snowshoe hares because it is an open landfill cap. Implementation of the Proposed Action will have no effect on snow depth and texture, denning habitat, and matrix (travel) habitat for snowshoe hare because the project area offers little to no habitat for snowshoe hares because it is an open landfill cap. Sagebrush and grassland communities similar to the existing landfill cap do not provide for denning and no impediments to lynx travel will be created. The Proposed Action does not pose potential for long-term decline in population and the temporary disturbance of implementation will not increase the potential for species to decrease in rarity and increase its listed status. The detailed biological evaluation for this species is presented in Golder (2013).

Elk – MIS

Elk are known to occur in the project area. Elk are not expected to be directly harmed under implementation of the Proposed Action due to timing stipulations what would be implemented during project construction. The project area lies outside of existing Elk Winter Crucial Range (Figure 6) and Elk Calving Areas (Figure

7). During implementation of the project, the Timing-Limitation Stipulations will be followed for the Big-Game Winter Range Standard (December 1 to April 30). The Big-Game Habitat Guidelines will be met because no changes in vegetation management are proposed from existing conditions.

The Analysis Area is located within the Fall Creek elk herd unit EL103. The Fall Creek herd has recently declined from an average of 5,900 (2007–2011) to 4,500 in 2012 (WGFD 2012). The population objective for this herd unit is 4,500 ± 10%. Late season antlerless hunts have resulted in a reduction toward the population objective.

Individual elk foraging in the project area could be disturbed by noise associated with implementation of the Propose Action; however, these effects would be temporary and would affect few individuals. Implementation of the Proposed Action may indirectly affect elk by temporarily altering a small amount of suitable foraging habitat in the project area. The Proposed Action does not pose potential for the species to becoming federally listed and no long-term decline in population are expected from the temporary disturbance of the Proposed Action.

The Proposed Action would neither help nor hinder numbers of wintering elk in the Analysis Area that continue to maintain the Fall Creek elk herd at or near its present level over the long-term. The Proposed Action does not contribute to maintaining elk at its current level and near the population objective of 11,000 elk. Collective, long-term disturbance would affect less than one percent of the available elk habitat in the project area. The inconsequential effect on elk habitat occurs at very small scale compared to those that operate on entire herd units Thus, the contribution of the Proposed Action toward the population objective is insignificant.

Golden Eagle – Bald and Golden Eagle Protection Act

There are no known active Golden eagle nests in the project area (WYNDD 2013). However, the South Park Wildlife Management Area is in close proximity to the project area, where Golden eagles may nest (Patla 2013b). Golden eagles have been observed flying over Horsethief Canyon in the spring and summer and may forage along the forest edges in the project area (Patla 2013b). There have not been documented nesting sites within a one-mile buffer of the project area (WYNDD 2013).

Golden eagles are not expected to be directly harmed under implementation of the Proposed Action due to timing stipulations what would be implemented near active Golden eagle nests, if any were discovered:

> *No activity potentially disruptive to nesting eagles from February 1 to August 15 (or until two week after young are fledged) within 1/4 mile of active nests (*Greater Yellowstone Bald Eagle Working Group 1996*).*

Individual Golden eagles foraging in the project area could be disturbed by the noise associated with the project; however, these effects would be temporary and would affect few individuals. In the slight chance that Golden eagles were to use the project area for nesting, implementation of the Proposed Action may indirectly affect Golden eagles by temporarily altering a small amount of suitable habitat in the project area.

Gray Wolf – Sensitive

Wyoming's wolf population is currently robust—the numerical, distributional, and temporal recovery goals established by the USFWS have been exceeded for ten years. During 2011, at least 328 wolves in >48 packs (including >27 breeding pairs) inhabited Wyoming, including Yellowstone National Park (Jimenez et al. 2012). Wolf mortality resulting from responses by the USFWS to livestock depredation is an important source of mortality for wolves in Western Wyoming. Individual wolves foraging in the project area could be disturbed by noise associated with implementation of the Propose Action; however, these effects would be temporary and would affect few individuals. Implementation of the Proposed Action may indirectly affect wolves by temporarily altering a small amount of suitable foraging habitat in the project area. The Proposed Action does not pose potential for the species to becoming federally listed and no

long-term decline in population are expected from the temporary disturbance of the Proposed Action. Collective, long-term disturbance would affect less than one percent of the available wolf habitat in the Analysis Area.

There is one documented occurrence of the species within a one-mile radius of the project area in 2006 (WYNDD 2013). The detailed biological evaluation for this species is presented in Biological Evaluation (Golder 2013).

Grizzly Bear – Threatened

The grizzly bear is not known to occur in the project area (WYNDD 2013). No direct effects are expected as a result of the Proposed Action because Grizzly bears are currently rare in the area and their known occupation areas are located outside the surrounding project area (Figure 8). The likelihood of a bear accidently obtaining human food that is associated with project operations is unlikely. As a conservation measure, Bridger-Teton food storage regulations will be observed by construction personnel during project implementation. Food storage regulations, in effect March 1 to December 1 on the Bridger-Teton, apply to the project area. Personnel will receive training and will be required to store food and refuse properly at all times. The detailed biological evaluation for this species is presented in Golder (2013).

Mule Deer – MIS

Mule deer are known to occur in the project area. Mule deer are not expected to be directly harmed under implementation of the Proposed Action due to timing stipulations what would be implemented during project construction. The project area lies outside of existing Mule Deer Crucial Winter Range (Figure 9). During implementation of the project, the Timing-Limitation Stipulations will be followed for the Big-Game Winter Range Standard (December 1 to April 30). The Big-Game Habitat Guidelines will be met because no changes in vegetation management are proposed from existing conditions.

The Analysis Area is located within the Sublette mule deer herd unit MD 104. The mule deer population trend for this herd is declining and the herd is currently below management objectives. The five-year (2006–2010) population average was 27,720 deer and an estimated 2012 population of 22,825 (WGFD 2012). The population objective for the Sublette deer herd unit is 32,000 ±10 %.

Individual mule deer foraging in the project area could be disturbed by noise associated with implementation of the Propose Action; however, these effects would be temporary and would affect few individuals. Implementation of the Proposed Action may indirectly affect mule deer by temporarily altering a small amount of suitable foraging habitat in the project area. The Proposed Action does not pose potential for the species to becoming federally listed and no long-term decline in population are expected from the temporary disturbance of the Proposed Action. Collective, long-term disturbance would affect less than one percent of the available mule deer habitat in the Analysis Area.

Golder evaluated the contribution of the cumulative actions and then inferred the effects of the Proposed Action on the above species at the herd unit scale. The thresholds for the analysis were the herd unit objective. The Proposed Action does not contribute toward achieving the herd objectives because it does not create nor destroy more favorable habitat conditions (woody browse) for the species, and thus carries no consequences for survival and fecundity at the scale of individual animals. Although the mule deer (Sublette) herds are currently below objective, this alternative does not contribute to changes in population numbers as desired by the Wyoming Game and Fish Commission.

Moose – MIS

Moose occur throughout the Gros Ventre watershed on a yearlong basis, save for alpine and rocky habitats at high-elevation. They use a variety of habitats from dense coniferous or quaking aspen forests to mixed-mountain shrublands, open meadows, and riparian areas. During the summer months, they are

associated with coniferous forests where they seek relief from warm temperatures. Gros Ventre moose typically move to lower elevation and use willow-dominated riparian areas in the winter. The Analysis Area supports a small area (7 acres) of crucial range for Moose located approximately a half mile to the southeast of the site (Figure 10) and no parturition range for moose.

The Analysis Area is located within the Jackson moose herd unit MO103. The Jackson moose population has been declining due to low adult survival coupled with low calf recruitment. The five-year (2007–2011) population average was 1,085 moose with an estimated 2012 population of 500 (WGFD 2012). The population objective for the Jackson moose herd unit is 3,600 ± 10%.

Individual moose foraging in the project area could be disturbed by noise associated with implementation of the Propose Action; however, these effects would be temporary and would affect few individuals. Implementation of the Proposed Action may indirectly affect moose by temporarily altering a small amount of suitable foraging habitat in the project area. The Proposed Action does not pose potential for the species to becoming federally listed and no long-term decline in population are expected from the temporary disturbance of the Proposed Action. Collective, long-term disturbance would affect less than one percent of the available moose habitat in the Analysis Area.

Golder evaluated the contribution of the cumulative actions and then inferred the effects of the Proposed Action on the above species at the herd unit scale. The thresholds for the analysis were the herd unit objective. The Proposed Action does not contribute toward achieving the herd objectives because it does not create nor destroy more favorable habitat conditions (woody browse) for the species, and thus carries no consequences for survival and fecundity at the scale of individual animals. Although the moose (Jackson) herds are currently below objective, this alternative does not contribute changes in population numbers as desired by the Wyoming Game and Fish Commission. The inconsequential effect on moose habitat occurs at very small scale compared to those that operate on entire herd units.

Trumpeter Swan – Sensitive

There are 9 known occurrences of Trumpeter Swans in and around the project area (WYNDD 2013). Trumpeter Swans are not expected to be directly harmed under implementation of the proposed action. The Proposed Action does not pose potential for the species to becoming federally listed and no long-term decline in population are expected from the temporary disturbance of the Proposed Action. The detailed biological evaluation for this species is presented in Golder (2013).

3.2.3.2.4 Alternative 2 – No Action – Direct and Indirect Effects

Under the No Action Alternative, the Forest Service would not authorize re-shaping and re-capping of the landfill and construction of groundwater and landfill gas monitoring wells on NFS land. Thus, no direct or indirect effects to listed, proposed, sensitive, or management indicator species would occur.

3.2.3.2.5 Cumulative Effects

Under the National Environmental Policy Act, "cumulative impacts" are the incremental impacts of the Proposed Action when added to other past, present, and reasonably foreseeable future federal, state, and private activities (40 CFR 1508.7). Within this analysis area, past, present, and reasonably foreseeable future activities that have the potential to impact the plants and wildlife included in this analysis include:

- Wildland fire
- Prescribed fire
- Recent U.S. Highway 189/191 reconstruction/improvements (FHWA/WYDOT)
- Squaw Creek Water District Test Well
- Teton County landfill reclamation

Many other activities also have the potential to affect wildlife and vegetation. The effects of some of these activities cannot be quantified. A general list of activities potentially affecting wildlife and vegetation also affected by the Proposed Action is presented in the BA/BE (Golder 2013; Table 3). A specific subset of activities affecting each wildlife and botanical species is included in the cumulative effects section of each individual species discussion.

Potential effects from these activities to wildlife and plant species may include direct and indirect effects to species and their habitats. Construction activities in occupied habitats may directly harm species that are unable to avoid these activities. Increases in human activity and project vicinity to traffic volumes may also directly increase vehicle collisions with wildlife and trampling of plant species. Wildlife occurring in these project locales may also be indirectly affected by being displaced from these areas because of the increased human activity. Wildlife displacement may have severe effects on some wildlife species when sufficient suitable habitats are not available and/or when displacement occurs during high-stress periods, including winter and calving. Wildlife species, particularly big game, can also be indirectly disturbed from increases in human activity. Such disturbance from these projects may also result in the introduction and spread of non-native plant species, which can out-compete native plant species and reduce habitat suitability for wildlife.

Not all species will be affected equally by the activities listed above. Highly mobile species with large home ranges will be affected by activities at a much greater distance than relatively immobile species with small home ranges. The specific actions potentially affecting each species are further described below in the individual species discussions. The actions and effects described above can be both additive and interactive to each other and to the direct and indirect effects described for all alternatives. As stated earlier, because current management and mitigation is designed to eliminate or reduce negative cumulative impacts by protecting sensitive and MIS plants from direct and indirect impacts, the cumulative effects to all species discussed in this analysis, under all alternatives, are expected to be minimal.

3.2.3.2.6 Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Table 5 summarizes Forest Plan compliance for each alternative.

Table 5: Forest Plan Compliance (Flora and Fauna)

Forest Plan Direction (USFS 1990)	Alternative 1 (Proposed Action)	Alternative 2 (No Action)
Goal 3.2 – Recovery is achieved for the Endangered species on the BTNF	Meets	Meets
Goal 3.3 – Sensitive species are prevented from becoming a federally listed Threatened species in Wyoming.	Meets	Meets
Objective 3 3(a) – Protect National Forest Service Intermountain Region Sensitive plant and animal species and provide suitable and adequate amounts of habitat to ensure that activities do not cause (1) long-term or further decline in population numbers or habitats supporting these populations and, (2) trends towards federal listing	Meets – sensitive plant and wildlife species and habitats are not impacted	Meets – sensitive plant and wildlife species and habitats are not impacted

Forest Plan Direction (USFS 1990)	Alternative 1 (Proposed Action)	Alternative 2 (No Action)
Aspen Management Guideline – Aspen sites should be managed for aspen-type perpetuation. The loss of aspen stands due to old age, conifer encroachment, and possible overgrazing should be prevented. Priority areas for aspen treatment should be big-game winter ranges, calving areas, and stands where type loss or conversion is imminent.	Meets – There are no expected impacts from the Proposed Action to the species. Although Aspen are preferred browse for elk, only a few individuals exist within the analysis area	Meets – There are no expected impacts from the Proposed Action to the species. Although Aspen are preferred browse for elk, only a few individuals exist within the analysis area.

3.3 Hydrology

3.3.1 Affected Environment

3.3.1.1 Surface Water

Hydrologic Units (HUCs) are the land units used as the basis for analysis of cumulative hydrologic impacts in this document. These HUCs are typically watersheds, although there are rare exceptions when HUC boundaries do not follow watershed divides. HUCs are assigned numbers based on a watershed coding system: the longer the number, the smaller the watershed being described, with two numbers identifying each successively smaller watershed. For most purposes, the Forest looks at watershed impacts on a 6th-field HUC basis (i.e., the watershed codes have twelve numbers). These HUCs are approximately 5,000 to 50,000 acres in size.

The project area is located in the Lower Flat Creek Watershed (HUC-12 170401030205). The Horsethief Canyon catchment drainage area is approximately 1,000 acres. There are no perennial streams within the catchment. An intermittent or ephemeral channel is located along the southeast boundary of the landfill, formed by the contact between the landfill and the adjacent natural topography.

The Horsethief Canyon catchment is tributary to a segment of Flat Creek (WYSR170401030205_01) that is on the Wyoming 303(d) (impaired) list (WDEQ 2012). The Water quality assessments conducted on Flat Creek by Teton Conservation District (TCD) indicate that the creek's ability to meet its aquatic life other than fish use is threatened, primarily by urban runoff, which contributes excess sediment to the stream and limits aquatic habitat.

Wyoming DEQ lists streams in the Wyoming Surface Water Classification List, Tables A and B, according to beneficial uses that are, or should be, supported for a given stream or reach. Flat Creek is listed as Class 2AB waters (http://deq.state.wy.us/wqd/watershed/surfacestandards/Downloads/Standards/2-3648-doc.pdf). "Class 2AB waters are those known to support game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable. Class 2AB waters are also protected for non-game fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture and scenic value uses"(available at http://deq.state.wy.us/wqd/WQDrules/Chapter_01.pdf.)

3.3.1.2 Groundwater

Hydrogeology

Hydrogeology in the proposed action area has been described in the Draft Nature and Extent of Contamination Work Plan for the Teton County Landfill (Golder 2012b; See Appendix B)), from which the following is excerpted. Four groundwater monitoring wells (GW-3, GW-4, GW-5A, and GW-5B) were installed in mid-2007, and all have 20-foot-long well screens. Well pair GW-5A and GW-5B were

completed to depths of 179 and 100 feet below ground surface (bgs), respectively. Wells GW-3 and GW-4 were installed to depths of 197 and 165 bgs, respectively. These four wells have been sampled quarterly by Teton County since 2008.

Observed water levels in all of the monitoring wells varied by only about one to two feet with no significant trends between July 2007 and October 2011. Further, the levels do not appear to show seasonal influences. Thus, it is inferred that groundwater levels may be controlled by regional flow rather than local seasonally-influenced flow.

Well GW-5B is screened at a much shallower elevation (6035 feet above mean sea level (ft amsl)) than the other three wells (5907 to 5956 ft amsl). Well GW-5B appears to be the only “water table” well with a water level within the screened interval, compared to other three wells where the water levels in the wells are about 52 to 85 feet above the top of the screened interval. When comparing groundwater levels between shallow and deep well pairs GW-5B and GW-5A, respectively, there appears to be a downward gradient of about 0.25 at this location. Gradients elsewhere on Site are unknown due to the lack of additional well pairs.

Based on the borehole logs for deep wells GW-3, GW-4, and GW-5A, it appears that the sediments were dry to moist until wet soil was encountered at the deeper interval screened. The soils in shallower well GW-5B were logged as being dry to slightly moist in the screened interval (80 to 100 feet bgs) and moist to very moist at 70 to 71 feet bgs, which is above the depths where groundwater has been consistently observed in this well (79 to 81.5 feet bgs).

Such observations of placing the screened interval at the first encountered wet soil during drilling in wells GW-3, GW-4 and GW-5A, followed by significantly higher water levels in the installed wells might imply confined conditions if there was a confining geologic unit present. However, the logged soils varied between gravelly silts or clayey silts and clayey silty gravels, with no obvious “confining layer.” Alternatively, higher water levels might indicate that the overlying soils were relatively impermeable and slow to release water. Based on the observed groundwater in well GW-5B, there does not appear to be a perched water layer at this depth. Thus, impermeable soils may be a more reasonable explanation for the Site.

Due to having only one “water table” well and it being located near the mouth of the canyon, it appears that additional shallower wells may be necessary to delineate the extent of the relatively “shallow” subsurface impacts. Investigation of the shallow groundwater may be complicated by the presence of the Hoback Fault system, especially at the upper portion of the canyon. Thus, multi-level wells may be necessary to adequately characterize the hydrogeology.

Known Contamination Distribution

In summary, 15 Volatile Organic Compounds (VOCs) have been detected in groundwater at well GW-5B between June 2008 and April 2012, including benzene, chloroethane, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, 1,1 dichloroethene, cis-1,2-dichloroethene, dichlorodifluoromethane, 1,2-dichloropropane, methylene chloride, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, trichlorofluoromethane, and vinyl chloride. Minimum and maximum detected concentrations for these constituents, along with the maximum time range between 2008 and 2012 over which they have been detected, are summarized in Table 6 below. Some of these constituents appeared to be detected at later time periods (e.g., tetrachloroethene and trichloroethene in 2010, and their breakdown products 1,1-dichloroethene, cis-1,2-dichlorethene and vinyl chloride in late 2011 and/or early 2012).

Based on the available groundwater data, it appears that only shallow well GW-5B exhibits landfill-related VOC impacts. It is not known if the VOCs are being derived from landfill gases and/or aqueous leachate. Aqueous leachate is considered a likely possibility because there also have been elevated general chemistry laboratory-measured parameters in well MW-5B (calcium, magnesium, sodium, bicarbonate, sulfate, nitrate+nitrite, and TDS) when compared with deeper wells GW-3, GW-4, and GW-5A. The water-level is relatively deep to be influenced by landfill gas. Also, field measured conductivity has

been significantly higher in well MW-5B (nearly double) when compared with deeper wells GW-3, GW-4, and GW-5A. Many of these general chemistry parameters are influenced by geochemical redox conditions, which can be depth-dependent relative to the water table. Oxidation-Reduction Potential (ORP) was measured in July and October 2011, which showed reducing conditions at all four wells of which GW-3 was the most reducing. Therefore, it is not known if the observed general geochemical differences at well GW-5B are sourced from landfill leachate and/or influenced by general geochemical redox-conditions. Further evaluation is considered warranted (Golder 2012b).

Table 6: VOC Maximum and Minimum Groundwater Concentrations in Well GW-5B

Constituent	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	WDEQ GPS (µg/L)(3)	Detection Time Ranges(1)
Benzene(2)	0.3 J	0.7 J	5.0	10/2011 – 4/2012
Chloroethane(2)	0.6 J	2.2	29.3	8/2008 – 4/2012
Chloroform	1.4	3.5	80.0	6/2008 – 4/2012
1,1-Dichloroethane	4.4	27	7,300	6/2008 – 4/2012
1,2-Dichloroethane(2)	0.3 J	0.3 J	5.0	4/2012
1,1-Dichloroethene(2)	0.3 J	0.4 J	7.0	10/2011 – 4/2012
cis-1,2-Dichloroethene(2)	0.3 J	0.3 J	70.0	4/2012
Dichlorodifluoromethane	11	17	7,300	10/2011 –- 4/2012
1,2-Dichloropropane(2)	0.5 J	0.5 J	5.0	4/2012
Methylene chloride	3.1	53	5.0	6/2008 – 4/2012
Tetrachloroethene	0.5 J	3.2	5.0	4/2010 – 4/2012
1,1,1-Trichloroethane	2.8	11	200.0	6/2008 – 4/2012
Trichloroethene(2)	0.3 J	1.5	5.0	7/2010 – 4/2012
Trichlorofluoromethane	5.2	16	10,900	6/2008 – 4/2012
Vinyl chloride(2)	0.3 J	0.3 J	2.0	4/2012

Notes:
1) Sampling dates are from June 2008 through April 2012; maximum detection time ranges shown.
2) J qualified constituent concentration is between the method detection level and the reporting limit (1 µg/L for most constituents).
3) GPS – Groundwater Protection Standard

The extent and degree of contamination on Forest Service land is unknown at this time, and the downgradient extent of the contamination on County land is also unknown. A Nature and Extent of Contamination Study and Assessment of Corrective Measures will be prepared, to meet WDEQ requirements.

3.3.2 Environmental Consequences

3.3.2.1 Issue Indicators – Forest Plan Direction

Soil, Water, and Air Prescription – Activities are planned to protect the quality of the basic watershed resources of soil, water, and air (USFS 1990). The Forest Plan objectives substantially supporting the BTNF Forest-wide standards and guidelines for soil, water, and air include 1.3 (a, b), 4.1 (b), 4.2 (d), and 4.3 (c). Land and resource management challenges for watersheds and streams include ensuring needed quantities of clean water, with the goal that water quantity and quality are retained or improved for local users. The objectives are to protect municipal, agricultural, and other potable water supplies; ensure that management activities do not deteriorate water flow timing, quantity, or quality; and meet or exceed current state water quality standards or FS water quality goals (USFS 1990). Forest-wide standards and guidelines applicable to water resources are listed below. The WDEQ regulates water quality. Management guidance in the Forest Plan ensures compliance with federal and state water quality laws and regulations.

Standards:

- Sediment Control Standard – Sediment control will take into account drainage density, slope position and configuration, and subsurface flow conditions.
- Water Quality Standard – FS or permitted activities or projects will, at a minimum, adhere to state rules and regulations concerning surface and groundwater quality.
- Streambank Vegetation – Grass and shrub vegetation will be maintained within 25 feet, plus 2 to 4 feet for each 1 percent side slope adjacent to live streams. Vegetation that gives greater stability because of rooting structure will be planted during the revegetation of channel banks following construction.
- Natural Drainage – Natural drainage channels will be protected during building activities. Following activities, the stream will be returned to its original width, depth, gradient, and curvature.

Guidelines:

- Restoring Stream Channel Conditions Guideline – Areas where human activities have resulted in adverse impacts, such as channel widening, channel aggradation, or lowering of the water table, should be restored.
- Construction Staging Area Guideline – Construction staging and equipment service areas will be located on level ground and at least 150 feet from riparian areas.
- On-site Erosion Guideline – Project-caused on-site potential soil erosion should be reduced by 50 percent 1 year after disturbance, and 95 percent 5 years after disturbance.
- National BMP for Water Quality on NFS lands FAC-2: Facility construction and Stormwater Control. Objective: Avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources by controlling erosion and managing stormwater discharge originating from ground disturbance during construction of developed sites. Specific practices are available in the project record.
- National BMP for Water Quality on NFS Lands FAC10: Facility Site Reclamation. Objective: Reclaim facilities and surrounding disturbed areas to as near to the predisturbed condition as is reasonably practicable following closure or completion of operations, or as necessary for mitigation purposes, to avoid, minimize, or mitigate long-term adverse effects to soil, water quality, and riparian resources. Specific practices are available in the project record.

Indicators to assess impacts to water resources include the following:

- Effects on stream channel conditions and stability
- Effects on surface water including natural flow characteristics, water quality, and quantity
- Effects on streambank stability
- Potential sedimentation
- Effects on groundwater quality and quantity
- Effects on local water users
- Compliance with Wyoming water quality standards
- Potential sediment delivery to stream channels (direct and indirect effect)
- Potential impacts to riparian vegetation and stream channel condition (direct and indirect effect)

Indicators of effects would include:

- Increased sediment delivery to Flat Creek that would violate in-stream standards.
- Permanent loss of or changes to riparian habitat.
- Noncompliance with FAC-2 or FAC-10

3.3.2.2 Spatial and Temporal Context

The direct and indirect area for hydrology is the project area. The cumulative effects area is the catchment area upgradient of the confluence with Flat Creek. Temporal effects were considered short term if less than ten years and long term if more than ten years into the past and future

3.3.2.3 Alternative 1 – Proposed Action

Effects to water quality could occur during earthwork activities if the Proposed Action is implemented. The most likely source of water quality impairment is increased sediment from erosion or spills of petroleum products from construction equipment or staging areas.

During regrading of MSW and reconstruction of the landfill cover, land will be cleared of existing vegetation and ground cover exposing mineral soil that may be more easily eroded by water, wind, and gravity. Changes in land use and impervious surfaces can temporarily or permanently alter stormwater runoff that, if left uncontrolled, can affect morphology, stability, and quality of nearby streams and other water bodies.

The greatest potential water quality concern with the proposed action is increased sediment production and delivery to stream channels. Riparian areas that are in good condition act as filters for the delivery of sediment and nutrients to water bodies. They also provide cover to maintain water temperatures, supply good habitat for aquatic organisms, and provide bank stability to ensure that stream channels have a form that allows them to transport the sediment being supplied to them from stream bank erosion and from their watersheds.

If the Proposed Action is chosen, Teton County will be required to obtain coverage under the General Stormwater discharge permit for Large Construction Projects (WYR 10-0000). Compliance with the permit requires preparing and implementing a Stormwater Pollution Prevention plan and implementing Best Management Practices designed to protect the exposed soil from erosion and control sediment discharge to receiving streams. Project design measures to protect water quality will include:

- Soil will be excavated and stockpiled from the project footprint prior to construction activities. Stockpiles will be protected from erosion.
- If soil is stockpiled for more than 2 months, stockpiles will be vegetated to maintain soil productivity.
- Exposed MSW will be within temporary berms, to control stormwater and prevent it from flowing from the exposed MSW. Daily cover will be used to prevent stormwater from contacting the MSW.
- Following regrading and reconstruction of the landfill cover, a seed mix specified by the Forest Service will be used to reseed the area. The seed mix will include native species that are adapted to the site.
- Construction staging and equipment service areas will be located a minimum of 150 feet from the riparian area.
- Sediment control BMPs, such as rock check dams, straw bales and wattles will be installed in the channels. Silt fencing will be installed during earthwork activities.
- A sediment basin will be installed on the downgradient edge of the property to prevent increased sediment loading to the 303(d) section of Flat Creek across Highway 189.
- Bioengineering (cuttings, live stakes, and wattles) will be used to reestablish riparian vegetation along the constructed channels.

The design criteria proposed will provide effective sediment control. For example, straw mulch can be placed at 10 ton/acre and has been shown to reduce sediment by about 95%. Silt fence can reduce sediment by an additional 37% and sediment basins can provide an additional 90% reduction. Combined, the three sediment control measures would reduce sediment by more than 99%. The design will incorporate all three of these control measures. The proposed vegetation is predicted to reduce sediment by 99.8% long-term.

The Water Erosion Prediction Project model interface for Disturbed Forest and Range Runoff, Erosion and Sediment Delivery ("Disturbed WEPP") was run for the footprint of the Proposed Action to assess potential sediment delivery to stream channels and riparian areas. The results are presented in the soils section (Chapter 3.1 Soils). The WEPP model predicts that there will be no measureable increase in sediment delivery to streams downgradient of the proposed action. In addition, the design criteria include construction of a sediment basin that will be sized to prevent sediment from being transported to Flat Creek.

Bioengineering techniques will be used to reestablish vegetation along the reconstructed channels, to comply with the Natural Drainage Standard.

Under the Proposed Action, construction activities are not expected to affect groundwater. The only possible source of groundwater would be spills of fuel or petroleum products related to construction equipment. Uncontrolled spills are unlikely because the SWPPP prepared to comply with the Construction Stormwater Discharge Permit requires secondary containment around bulk storage containers of petroleum products equal to the volume of the largest container, plus 10%. Stormwater controls included in the Proposed Action Design Criteria will reduce contact between stormwater and exposed MSW and prevent contamination of surface water.

The long-term effect to groundwater quality is expected to be an improvement in water quality, as the purpose of the new landfill cap is to minimize the infiltration of surface water, reduce the production of leachate, reduce further impacts to groundwater and provide a barrier to surface intrusion into the MSW. This cap will be far superior to the current cap and the standard soil cap that is the default cap in Wyoming. The reason for this is that the geomembrane is essentially impermeable. The reduction in seepage cannot be quantified at this time, in part because the current seepage rate is unknown. The models only account for some leakage based on the number of imperfections in the liner. In the modeling, it becomes an academic exercise to estimate the number of imperfections. Golder's previous experience installing similar liners with a geomembrane is that a well installed liner will have a leakage rate equivalent to 10^{-12} cm/second, which is an improvement of five orders of magnitude over the standard soil cap required by WDEQ (10^{-7} cm/sec). WDEQ will require a Quality Control/Quality Assurance plan as part of the final design that will assure good quality installation.

WDEQ will require Teton County to prepare an Environmental Monitoring Plan, including surface water, groundwater and methane monitoring, as part of the landfill closure permit application.

3.3.2.4 Alternative 2 – No Action

Under the No Action Alternative, the Forest Service would not authorize re-shaping and re-capping of the landfill and construction of groundwater and landfill gas monitoring wells on NFS land. Thus, no direct or indirect effects to surface water would occur. Seepage of leachate from the landfill would continue, potentially causing further degradation of groundwater quality. The No Action Alternative would not meet the WDEQ requirement to construct a more robust cap on all portions of the landfill.

3.3.2.5 Cumulative Effects

Within this analysis area, past, present, and reasonably foreseeable future activities that have the potential to impact the surface water or groundwater include:

- Recent U.S. Highway 189/191 reconstruction/improvements (FHWA/WYDOT)
- Squaw Creek Water District Test Well
- Teton County landfill reclamation

Each project incorporates mitigation measures, including soil salvage and revegetation, and erosion control BMPs that minimize effects to surface water and groundwater. Because no measureable effects to surface water are expected for the Proposed Action, and beneficial effects for groundwater, no measureable cumulative effects are expected.

3.4 Noise

3.4.1 Affected Environment

Noise is generally defined as unwanted sound. The proposed project area is undeveloped Forest Service land in the Horsethief Canyon area. Most noise heard in the area can be attributed to traffic on Highway 26/89/189/191 and operation of the Teton County Municipal Solid Waste (MSW) Transfer Station. The Jackson Hole Gun Club and Jackson Hole Shooting Experience are located just south of the proposed project area and contribute to noise in the area as well. There are no residences within 1 mile of the project site. The closest residential neighborhood is approximately 1.5 miles south of the proposed project area. EPA guidelines, and those of many other federal agencies, state that outdoor sound levels in excess of 55 decibels (dB) Day-Night Average Sound Level are “normally unacceptable” for noise-sensitive land uses such as residences, schools, or hospitals (EPA 1974). For occupational noise, the National Institute for Occupational Safety and Health (NIOSH) set the recommended exposure limit at 85 dB, A-weighted, as an 8-hour time-weighted average. Exposures at or beyond this level are considered hazardous (NIOSH 1998).

3.4.2 Environmental Consequences

3.4.2.1 Issue Indicators – Forest Plan Direction

The Forest plan does not address noise relating to activities on Forest Service land.

3.4.2.2 Alternative 1 – Proposed Action

The proposed action would result in short-term increases in noise levels during the construction phase of the project. Due to limited use of the area it is not anticipated that increased noise levels would impact any sensitive receptors. The south wall of the canyon serves as a buffer between the landfill and the residential community located to the south. Construction would be limited to work day hours and would not take place at night. Once construction is complete, the landfill will be closed and activity in the project area will be limited to maintenance of the cap. Vehicle traffic through the project area associated with operation of the Teton County Transfer station will remain the same and there will be no increase in noise with implementation of the proposed project.

3.4.2.3 Alternative 2 – No Action

If the No Action Alternative is chosen, there will be no noise impacts on Forest Service land.

3.4.2.4 Cumulative Effects

Under the National Environmental Policy Act, "cumulative impacts" are the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future federal, state, and private activities (40 CFR 1508.7). Within this analysis area past, present and reasonably foreseeable future activities that have the potential to result in noise impacts included in this analysis include:

- Recent U.S. Highway 189/191 Reconstruction/Improvements (FHWA/WYDOT)
- Squaw Creek Water District Test Well

The actions and effects described above can be both additive and interactive to each other and to the direct and indirect effects described for all alternatives. The proposed action will include construction activities that may result in a temporary increase in noise levels in the immediate area. Cumulative impacts are not anticipated to result from the proposed action.

3.5 Visual Resources

3.5.1 Affected Environment

The proposed project area is located in a long, narrow canyon approximately seven miles south of the Town of Jackson along Highway 26/89/189/191. This area, known as Horsethief Canyon, is located on the east side of the highway with views of the valley below. Vacant land is the predominant feature of the viewshed. While there are no residential homes within the canyon, there are residential areas in the valley below. The site is currently operated by Teton County Landfill and consists of a soil cap and surface water control channels placed on top of the landfill in 1989. The area of the landfill that is on Forest Service land consists of open land with surface water channels.

PHOTO 1 View from the halfway point up the canyon looking west across the valley. The current Teton County Transfer Station in the center area of the photograph is on Teton County land.	
PHOTO 2 View looking east up the canyon from the upper area of the landfill.	
PHOTO 3 View from the southern area of the landfill looking northeast up the canyon.	

The Forest Plan describes most of the Bridger-Teton National Forest as in an undisturbed condition, with essentially natural landscape. The Forest Plan states that Classified Wilderness and roadless lands managed for semi-primitive recreation are to remain in an undisturbed state. The Forest Plan acknowledges that some lands on the National Forest that are natural will be altered for designated activities. Alterations to the natural landscape will be made within the constraints of the visual quality objectives (VQOs). It states that although landscape-altering projects will be designed to meet VQOs, there will be a change in the appearance of some parts of the National Forest.

3.5.2 Environmental Consequences

3.5.2.1 Issue Indicators – Forest Plan Direction

Guidance related to visual quality is included on page 123 in the Forest plan. Standards and Guidelines applicable to the Proposed Action include:

- Visual Quality Prescription – Visual quality objectives for the project area are retention and partial retention.
- Sensitive Travel Route Standard – Along certain visually sensitive travel routes, the Visual Quality Objective will be Retention or Partial Retention. The Management Area narratives at the end of this chapter contain identifications of visually sensitive routes.

Issue indicators would be changes in the visual character that do not comply with the Visual Quality Prescription for the area, which is retention for the lower section and partial retention for the upper section of the landfill.

3.5.2.2 Alternative 1 – Proposed Action

The proposed action involves re-grading and re-capping the portion of the Teton County Landfill that is on Forest Service property. The proposed action is located in a narrow canyon on the east side of Highway 26/89/189/191 south of the Town of Jackson. The proposed action would result in a change in the area's visual resources temporarily during construction. Once construction is completed and the area is re-graded and capped, it will look similar to the existing cap and blend naturally with the surrounding landscape. Construction activities for the proposed project would be visible by vehicles traveling along the highway.

The proposed action involves the removal and replacement of the landfill cap. The new cap would include a gas collection system including gas vents designed to collect and vent landfill gas (methane and carbon dioxide). The anticipated spacing for the gas vents is 200 feet, resulting in approximately one vent per 40,000 square feet. On the 17.8-acre Forest Service property, based on this spacing, it is anticipated that there would be approximately 19 vents. The proposed gas vents would be constructed out of perforated HDPE pipe and have a 6-inch diameter. The gas vents may be visible from the landfill area, but would not be obvious from the highway. Due to the limited access and use of this property, it is not anticipated that they would result in an impact to visual resources.

3.5.2.3 Alternative 2 – No Action

If the No Action Alternative is chosen, there will be no visual impacts on Forest Service land.

3.5.2.4 Cumulative Affects

Under the National Environmental Policy Act, "cumulative impacts" are the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future federal, state, and private activities (40 CFR 1508.7). Past, present and reasonably foreseeable future activities that have the potential to impact visual resources include:

- Wildland fire
- Prescribed fire
- Recent U.S. Highway 189/191 reconstruction/improvements (FHWA/WYDOT)
- Teton County landfill reclamation

The actions and effects described above can be both additive and interactive to each other and to the direct and indirect effects described for all alternatives. The proposed action would be confined to Horsethief Canyon and would not contribute to visual quality impacts related to the above projects and activities. Thus cumulative impacts are not anticipated.

3.6 Recreation

3.6.1 Affected Environment

The Bridger-Teton National Forest offers a broad range of recreational opportunities, including hiking, fishing, camping, backpacking, mountaineering, biking, skiing, and other winter and summer activities. Jackson is a destination for outdoor enthusiasts and is home to an active local population. The proposed project area is located in Horsethief Canyon on the east side of Highway 26/89/189/191, south of the Town of Jackson. The canyons in this area have trails that are used by recreationists. However, recreationists seeking to hike on the Forest Service property or higher up Horsethief Canyon would have to hike through the landfill property (Teton County property) in order to access the area. Recreationists paraglide off of the ridges along Horsethief Canyon and access these ridges through trails in Adams and Wilson Canyons.

3.6.2 Environmental Consequences

3.6.2.1 Issue Indicators – Forest Plan Direction

Guidance related to recreation is included on pages 122 – 123 in the Forest plan and do not appear to be applicable to the proposed action. The following is an access trail guideline that would apply to trails that are accessed from areas outside of the proposed action area:

- Access: Trails Prescription – Non-motorized and motorized trails are provided for a wide variety of uses and difficulty levels. Trails are maintained to appropriate levels or signed as closed with reasons stated. Driveways are maintained for stock movement.

Issue indicators would include loss of access to recreation areas on NFS land or impacts to visual resources.

3.6.2.2 Alternative 1 – Proposed Action

The proposed action would involve earth-moving activities on the Forest Service property and may cause a temporary impact to visual resources for recreationists during construction. With the limited access and use of the area for recreation it is not anticipated that the project will cause impacts to recreational resources. Access to the area and surrounding canyons will remain the same with the implementation of the proposed action.

3.6.2.3 Alternative 2 – No Action

If the No Action Alternative is chosen, there will be no recreation impacts on Forest Service land.

3.6.2.4 Cumulative Effects

Under the National Environmental Policy Act, "cumulative impacts" are the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future federal, state, and private activities (40 CFR 1508.7). Past, present and reasonably foreseeable future activities that have the potential to impact recreation include:

- Wildland fire
- Prescribed fire
- Teton County landfill reclamation

The actions and effects described above can be both additive and interactive to each other and to the direct and indirect effects described for all alternatives. As stated earlier, impacts to recreation from the proposed action are not anticipated and thus the cumulative effects are expected to be minimal.

3.7 Traffic

3.7.1 Affected Environment

The proposed project area is located approximately seven miles south of the Town of Jackson along Highway 26/89/189/191. This area, known as Horsethief Canyon, is located on the east side of the highway, approximately six miles north of Hoback Junction. This section of highway is used by travelers driving to and from the Town of Jackson, Grand Teton National Park, the Bridger-Teton National Forest, and other areas in Northwest Wyoming.

Wyoming Department of Transportation's (DOT) Automatic Traffic Recorder Report for 2012 shows average daily traffic counts for the day of the week and time of day. The Annual Average Daily Traffic recorded for US 26/89/189/191 South of Jackson at milepost 148.7 (near the proposed project area) is 7,516. Monthly average daily traffic counts are higher in the summer months, ranging from 9,809 in June to 11,427 in July, and 10,810 in August. For comparison, the monthly average daily count is 5,293 in January.

Traffic along Highway 26/89/189/191 currently backs up at the transfer station and landfill due to vehicles waiting to turn into the transfer station. The transfer station has only one scale, resulting in cars lined up on the off-ramp from the highway, many times backing up onto the highway.

3.7.2 Environmental Consequences

3.7.2.1 Issue Indicators – Forest Plan Direction

Guidance related to traffic is included on pages 139 and 140 in the Forest Plan. Standards and Guidelines applicable to the Proposed Action include:

Access: General Prescription – A network of roads and trails reflects designs adapted to resource conditions and meets the needs of National Forest users.

Road and Trail Drainage Standard – Existing roads will be evaluated for sediment delivery to live streams, lakes, and riparian areas. Roads and trails will be designed and maintained so that drainage from the road or trail surface does not directly enter live streams, ponds, lakes, or impoundments. Water will be directed off the road or trail into vegetation buffer strips or controlled through other sediment-reduction practices.

Road Restriction Guideline – Road use restrictions may be applied in many situations including: during cattle trailing, to meet recreation objectives, during critical periods for wildlife, during spring breakup, and to limit effects on soil or water quality. Restrictions applied may include temporary closures, vehicle size restrictions, and weight limits.

3.7.2.2 Alternative 1 – Proposed Action

The proposed action would temporarily increase the traffic north and south of the proposed project area along Highway 26/89/189/191 during construction. Construction employees, materials, and equipment would use this section of highway to access the project area on a daily basis throughout the construction period. Traffic would increase during the morning and evening hours as a result of construction workers commuting to and from the site. Large trucks would be entering and exiting the project area throughout the day when construction activities are taking place. The main effect will be related to hauling clean sand to the site for the drainage layer. The estimated 38,000 cubic yards will require approximately 3,300 trips. Over the three-year project life, assuming a six month construction, this equates to approximately 6 trips per day. The increase in traffic in this area during the construction period is expected to be negligible and impacts from construction traffic are not anticipated. This is a worst-case scenario, as the final design may utilize a geosynthetic drainage layer, which would only require a few trips to transport to the site.

After the construction period traffic would return to the pre-construction baseline. The proposed project is not expected to increase the number of employees at the landfill and thus would not increase traffic. The closure of the landfill and re-design of the transfer station on Teton County land is expected to alleviate current backups that occur along Highway 26/89/189/191 at the transfer station. Thus, once the proposed project is implemented, it is anticipated to have a beneficial impact on traffic along the Highway 26/89/189/191 corridor.

3.7.2.3 Alternative 2 – No Action

If the No Action Alternative is chosen, there will be no traffic impacts on forest service land or along Highway 26/89/189/191. Traffic patterns along the Highway 26/89/189/191 corridor near the transfer station would remain the same and the benefits to traffic along this highway corridor resulting from the proposed action would not be realized.

3.7.2.4 Cumulative Effects

Under the National Environmental Policy Act, "cumulative impacts" are the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future federal, state, and private activities (40 CFR 1508.7). Past, present and reasonably foreseeable future activities that have the potential to impact traffic include:

- Recent U.S. Highway 189/191 reconstruction/improvements (FHWA/WYDOT)
- Teton County landfill reclamation

The actions and effects described above can be both additive and interactive to each other and to the direct and indirect effects described for all alternatives. As stated earlier, the proposed action would temporarily increase the traffic north and south of the proposed project area along Highway 26/89/189/191 during construction, however once the proposed project is implemented, it is anticipated to have a beneficial impact on traffic along the Highway 26/89/189/191 corridor. Cumulative impacts are not anticipated as a result of the proposed action.

3.8 Air Quality

3.8.1 Affected Environment

The proposed project area is located in Teton County seven miles south of the Town of Jackson. The Town of Jackson is located at an elevation of 6,237 feet (1,901 m) above sea level and is surrounded by the Teton and Gros Ventre mountain ranges. Jackson experiences a climate characterized by large seasonal temperature differences, with warm to hot (and often humid) summers and cold (sometimes severely cold) winters. Average rainfall is approximately 16 inches per year, with average temperatures ranging from a minimum of approximately 22°F to a maximum of approximately 53°F.

The State of Wyoming has one ozone nonattainment area located in the Upper Green River Basin (UGRB) which includes Sublette County and portions of Lincoln and Sweetwater Counties. This area was classified as a "marginal" nonattainment area by the Environmental Protection Agency (EPA) effective July 20, 2012. A nonattainment area is one in which air quality does not meet the ozone standards set forth by the Federal government in 2008, which is 75 parts per billion over an eight-hour period. While Sublette County borders Teton County to the south, the nonattainment area does not include Teton County, where the proposed project area located.

The Forest Plan indicates that trends in air quality in the Bridger-Teton National Forest will be towards prescribed burning and natural fire management, resulting in larger amounts of particulates contributed into the atmosphere. However, re-designation or re-classification to nonattainment areas is not likely in the vicinity of the proposed project area.

3.8.1.1 Greenhouse Gases

Greenhouse gases (GHG) allow sunlight to enter atmosphere freely but absorb and re-radiate some of the heat that would otherwise return to space. These gases, which trap heat in the atmosphere, include carbon dioxide (CO2), methane (CH4), nitrous oxide (N20) and several fluorinated species of hydrocarbons. CO2 is emitted from the combustion of fossil fuels, including from the use of construction equipment. Methane can be emitted from decomposing garbage. CO2 and other GHGs are naturally occurring gases in the atmosphere. Their status as pollutants is not related to their toxicity, but instead due to the added long-term impacts they may have on climate because of incremental increasing levels in the earth's atmosphere. Because they are non-toxic and non-hazardous at normal ambient concentrations, CO2 and other naturally occurring GHGs do not have applicable ambient standards or emission limits under the major environmental regulatory programs. There will be no change in GHG emissions with the implementation of the proposed action. The amount of methane emitted from the landfill is not anticipated to change with installation of the new cap; it will simply be emitted through different means.

3.8.1.2 Class I Areas

Class I Areas are established by the Clean Air Act and are administered by Federal Land Managers with oversight from the EPA. The Clean Air Act defines mandatory Federal Class I areas as certain National Parks (over 6,000 acres), Wilderness areas (over 5,000 acres), National Memorial Parks (over 5,000 acres), and international parks that were in existence as of August 1977. Grand Teton and Yellowstone National Parks, and the Teton, Bridger, Fitzpatrick, and Washakie Wilderness areas are Class 1 Areas near the project area.

3.8.2 Environmental consequences

3.8.2.1 Issue Indicators – Forest Plan Direction

The Forest Plan addresses air quality only related to forest fires and oil and gas operations. Air quality relating to other activities on Forest Service land is not discussed in the Forest Plan.

Issue indicators would include exceedance of national or state Ambient Air Quality Standards.

3.8.2.2 Alternative 1 – Proposed Action

Part of the proposed action involves the removal and replacement of the landfill cap. The new cap will include a gas collection layer consisting of a 1-foot-thick layer of permeable material (sand, shredded tires, or a geosynthetic), and gas vents (6-inch diameter perforated PVC pipe), designed to collect and vent landfill gas (methane and carbon dioxide), preventing build-up of gasses. The anticipated spacing for the gas vents is 200 feet, resulting in approximately one vent per 40,000 square feet. On the 17.8-acre Forest Service property, based on this spacing, it is anticipated that there will be approximately 19 vents. Golder used US EPA's LandGEM Landfill Gas Emissions Model, Version 3.02 to estimate emissions from the decomposition of landfilled waste at Teton County Landfill. Using the LandGEM model, Golder approximated that each gas vent will release an average of approximately 1.1 cubic feet per minute (CFM) or 12 tons per year (TPY) of methane gas for 2013. Emissions will decrease over time, as demonstrated in the model results. For the model inputs, Golder assumed a design capacity of 558,000 tons of MSW in the landfill spread evenly between 1960 and 1989. The Landfill Gas Emission Model Report Summary is provided in Appendix C

Methane gas is currently emitted from the landfill through seepage through the cap. The re-capping of the landfill and installation of the gas vents will direct the methane emitting from the landfill to vent in a consolidated and controlled manner. The amount of methane emitted from the landfill is not anticipated to change with installation of the new cap; it will simply be emitted through different means.

3.8.2.2.1 Construction

Emissions generated from common construction activities include:

- Exhaust emissions of particulate matter (PM) and oxides of nitrogen (NO_X) from fuel combustion for mobile heavy duty diesel and gasoline powered equipment, portable auxiliary equipment, material delivery trucks, and worker commute trips
- Fugitive PM dust from soil disturbance and demolition activity
- Exhaust emissions of GHGs such as CO_2, CH_4, and N_2O
- Windblown exposed MSW

The proposed action would cause a short-term decline in localized air quality as a result of construction activities. During construction, approximately 17.8 acres of Forest Service land will be disturbed. In addition, the landfill cap will be re-graded and replaced. During construction, exposed soil could contribute to an increase in the dust particulates in the local air column. Fugitive dust and vehicular emissions would contribute to air emissions. These are considered short-term effects and would last only as long as the estimated construction period. In addition, due to the remote location of the proposed project, it is expected that the construction activities would contribute minimally to the concentrations of air pollutants at the nearest residences, located approximately 1.5 miles to the south and on the other side of Horsethief Canyon.

Prior to beginning construction Teton County will be required to apply for a Construction permit from the Wyoming DEQ Air Quality Division. Compliance with the permit requires use of Best Available Control Technology such as treatment of haul roads, stockpiles and active work areas with a dust suppressant, and vegetation of soil stockpiles.

There will be a performance specification that no windblown MSW will be allowed to exit the construction area. Teton County will monitor full-time to make sure this requirement is met. The construction contractor will be required to provide a plan outlining what methods will be used to control windblown MSW until the MSW is covered with final cover material. MSW landfills employ a number of means to control windblown MSW, including daily cover. The contractors will employ daily cover methods that allow relatively easy

removal and reuse such as tarps that are sand-bagged. Litter fences can also be used to catch any MSW that is not dealt with by daily cover.

3.8.2.2.2 Odors

Odors resulting from the proposed action will be similar in nature and intensity to the odors that already exist at the landfill. There could be a temporary noticeable increase in odor during construction with the movement of landfill material; however this would occur only during construction activities and would be localized at the proposed project area.

3.8.2.3 Alternative 2 – No Action

If the No Action Alternative is chosen, air quality impacts on Forest Service land would remain the same due to the methane gas currently emitted from the landfill through seepage through the cap.

3.8.2.4 Cumulative Effects

Under the National Environmental Policy Act, "cumulative impacts" are the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future federal, state, and private activities (40 CFR 1508.7). Past, present and reasonably foreseeable future activities that have the potential to impact air quality include:

- Wildland fire
- Prescribed fire
- Recent U.S. Highway 189/191 reconstruction/improvements (FHWA/WYDOT)
- Teton County landfill reclamation

The actions and effects described above can be both additive and interactive to each other and to the direct and indirect effects described for all alternatives. The above projects incorporate mitigation measures, such as dust control measures and emission controls, which minimize effects to air quality. Wildland and prescribed fires are addressed in the Forest Plan. As stated previously, re-designation or re-classification to non-attainment in the project area is not likely according to the Forest Plan. Cumulative impacts related to air quality are not anticipated for the proposed action.

4.0 PREPARERS AND CONSULTATION

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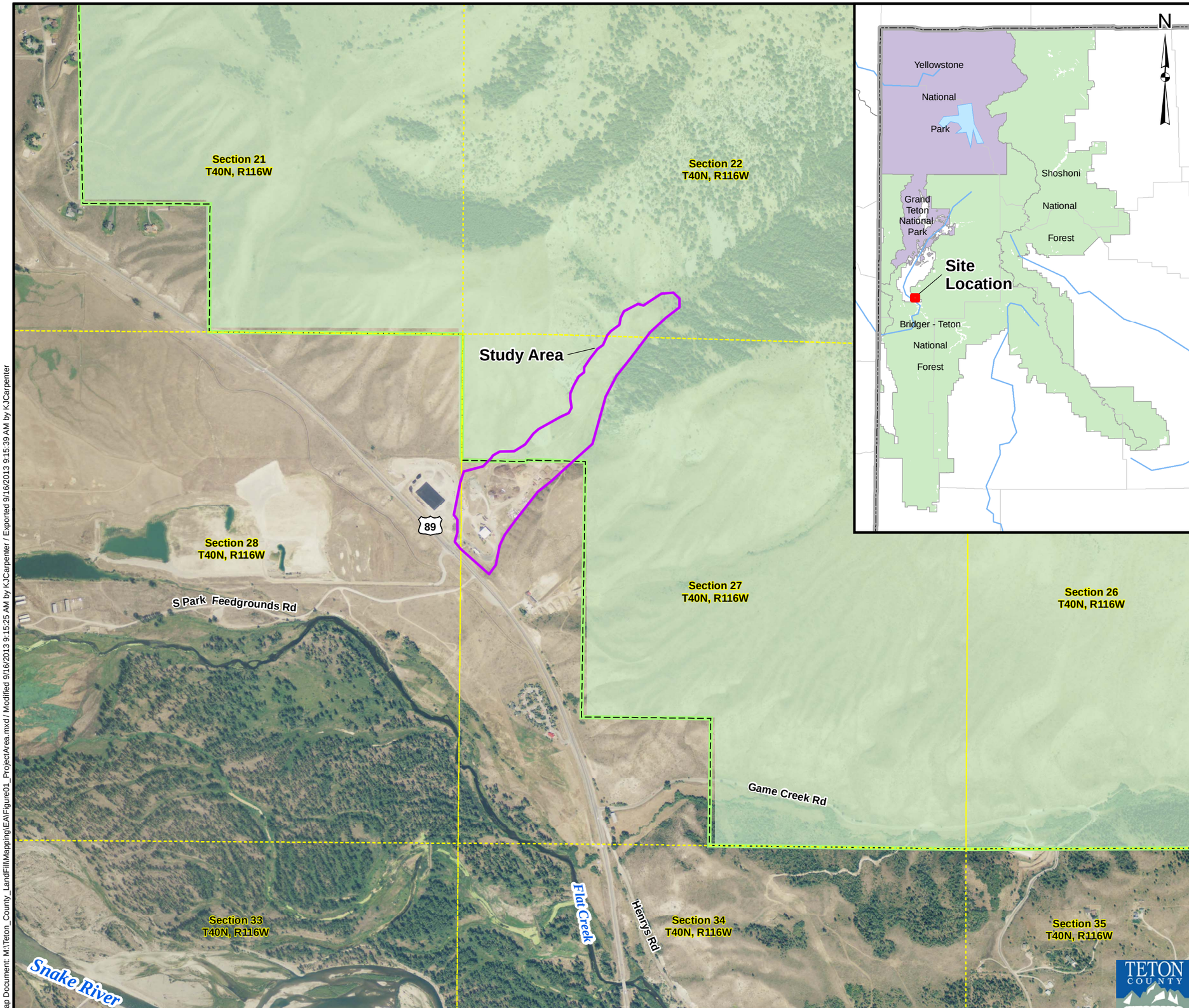
FIGURES



LEGEND

- APPROXIMATE SITE LIMIT
- BTNF BOUNDARY

SURFACE OWNERSHIP

- FOREST SERVICE
- NATIONAL GRASSLANDS
- NATIONAL PARK SERVICE

REFERENCES

COORDINATE SYSTEM: NAD 1983 STATEPLANE WYOMING WEST FIPS 4904 FEET.
WYOMING LAND OWNERSHIP PROVIDED BY BLM, 2010.
U.S. STATES (GENERALIZED), U.S. COUNTIES (GENERALIZED), U.S. DRAINAGE SYSTEMS (GENERALIZED), AND U.S. LAKES (GENERALIZED) PROVIDED BY ESRI, 2012.
U.S. NATIONAL TRANSPORTATION ATLAS INTERSTATE HIGHWAYS PROVIDED BY ESRI AND BUREAU OF TRANSPORTATION STATISTICS, 2012.
2012 AERIAL PHOTOGRAPHY PROVIDED BY USDA-FSA AERIAL PHOTOGRAPHY FIELD OFFICE.

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PROJECT
TETON COUNTY LANDFILL
ENVIRONMENTAL ASSESSMENT
TETON COUNTY, WYOMING

TITLE
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Golder Associates

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REVIEW	XX	9/16/2013		

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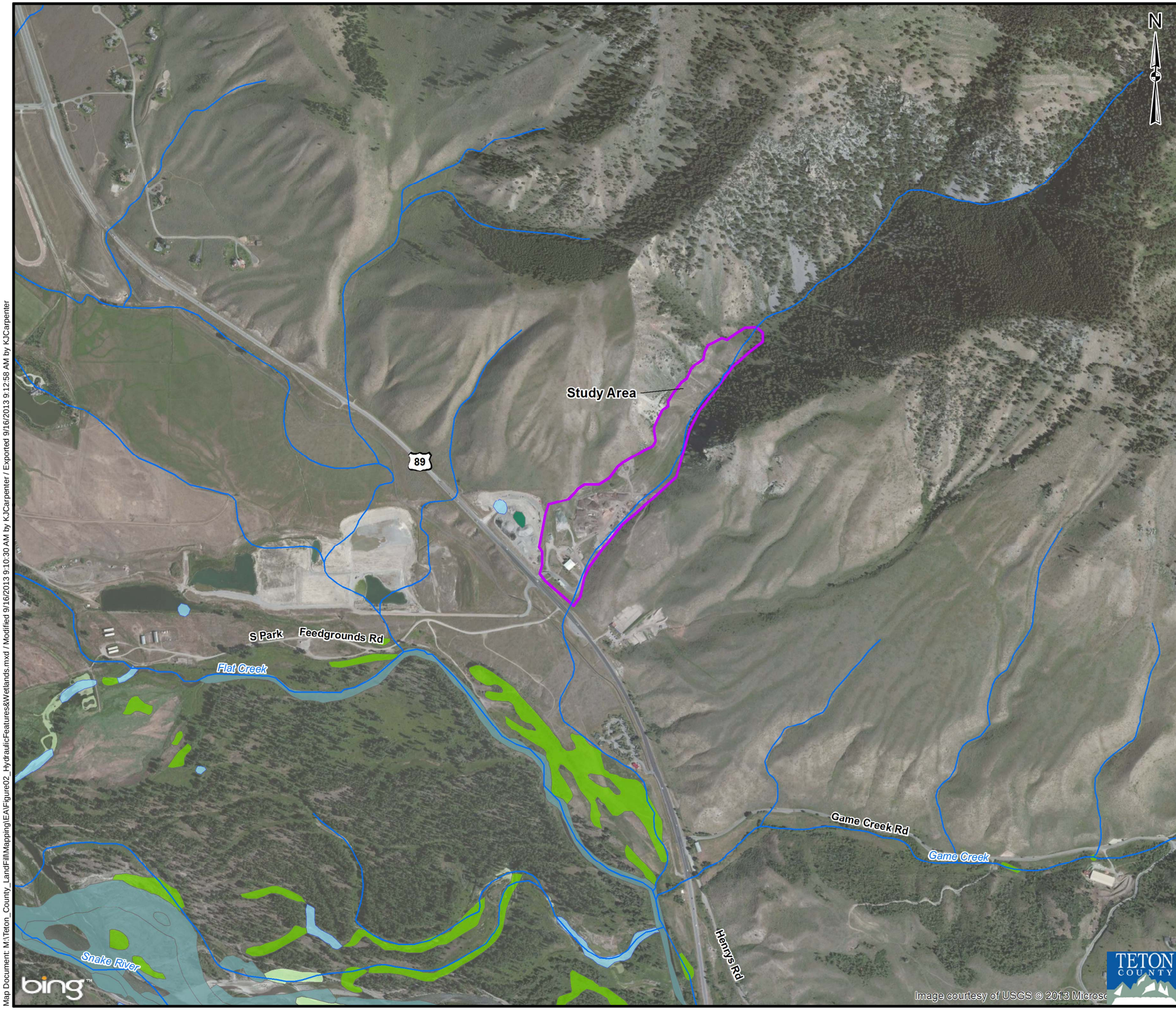

LEGEND

- RIVER/STREAM
- APPROXIMATE SITE LIMIT

NWI WETLAND CLASS

- FRESHWATER EMERGENT WETLAND
- FRESHWATER FORESTED/SHRUB WETLAND
- FRESHWATER POND OR LAKE
- RIVERINE
- OTHER

REFERENCES

COORDINATE SYSTEM: NAD 1983 STATEPLANE WYOMING WEST FIPS 4904 FEET.
HYDROLOGIC DATA: NATIONAL HYDROLOGIC DATASET.
WETLANDS DATA: NATIONAL WETLANDS INVENTORY.

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PROJECT
TETON COUNTY LANDFILL
ENVIRONMENTAL ASSESSMENT
TETON COUNTY, WYOMING

TITLE
HYDRAULIC FEATURES AND WETLANDS

Golder Associates

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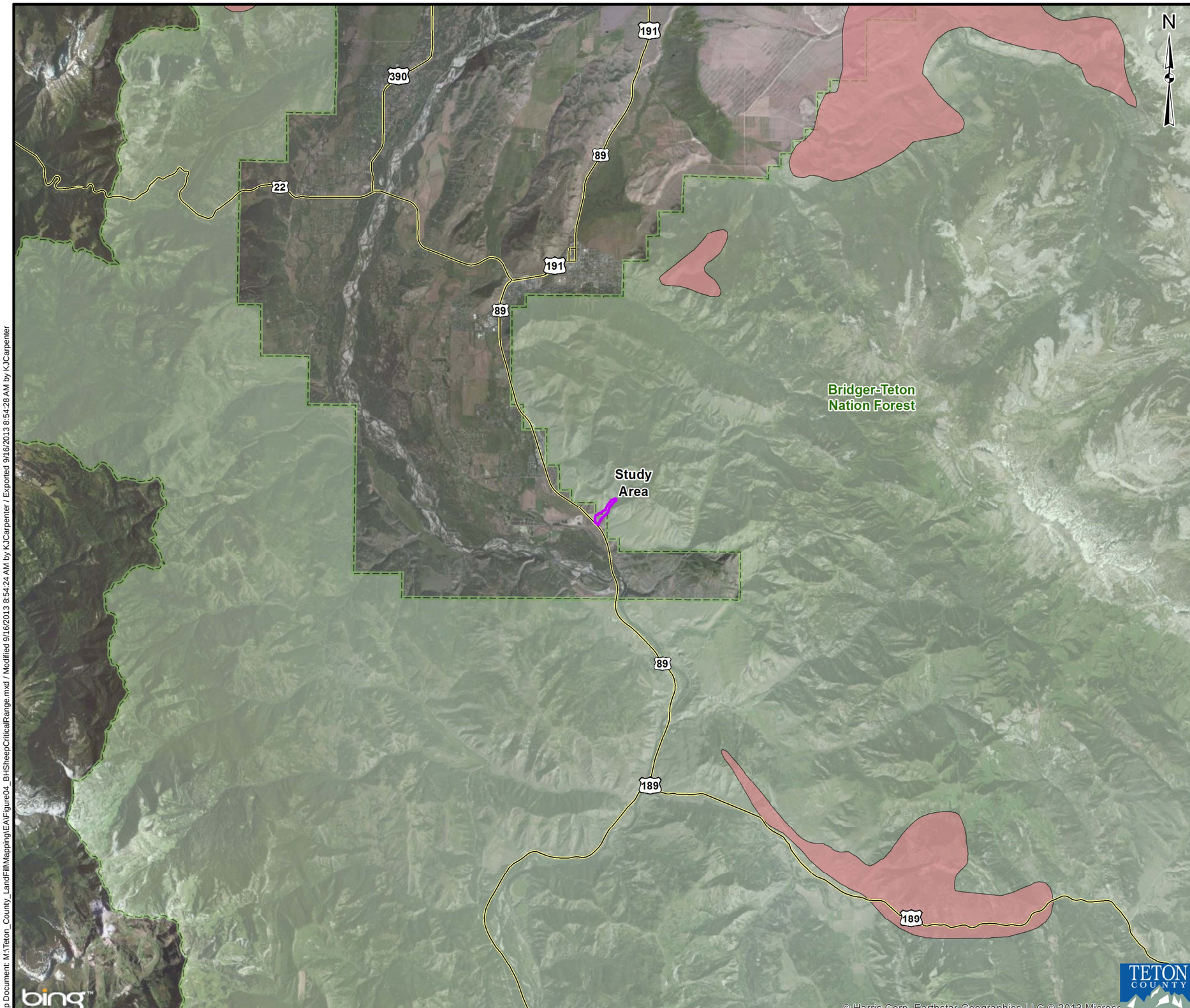

LEGEND

- BIG HORN SHEEP CRITICAL RANGE
- APPROXIMATE SITE LIMIT
- BTNF BOUNDARY

REFERENCES

COORDINATE SYSTEM: NAD 1983 STATEPLANE WYOMING WEST FIPS 4904 FEET.
BIG HORN SHEEP CRITICAL RANGE DATA: WYOMING GAME AND FISH DEPARTMENT, GIS SECTION, STATE OF WYOMING, 2011. PROVIDED TO GOLDER BY BRIDGER-TETON NATIONAL FOREST, 2013.

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PROJECT
TETON COUNTY LANDFILL
ENVIRONMENTAL ASSESSMENT
TETON COUNTY, WYOMING

TITLE
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Golder Associates

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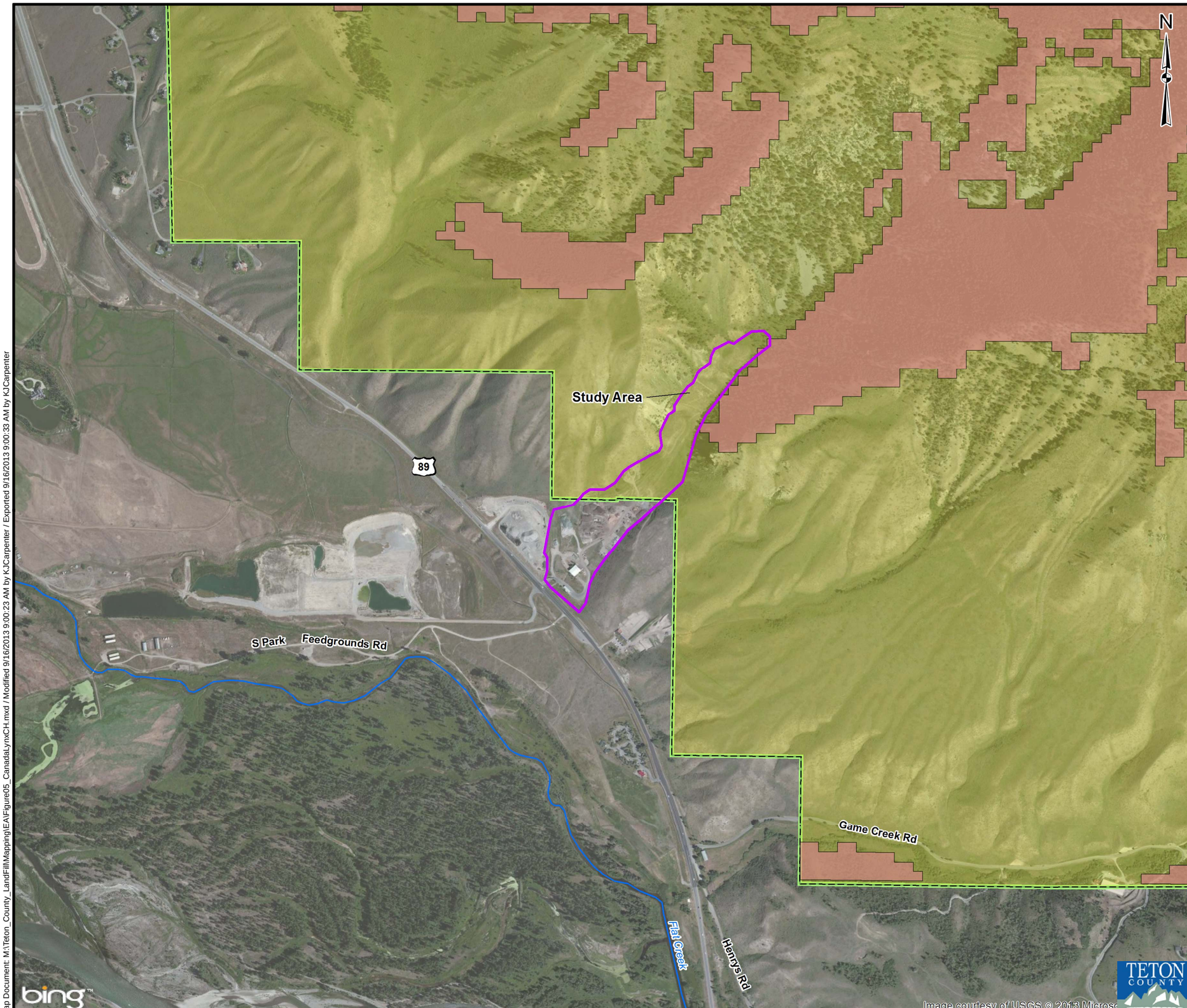

LEGEND

- APPROXIMATE SITE LIMIT
- MAPPED POTENTIAL LYNX HABITAT
- CANADA LYNX CRITICAL HABITAT
- BTNF BOUNDARY

REFERENCES

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PROJECT
TETON COUNTY LANDFILL
ENVIRONMENTAL ASSESSMENT
TETON COUNTY, WYOMING

TITLE
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Golder Associates

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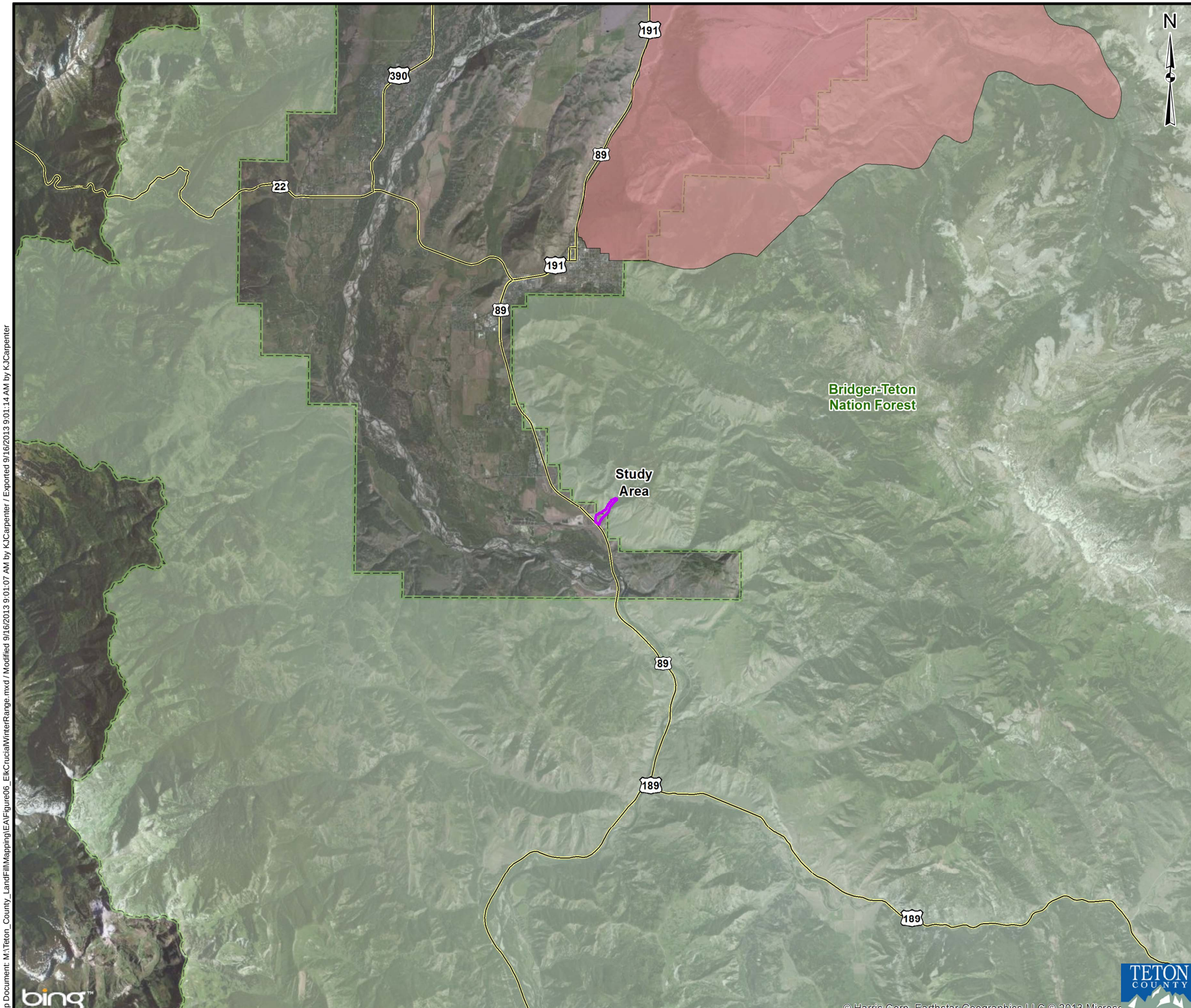

LEGEND

- ELK CRUCIAL WINTER RANGE
- APPROXIMATE SITE LIMIT
- BTNF BOUNDARY

REFERENCES

COORDINATE SYSTEM: NAD 1983 STATEPLANE WYOMING WEST FIPS 4904 FEET.
ELK CRUCIAL WINTER RANGE DATA: WYOMING GAME AND FISH DEPARTMENT, GIS SECTION, STATE OF WYOMING, 2011. PROVIDED TO GOLDER BY BRIDGER-TETON NATIONAL FOREST, 2013.

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PROJECT
TETON COUNTY LANDFILL
ENVIRONMENTAL ASSESSMENT
TETON COUNTY, WYOMING

TITLE
ELK CRUCIAL WINTER RANGE

Golder Associates

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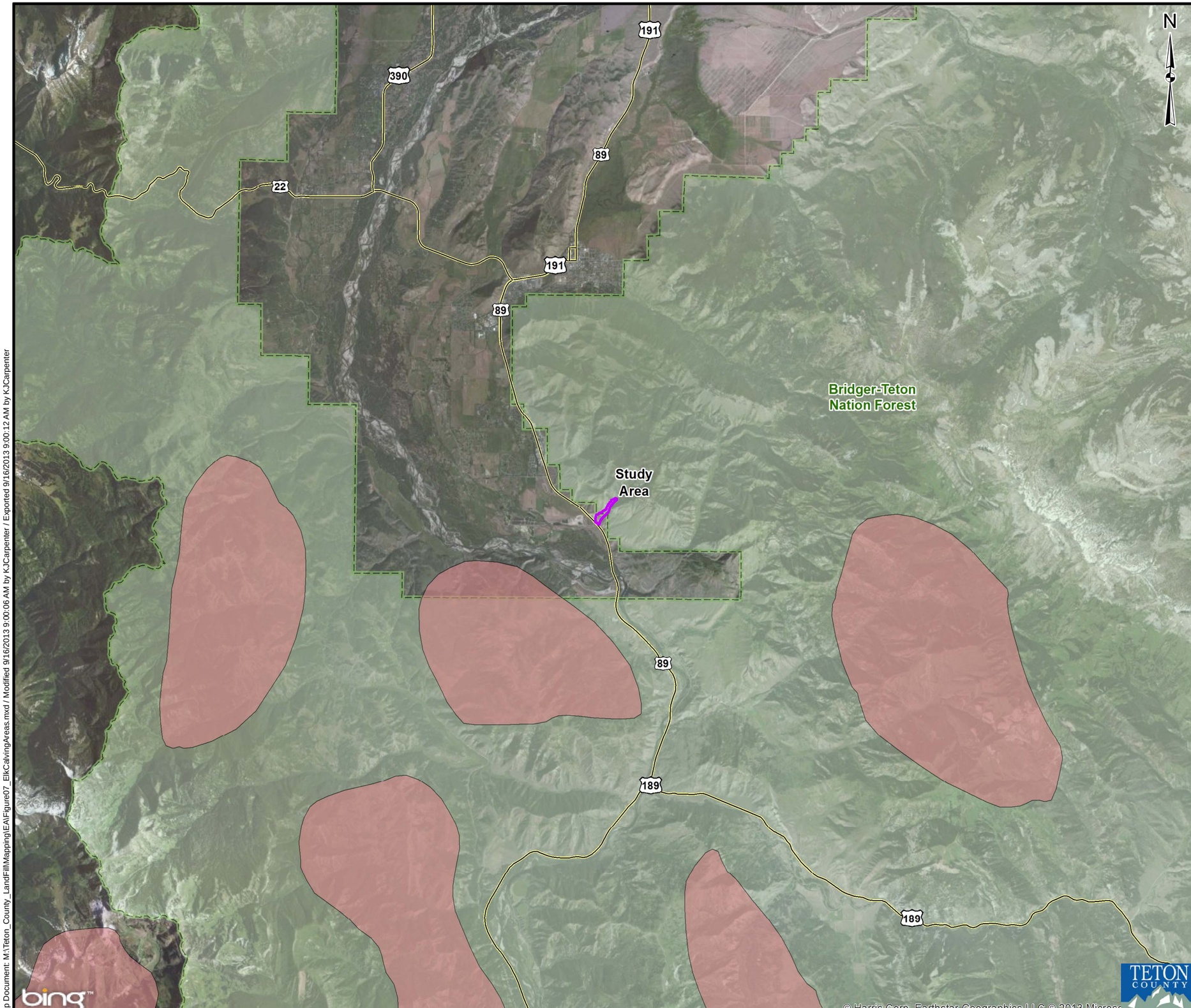

LEGEND

- ELK CALVING AREA
- APPROXIMATE SITE LIMIT
- BTNF BOUNDARY

REFERENCES

COORDINATE SYSTEM: NAD 1983 STATEPLANE WYOMING WEST FIPS 4904 FEET.
ELK CALVING DATA: WYOMING GAME AND FISH DEPARTMENT, GIS SECTION, STATE OF WYOMING, 2012. PROVIDED TO GOLDER BY BRIDGER-TETON NATIONAL FOREST, 2013.

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PROJECT
TETON COUNTY LANDFILL
ENVIRONMENTAL ASSESSMENT
TETON COUNTY, WYOMING

TITLE
ELK CALVING AREAS

Golder Associates

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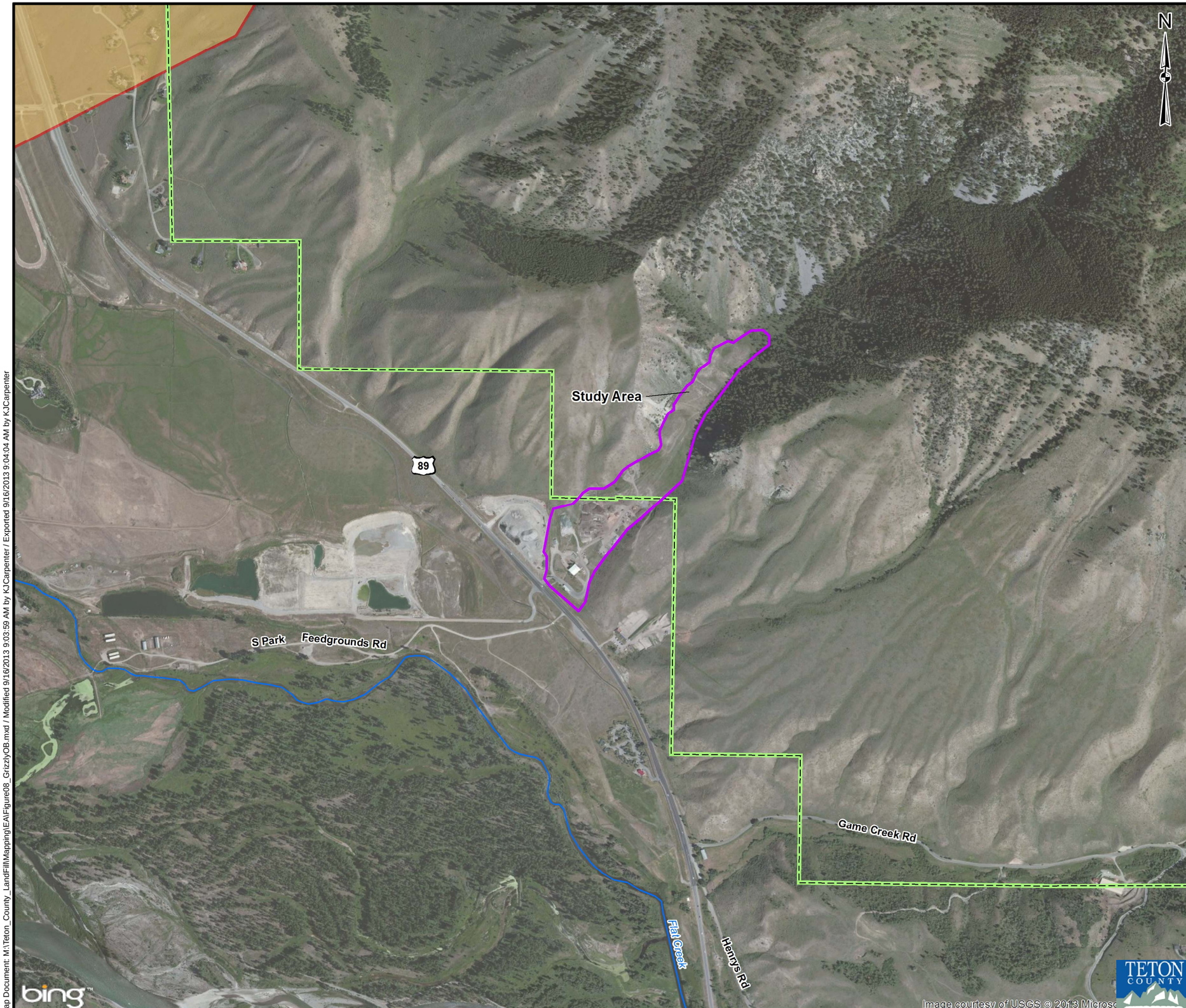

LEGEND

- APPROXIMATE SITE LIMIT
- GRIZZLY BEAR OCCUPANCY BOUNDARY
- BTNF BOUNDARY

REFERENCES

COORDINATE SYSTEM: NAD 1983 STATEPLANE WYOMING WEST FIPS 4904 FEET.
GRIZZLY BEAR OCCUPANCY BOUNDARY: UNITED STATES FOREST SERVICE, LARGE CARNIVORE MANAGEMENT SECTION, WG&F, LANDER WY, 2010.

1,000 0 1,000
Feet

PROJECT
TETON COUNTY LANDFILL
ENVIRONMENTAL ASSESSMENT
TETON COUNTY, WYOMING

TITLE
GRIZZLY BEAR OCCUPANCY BOUNDARY

Golder Associates

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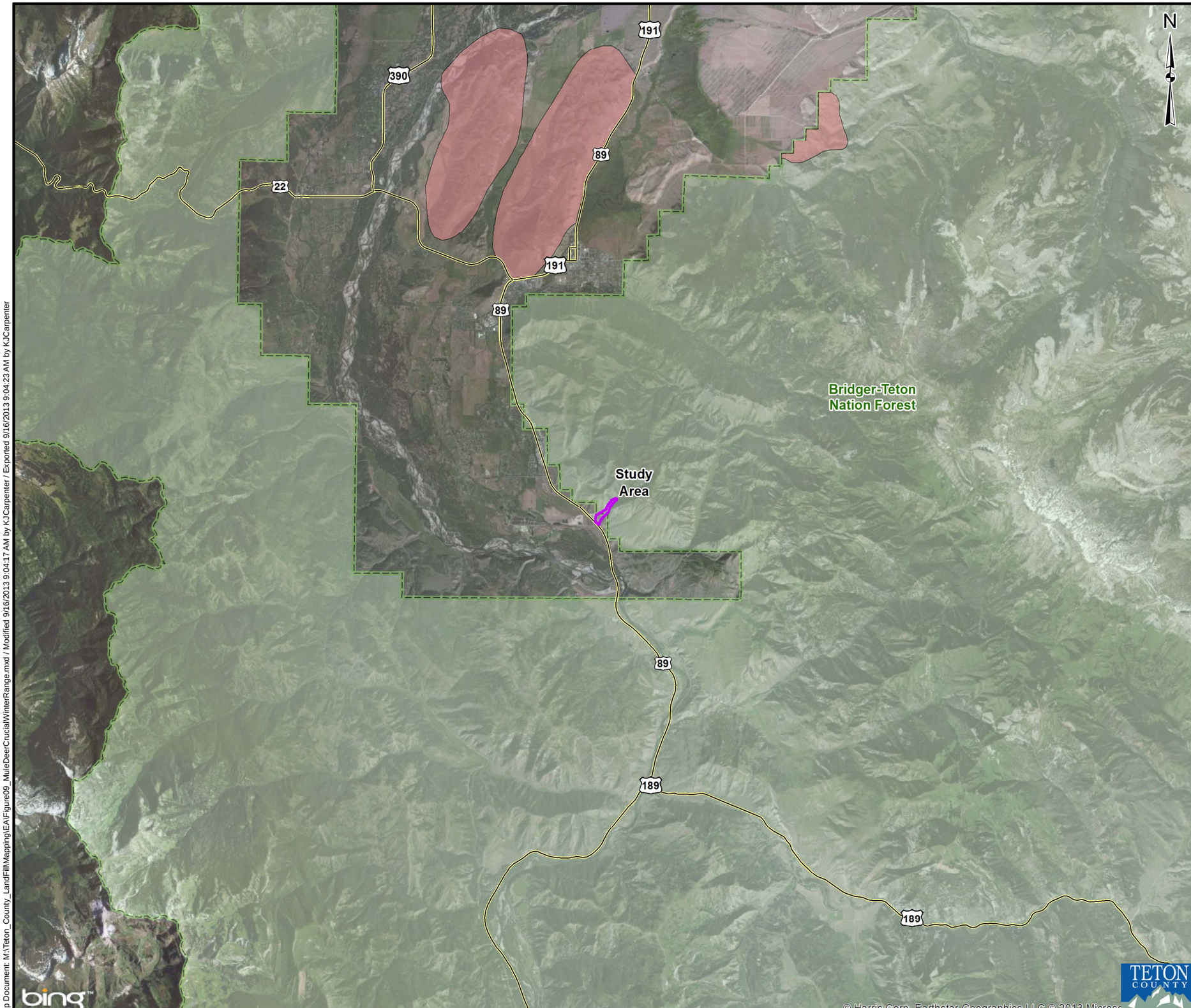

LEGEND

- MULE DEER CRUCIAL WINTER RANGE
- APPROXIMATE SITE LIMIT
- BTNF BOUNDARY

REFERENCES

COORDINATE SYSTEM: NAD 1983 STATEPLANE WYOMING WEST FIPS 4904 FEET.
MULE DEER CRUCIAL WINTER RANGE DATA: WYOMING GAME AND FISH DEPARTMENT, GIS SECTION, STATE OF WYOMING, 2011. PROVIDED TO GOLDER BY BRIDGER-TETON NATIONAL FOREST, 2013.

2 0 2 Miles

PROJECT
TETON COUNTY LANDFILL
ENVIRONMENTAL ASSESSMENT
TETON COUNTY, WYOMING

TITLE
MULE DEER CRUCIAL WINTER RANGE

Golder Associates

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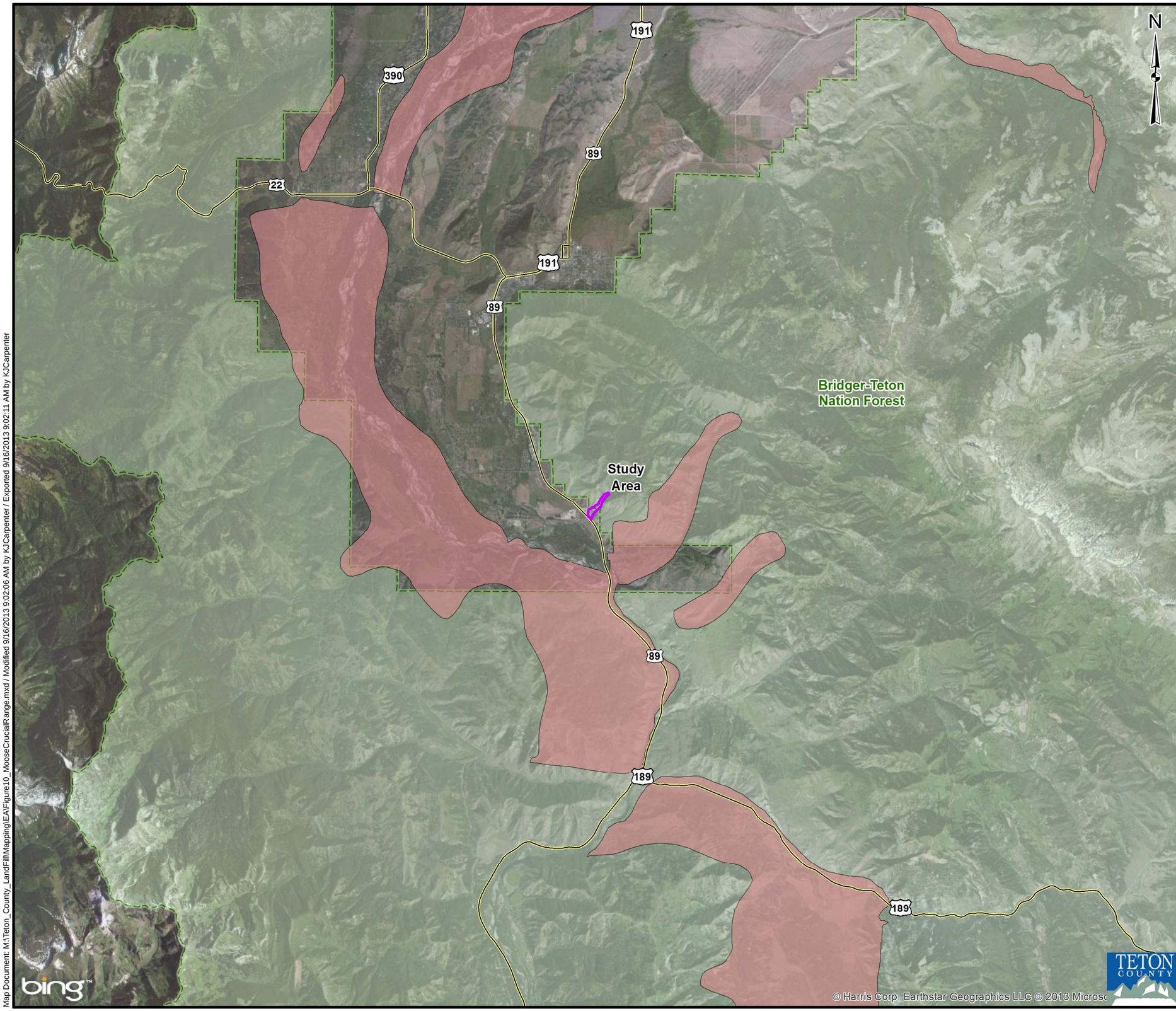

LEGEND

- MOOSE CRUCIAL RANGE
- APPROXIMATE SITE LIMIT
- BTNF BOUNDARY

REFERENCES

COORDINATE SYSTEM: NAD 1983 STATEPLANE WYOMING WEST FIPS 4904 FEET.
MOOSE CRUCIAL RANGE DATA: WYOMING GAME AND FISH DEPARTMENT, GIS SECTION, STATE OF WYOMING, 2005. PROVIDED TO GOLDER BY BRIDGER-TETON NATIONAL FOREST, 2013.

2 0 2 Miles

PROJECT
TETON COUNTY LANDFILL
ENVIRONMENTAL ASSESSMENT
TETON COUNTY, WYOMING

TITLE
MOOSE CRUCIAL RANGE

Golder Associates

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APPENDIX A
TETON COUNTY LANDFILL CLOSURE ALTERNATIVES EVALUATION

CLOSURE ALTERNATIVES EVALUATION

TETON COUNTY LANDFILL CLOSURE ALTERNATIVES EVALUATION

TETON COUNTY, WYOMING

Submitted To: Teton County Landfill
5400 S. US Highway 89
Jackson, WY 83001

Submitted By: Golder Associates Inc.
44 Union Boulevard, Suite 300
Lakewood, CO 80228

August 2012

Project No. 123-81604

A world of capabilities delivered locally

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1.0 INTRODUCTION AND BACKGROUND

Golder Associates Inc. (Golder) has prepared this Teton County Landfill Closure Alternatives Evaluation (Alternatives Evaluation) for Teton County (County) in accordance with our scope-of-work dated March 20, 2012. The purpose of the Alternatives Evaluation is to assist the County in selecting a cost-effective Closure Alternative for the Teton County Landfill (Landfill).

The Landfill property (Site) is located approximately seven miles south of the Town of Jackson along Highway 26/89/189/191, in an area known as Horsethief Canyon (Figure 1). The Landfill property encompasses approximately 40.5 acres owned by Teton County in the SW1/4 of the NW1/4 of Section 27, Township 40 North, Range 116 West, in Teton County, Wyoming and an adjacent 17.8-acre United States Forest Service (USFS) parcel to the east of the 40.5-acre parcel, hereinafter called the Site. Approximately 37.7 of the 40.5 acres lie northeast of the highway right-of-way and contain a portion of the Landfill and the Municipal Solid Waste (MSW) Transfer Station. The southeast corner of the noted 37.7 acres lies in an adjacent canyon and encompasses a portion of a public shooting range. The balance of the 40.5-acre parcel, in the southwest corner of Section 27, is used as a right-of-way for Highway 26/89/189/191 (approximately 2.79 acres) and to access adjacent parcels (approximately 0.05 acres).

There are two permanent structures on the 40.5-acre tract: a scale house and the MSW Transfer Station. In addition, a compost facility currently operates on the Site and there are several stockpile areas for recyclables such as metal, glass and tires. The internal roads connecting these areas are gravel surfaced.

The Site was used as a community landfill beginning in the 1960's and possibly as early as the 1950's and this practice continued into the 1980s. In 1989, all landfill operations ceased, and portions of the Site which had been used as a MSW landfill were capped with approximately 18 inches of compacted soils and six inches of topsoil, as per applicable state closure standards at that time (WDEQ, 1975). Methane gas and groundwater monitoring wells have been installed on the Site.

This Alternatives Evaluation has been developed to provide a comparison of feasible closure alternatives (Closure Alternatives) that would meet requirements of the Wyoming Department of Environmental Quality (WDEQ) (Wyoming Solid Waste Rules, Chapter 1, Section 2 (g and h) and Chapter 2, Section 7) and those of the USFS) (pursuant to input gained through working meetings), and allow for future beneficial use of the Site to meet the needs of the County. This would include continued use of the Site for various solid waste management activities, including the MSW Transfer Station, stockpiling of recyclables, composting, dead animal disposal, etc.

The data from the recently completed Site Assessment (Appendix A) was used to assist with estimating areas and quantities associated with the alternatives. Also, a draft “Nature and Extent of Contamination”

(Nature and Extent) Work Plan has been developed (Appendix B) to present preliminary recommended landfill gas and groundwater monitoring points needed to assess the nature and extent of contamination at the Site. It is envisioned that these monitoring points will ultimately become part of the respective long-term monitoring networks. The draft Nature and Extent Work Plan will be finalized under separate cover.

The primary purpose of this Alternatives Evaluation is to develop feasible closure alternatives and to summarize the advantages and disadvantages, including cost, of those alternatives to facilitate the County's selection of the best closure alternative. The development of the alternatives is conceptual at this point to allow for comparison of alternatives and the development of budgetary cost estimates. The selected alternative will be then be refined and value-engineering conducted, followed by a permit-level design to be prepared as a part of the closure application to WDEQ for the Site.

2.0 SITE ASSESSMENT AND QUANTITY ESTIMATES

The first step in the development and evaluation of alternatives was to generate concept-level aerial maps that show the existing topography, the approximate top of MSW elevations and estimated lateral extent, and the approximate bottom of MSW. From these maps, the estimated volumes of MSW and existing cover soil were calculated and grading plans for the different alternatives developed. Cover thickness and MSW depths that formed the basis for these maps were based not only on data obtained from the Site Assessment, but also incorporated previous data collected at the Site by others. A detailed list of references of previous subsurface investigation and monitoring activities is provided in Appendix B. Specifically, the concept-level surfaces (maps) that were developed in AutoCAD for this purpose were:

- Top of existing cover (Figure 1);
- Approximate top of existing MSW (Figure 2; i.e., top of cover minus estimated depth of current cover soils); and
- Approximate bottom of existing MSW (Figure 3; i.e., top of existing cover minus depth of cover and MSW).

While the two top surfaces were relatively straightforward to generate from the existing data, the bottom of MSW surface required more engineering judgment to interpolate between actual MSW depth data points. Since some of the MSW was placed within trenches, and waste was “redistributed” when the grading was performed to construct the initial cover in 1989, the bottom of MSW surface is irregular. The bottom of MSW surface developed for this assessment and presented on Figure 3 represents a reasonable surface to which an earthworks/heavy civil contractor would excavate if the MSW was to be entirely removed from the Site. In other words, the grading for the bottom of MSW surface was developed to honor specific data points, but was also “smoothed” to avoid abrupt grade changes since these would be difficult and impractical for a contractor to achieve. A summary of estimates of current final cover and MSW aerial extent and volumes is provided in Table 1. It should be noted that, even though the Site Assessment yielded data that reduces the uncertainty of the MSW volume, the costs associated with comparable MSW removal projects are subject to significant uncertainty, much of which is related to volume uncertainty.

3.0 ALTERNATIVES DEVELOPMENT

Five Closure Alternatives have been developed for the Site. The Closure Alternatives address MSW on both USFS property and Teton County property. The five Closure Alternatives are:

- **Alternative 1: Total MSW Removal.** This alternative would include the following:
  - Remove and segregate topsoil;
  - Remove and segregate remaining final cover;
  - Remove MSW and dispose in another (off-site) solid waste landfill;
  - Regrade surface to "natural conditions" on USFS property using stockpiled soil and topsoil and revegetate;
  - Regrade surface using stockpiled soil on County property to allow for continued solid waste management activities;
  - Regrade area near Test Pit 3 (TP-3) on hill in the southeast corner of the Site to allow for composting operations;
  - Control surface water by installing armored channels along the east and southwest boundaries of waste removal (i.e., current waste footprint) to collect and convey runoff to discharge points along the southwest boundary of the Site; and
  - Incorporate the revised groundwater monitoring program into post-closure activities. This is necessary because there is evidence that contaminants may have migrated from the MSW into underlying soils that would not be removed under this alternative.
- **Alternatives 2A and 2B: Regrading and Capping; Composting on Teton County property near TP-3 (Alternative 2A) or on USFS Property (Alternative 2B).** These alternatives would include the following:
  - Remove and segregate topsoil;
  - Remove and segregate remaining final cover;
  - "Reshape" waste and use segregated soil as needed to develop foundation grading for cap subgrade. This would also include grading an approximate area of about 5 acres on USFS property for a composting operation (Alternative 2B) or on County property (Alternative 2A);
  - Regrade subgrade surface on County property by reshaping MSW and using stockpiled soil on property to allow for continued solid waste management activities;
  - Place gas collection layer and gas vents, PVC liner, drainage layer, vegetation support layer and topsoil, and revegetate to form final cover system for 30 acres;
  - Regrade 5-acre area on USFS property (Alternative 2B) or near TP-3 (Alternative 2A), and construct haul road to allow for composting operations;
  - Control surface water by installing armored channels along the east and southwest portions of the landfill perimeter to collect runoff from the final cap and convey it to the southwest boundary of the Site;
  - Remove waste on 2-acre area adjacent to Transfer Station;

- Alternative 2A grades excavated waste on Teton County property and remainder of MSW is disposed at off-site landfill;
- For Alternative 2B, all MSW removed from 2-acre area is regraded on Teton County and USFS properties;
- Allow for double-lined cap in capped waste management area on 2-acre area of Teton County property near Transfer Station; and
- Incorporate a revised groundwater and landfill gas monitoring program into post-closure activities. This is necessary because there is evidence that contaminants may have migrated from the MSW into groundwater, and also because MSW will remain in-place and continue to generate landfill gas.

- **Alternatives 3A and 3B: Regrading and Capping, Composting on Teton County Property near TP-3.** These alternatives will include the following:
  - Remove and segregate topsoil;
  - Remove and segregate remaining final cover;
  - "Reshape" waste and use segregated soil as needed to develop foundation grading for cap subgrade;
  - Regrading an area of approximately 5 acres on County property near TP-3 for a composting operation;
  - Construct aggregate haul road to TP-3 area;
  - Remove MSW on 5-acre area near Transfer Station;
  - Alternative 3A grades minimal excavated MSW on Teton County property and remainder of MSW disposed at off-site landfill;
  - Alternative 3B all MSW removed from 5-acrea area is regraded on Teton County and and USFS properties;
  - Regrade subgrade surface on County property by reshaping MSW and using stockpiled soil on property to allow for continued solid waste management activities;
  - Place gas collection layer and gas vents, PVC liner, drainage layer, vegetation support layer and topsoil, and revegetate to form final cap system;
  - Provide double-lined cap area for MSW management activities on capped area 2-acre area of Teton County property near Transfer Station;
  - Control surface water by installing armored channels along the east and southwest portions of the landfill perimeter to collect runoff from the final cap and convey it to the southwest boundary of the Site; and
  - Incorporate a revised groundwater and landfill gas monitoring program into post-closure activities. This is necessary because there is evidence that contaminants may have migrated from the MSW into groundwater, and also because MSW will remain in-place and continue to generate landfill gas.

Figures 4, 5A, 5B, 6A and 6B provide the conceptual grading plans for Alternatives 1, 2A, 2B, 3A and 3B, respectively. Final cap grades for Alternatives 2A, 2B, 3A and 3B have been maintained in the 10% to 25% range. These grades will minimize earthworks since the existing grades at the Landfill are in this range. Grades near the southern waste face will be steeper and carefully selected and engineered to withstand seismic loadings. A minimum of 3 feet of fill will maintained above the geomembrane in all areas, and 4 feet will be maintained in areas where solid waste management activities will be conducted on top of the cap during the post-closure period. Conceptual details for the cap design for Alternatives 2A, 2B, 3A and 3B, and for the stormwater channels for all alternatives, are provided on Figure 8. The conceptual grades and stormwater channels have been designed to be sufficient to control stormwater in compliance with WDEQ Chapter 2, Section 4 regulations, which require the 100-year, 24 hour storm event to be controlled so as not to damage the permanent final cap. The grading plans, cap designs and stormwater improvements as appropriate will be refined during final design for the selected alternative, but are provided herein at the conceptual level to form a basis for alternative comparison and development of budgetary cost estimates. It is assumed that stormwater will continue to be retained on the north side of Highway 76/89/189/191. Appendix B presents the draft Work Plan for the Nature and Extent investigation, including recommended locations for additional landfill gas and groundwater monitoring points, which are also shown on Figure 7.

The estimated capital costs to implement Alternatives 1, 2A, 2B, 3A and 3B are provided in Tables 2, 3A, 3B, 4A and 4B, respectively. The costs were developed for the approximate areas and volumes summarized in Table 1. There are several key assumptions that were made to develop the budget-level cost estimates; these include:

- The MSW and earthmoving volumes are based upon the data available and concept-level quantities described in Section 2.0 and Table 1 of this report. Actual volumes could change considerably during final design and construction. In particular, the volumes of MSW for removal are subject to significant uncertainty due to an irregular “bottom of MSW” surface and a limited number of data points.

- Major elements of the various alternatives (cap design, passive gas system, grading plans, stormwater controls, groundwater monitoring) were developed at a conceptual level sufficient to show that the alternatives would be feasible and to develop cost estimates for alternative comparison and budgeting purposes. The grading plans, cap design, and stormwater controls were developed consistent with similar capping projects conducted in Wyoming and neighboring states. It should be noted that one of the largest cost components for capping Alternatives 2A, 2B, 3A and 3B is importing the sand for gas collection and drainage layers in the cap. We believe that, through additional design and value-engineering, it may be possible to reduce the thickness of these layers and/or replace part or all of the layers with other materials (i.e., shredded tires, crushed concrete or geosynthetic drainage layers) that could reduce the estimated cost for these cap components.

- Unit costs for the cost estimates were obtained from recent comparable projects (i.e., City of Casper), estimates from local contractors, vendors and professional judgment. These unit costs are subject to fluctuations in the construction market and thus could change by the time the County is ready to commence construction.

- It is assumed that at least 4 feet of soil cover must be placed over the PVC liner in any area where solid waste management activities (i.e., stockpiling, composting, etc.) are to occur during post-closure. Additionally, Alternatives 2A, 2B, 3A and 3B included 2-acre areas that have a double-liner in the cap.

- Removal of existing recycling areas would be coordinated with existing vendors so that these areas could be removed just prior to construction and thus avoid incurring removal or relocation costs as a part of the construction contract. While there would be costs associated with moving the composting operation to a new location (either on USFS property or near TP-3), these costs would be relatively equal between all three alternatives and therefore have not been factored in to the capital cost estimates.

4.0 ALTERNATIVES EVALUATION

Each of the three alternatives developed is feasible to implement and will meet the requirements of the WDEQ for closure, USFS requirements and will allow continued use of the Site for solid waste management activities as described above. Each alternative has advantages and disadvantages as summarized in Table 5. The most significant disadvantage of the "total MSW removal" alternative (Alternative 1) is capital cost. The capital cost of this alternative is significantly higher than that of either of the two predominantly capping alternatives (Alternatives 2A, 2B, 3A and 3B), as summarized below:

- Alternative 1 - $49,207,000
- Alternative 2A - $ 13,268,000
- Alternative 2B - $ 9,291,000
- Alternative 3A - $ 21,917,000
- Alternative 3B - $ 9,800,000

While the long-term monitoring for landfill gas and operation and maintenance (O & M) for the capping alternatives would provide some additional ongoing cost (estimated to be about $5,000 per year), these costs are relatively insignificant compared to the capital cost associated with total MSW removal. As noted in Table 5, the most significant component of ongoing monitoring and O & M is groundwater monitoring and this would need to be continued for Alternative 1 since there is evidence that removing MSW will not completely remove the source of the groundwater contaminants.

The largest cost component for total removal (Alternative 1) is the excavation, hauling and disposal of MSW. Also, there is considerable cost uncertainty with this alternative as: 1) waste volumes and densities may deviate from initial estimates, and 2) there is potential to encounter special wastes (e.g., asbestos-containing material) and/or hazardous waste (e.g., drums with hazardous liquids, polychlorinated biphenyls (PCBs), lead-based paint) that would require more expensive handling, shipment and disposal. Thus, the costs for this alternative are more likely to increase compared to the mostly capping alternatives as they are not subject to the level of cost uncertainties associated with waste volumes and material types.

The largest cost component for the capping alternatives (Alternatives 2A, 2B, 3A and 3B) is the importation of sand for the drainage and gas collection layers in the cap. These alternatives also involve some more limited MSW removal. The cost for regrading the MSW on Teton County and USFS property (Alternatives 2B and 3B) is significantly less than hauling and disposing of some MSW off-site. Alternatives 2A and 3A require hauling some MSW offsite because there is not enough space to grade only on Teton County property. As mentioned above, we believe that there are substantial opportunities for cost savings for capping alternatives by further evaluating the necessary flow capacity and thickness of the two sand layers, and considering alternative materials that could be less expensive. This would be a major focus of detailed design efforts for the capping alternatives.

The capping alternatives have the disadvantage of limiting the future activities that may be conducted on top of the landfill as compared to the total removal alternative. Specifically, building construction on top of the cap in MSW areas would be problematic because of the likelihood of differential settlement and the potential for accumulation of landfill gas. Therefore, from a practical standpoint, it is considered that activities conducted on top of Landfill areas could include open air composting, material processing and storage, etc., but would not include location of a building for an indoor composting operation or a new transfer station. In this respect, Alternatives 2A, 3A and 3B are considered more flexible than 2B, because the option for an indoor composting operation in the area of TP-3 and areas where waste is being removed would still be available since they would not be in a Landfill area.

The capping alternatives also would require ongoing control and removal of landfill gas from beneath the final cap. The reasons for this are threefold:

- Prevent uplift on the geomembrane in the cap;
- Control the lateral movement of landfill gas; and
- Minimize any future impacts to groundwater.

Based upon the age of the MSW in the Landfill, the conceptual designs for Alternatives 2A, 2B, 3A and 3B include passive venting for landfill gas. The age of the MSW is an important variable, as older MSW tends to exhibit lower gas generation rates. The gas vents would need to be spaced on an approximate 200-foot grid based upon our experience at comparable sites. These gas vents are a disadvantage in that they will need to be sited to minimize disruption to other activities and will require repair if damaged. There is also the potential that part or all of the landfill gas venting system may have to be converted to an active collection system (i.e., landfill gas wells connected to a blower and flare to induce more flow from the system) to control landfill gas, if future landfill gas monitoring results indicate that landfill gas concentrations exceed WDEQ standards (25% of the lower explosive limit (LEL)) at the facility boundaries.

Another disadvantage of the capping alternatives is the presence of a fault (Hoback Fault) that transects the Landfill. The fault is classified as Class B by the United States Geological Survey (USGS) and has not experienced significant movement in recent geologic time. However, the fault is of significance in two regards:

- It's presence in such close proximity to the Site could produce significant horizontal accelerations should a seismic event occur; therefore, the cap needs to be designed to withstand these forces; and
- If significant displacement occurred along the fault where it transects the Landfill, it could cause tensile stresses in the geomembrane in the cap that could rupture the geomembrane.

Golder evaluated the loadings on the cap should a seismic event occur, and concluded that the cap configurations being considered, particularly with slopes in the 10% to 25% range, would be stable for a seismic event that has a 2% probability of occurring every 50 years, which is the standard recurrence interval for solid waste facility seismic design in the United States (USGS, 2008). The highest slopes will be evaluated and refined as necessary during final design. We have also concluded that the fault has an extremely low probability of exhibiting significant displacement during the post-closure period (a minimum of 30 years to comply with WDEQ regulations, but could extend beyond that depending upon landfill gas and groundwater monitoring data) (see write-up in Appendix C). Further, any necessary repairs to the geomembrane and cap associated with fault displacement would be relatively straightforward to conduct since the geomembrane is only covered with 3 feet to 4 feet of soil, and these repairs could be observed/inspected as part of post-closure monitoring activities. The costs for making such repairs are relatively small compared to the costs associated with Alternative 1, and therefore, given the unlikelihood of this scenario, capping alternatives are considered viable alternatives for the Site.

5.0 CONCLUSIONS

Golder has developed five concept-level closure alternatives for the County Landfill. An evaluation of the alternatives indicates that all five are feasible to implement and that there are distinct advantages and disadvantages for each alternative, particularly for the total removal alternative (Alternative 1) compared to the primarily capping alternatives (Alternatives 2A, 2B, 3A and 3B). While the capping alternatives present some limitations for future use of the Landfill areas after closure, along with some additional monitoring and potential maintenance requirements (largely for landfill gas), the capital cost of the capping alternatives is significantly less than that of total removal. While Alternatives 2A, 2B, 3A, and 3B involve some MSW removal, the costs can be substantially controlled if the MSW can be regraded on-site (Alternatives 2B and 3B). Our opinion is that the issues associated with long-term maintenance of the caps and additional monitoring are relatively straightforward to address and can be conducted at far less cost than the total removal alternative. Also, there are potential opportunities for cost savings on the capping alternatives that have yet to be explored (e.g., through the use of alternative materials) that could make these alternatives even more attractive.

If you have questions or comments on this evaluation, feel free to contact the undersigned at 303-980-0540.

Sincerely,

GOLDER ASSOCIATES INC.

Maureen Yaskanin, PE
Senior Consultant

Mark McClain, PE
Principal

MAY/MEM/kag

6.0 REFERENCES

United States Geological Survey (USGS), Peak acceleration (%g) with 2% probability of exceedance in 50 years, May 2008

TABLES

TABLE 1

SUMMARY OF ESTIMATED AREAS AND VOLUMES FOR TETON COUNTY LANDFILL CLOSURE ALTERNATIVES

Item	Quantity
Area of MSW for Capping	31.6 – 32.3 Acres
Volume of Existing Topsoil	25,000 CY
Volume of Existing Cover Soils (Excluding Topsoil)	144,000 CY
Volume of Existing MSW	764,000 CY

CONCEPTUAL COST ESTIMATE
TETON COUNTY LANDFILL CLOSURE ALTERNATIVE 1

Item	Total Quantity	Units	Unit Cost	Closure Cost
Mobilization/Demobilization General Contractor	1	LS	$ 200,000.00	$ 200,000.00
Survey	1	LS	$ 70,000.00	$ 70,000.00
Strip topsoil and stockpile	25,000	CY	$ 3.50	$ 88,000.00
Excavate Clean Soil from Cover and Stockpile	144,000	CY	$ 3.50	$ 504,000.00
Excavate and Load Existing MSW	558,000	Ton	$ 1.40	$ 781,000.00
MSW Waste Hauling and Disposal[5]	558,000	Ton	$ 64.00	$ 35,712,000.00
Excavate and Load Existing MSW, 10% Contingency	55,800	Ton	$ 1.40	$ 78,000.00
MSW Waste Hauling and Disposal, 10% Contingency	55,800	Ton	$ 64.00	$ 3,571,000.00
Regrade Area near TP-3	109,000	CY	$ 4.25	$ 463,000.00
Regrade Road to TP-3 Area	13,400	CY	$ 2.50	$ 34,000.00
Road Base for Road to TP-3 Area	1	LS	$ 13,000.00	$ 13,000.00
Regrade Site with On-site Clean Borrow	253,000	CY	$ 3.50	$ 886,000.00
Apply stockpiled topsoil	25,000	CY	$ 3.50	$ 88,000.00
Stormwater Channel (rip-rap)	4,040	LF	$ 15.40	$ 62,000.00
Seed/Mulch/Fertilize	32	AC	$ 2,000.00	$ 64,000.00
CM and Engineering	1	LS	$ 175,000.00	$ 175,000.00
Subtotal				**$ 42,789,000.00**
Contingency (15%)				**$ 6,418,000.00**
Total				**$ 49,207,000.00**

Notes

1. Unit cost from local contractors, vendors, recent projects and professional judgment
2. 10% MSW Contingency for Volume and Density Uncertainty
3. Costs reflect a balance of cut and fill on-site.
4. 15% General Contingency for Unit Cost Variations, and Limits of Design Level
5. Bulk density of MSW assumed as 0.73 tons/cy (54 lbs/ft^3)

CONCEPTUAL COST ESTIMATE
TETON COUNTY LANDFILL CLOSURE ALTERNATIVE 2A

Item	Total Quantity	Units	Unit Cost	Closure Cost
Mobilization/Demobilization General Contractor	1	LS	$ 200,000.00	$ 200,000.00
Survey	1	LS	$ 90,000.00	$ 90,000.00
Strip Topsoil and Stockpile	25,000	CY	$ 3.50	$ 88,000.00
Excavate and Shape Existing Waste	21,000	CY	$ 1.50	$ 32,000.00
Excavate and Shape Existing Waste for Waste Management Areas	22,000	CY	$ 3.00	$ 66,000.00
Road Base for Road to Waste Management Areas	1	LS	$ 51,500.00	$ 52,000.00
Regrade area near TP-3	109,000	CY	$ 4.25	$ 463,000.00
Regrade Road to TP-3 area	13,400	CY	$ 2.50	$ 34,000.00
Road base for Road to TP-3 area	1	LS	$ 13,000.00	$ 13,000.00
Excavate and Load Existing MSW	45,300	Ton	$ 1.40	$ 63,000.00
MSW Hauling and Disposal[6]	45,300	Ton	$ 64.00	$ 2,899,000.00
Excavate and Load Existing MSW, 10% Contingency	4,530	Ton	$ 1.40	$ 6,000.00
MSW Waste Hauling and Disposal, 10% Contingency	4,530	Ton	$ 64.00	$ 290,000.00
Excavate Clean Borrow Soil from Cover	144,000	CY	$ 3.50	$ 504,000.00
PVC Geomembrane (40-mil) Installed	1,302,000	SF	$ 0.65	$ 846,000.00
Secondary PVC Geomembrane (40-mil) Installed on 2-Acre Waste Management Area	87,120	SF	$ 0.65	$ 57,000.00
Gas Collection Layer	43,800	CY	$ 55.00	$ 2,409,000.00
Clean Sand Drainage Layer (top offsite)	43,800	CY	$ 55.00	$ 2,409,000.00
Vegetation Support and General Fill Layer	144,000	CY	$ 3.50	$ 504,000.00
Stormwater Channel (rip-rap)	4,040	LF	$ 15.40	$ 62,000.00
Seed/Mulch/Fertilize	30	AC	$ 2,000.00	$ 60,000.00
Passive Gas Vents	32	EA	$ 1,000.00	$ 32,000.00
Apply Stockpiled Topsoil	25,000	CY	$ 3.50	$ 88,000.00
Electrical Leak Location Survey	30	AC	$ 1,500.00	$ 45,000.00
CM, CQA, and Engineering	1	LS	$ 225,000.00	$ 225,000.00
Subtotal				**$ 11,537,000.00**
Contingency (15%)				**$ 1,731,000.00**
Total				**$ 13,268,000.00**

Notes

1. Unit cost from local contractors, vendors, recent projects and professional judgment
2. Costs reflect a balance of cut and fill on-site.
3. Clean sand drainage layer thickness is assumed to be 1.0 feet.
4. Vegetative support layer thickness is assumed to be 2.0 feet, except 3.0 feet in activity areas.
5. 15% General Contingency for Unit Cost Variations, and Limits of Design Level
6. Bulk density of MSW assumed as 0.73 tons/cy (54 lbs/ft^3)

CONCEPTUAL COST ESTIMATE
TETON COUNTY LANDFILL CLOSURE ALTERNATIVE 2B

Item	Total Quantity	Units	Unit Cost	Closure Cost
Mobilization/Demobilization General Contractor	1	LS	$ 200,000.00	$ 200,000.00
Survey	1	LS	$ 90,000.00	$ 90,000.00
Strip Topsoil and Stockpile	25,000	CY	$ 3.50	$ 88,000.00
Excavate and Shape Existing Waste	104,000	CY	$ 1.50	$ 156,000.00
Excavate and Shape Existing Waste for Waste Management Areas	84,000	CY	$ 3.00	$ 252,000.00
Road Base for Road to Waste Management Areas	1	LS	$ 51,500.00	$ 52,000.00
Excavate Clean Borrow Soil from Cover	144,000	CY	$ 3.50	$ 504,000.00
PVC Geomembrane (40-mil) Installed	1,302,000	SF	$ 0.65	$ 846,000.00
Secondary PVC Geomembrane (40-mil) Installed on 2-Acre Waste Management Area	87,120	SF	$ 0.65	$ 57,000.00
Gas Collection Layer	43,800	CY	$ 55.00	$ 2,409,000.00
Clean Sand Drainage Layer (top offsite)	43,800	CY	$ 55.00	$ 2,409,000.00
Vegetation Support and General Fill Layer	144,000	CY	$ 3.50	$ 504,000.00
Stormwater Channel (rip-rap)	4,040	LF	$ 15.40	$ 62,000.00
Seed/Mulch/Fertilize	30	AC	$ 2,000.00	$ 60,000.00
Passive Gas Vents	32	EA	$ 1,000.00	$ 32,000.00
Apply Stockpiled Topsoil	25,000	CY	$ 3.50	$ 88,000.00
Electrical Leak Location Survey	30	AC	$ 1,500.00	$ 45,000.00
CM, CQA, and Engineering	1	LS	$ 225,000.00	$ 225,000.00
Subtotal				**$ 8,079,000.00**
Contingency (15%)				**$ 1,212,000.00**
Total				**$ 9,291,000.00**

Notes

1. Unit cost from local contractors, vendors, recent projects and professional judgment
2. Costs reflect a balance of cut and fill on-site.
3. Clean sand drainage layer thickness is assumed to be 1.0 feet.
4. Vegetative support layer thickness is assumed to be 2.0 feet, except 3.0 feet in activity areas.
5. 15% General Contingency for Unit Cost Variations, and Limits of Design Level

CONCEPTUAL COST ESTIMATE
TETON COUNTY LANDFILL CLOSURE ALTERNATIVE 3A

Item	Total Quantity	Units	Unit Cost	Closure Cost
Mobilization/Demobilization General Contractor	1	LS	$ 200,000.00	$ 200,000.00
Survey	1	LS	$ 90,000.00	$ 90,000.00
Strip Topsoil and Stockpile	25,000	CY	$ 3.50	$ 88,000.00
Excavate and Shape Existing Waste	21,000	CY	$ 1.50	$ 32,000.00
Excavate and Shape Existing Waste for Waste Management Areas	2,000	CY	$ 3.00	$ 6,000.00
Road Base for Road to Waste Management Areas	1	LS	$ 51,500.00	$ 52,000.00
Excavate and Load Existing MSW	155,400	Ton	$ 1.40	$ 218,000.00
MSW Hauling and Disposal[7]	155,400	Ton	$ 64.00	$ 9,946,000.00
Excavate and Load Existing MSW, 10% Contingency	15,540	Ton	$ 1.40	$ 22,000.00
MSW Waste Hauling and Disposal, 10% Contingency	15,540	Ton	$ 64.00	$ 995,000.00
Excavate Clean Borrow Soil from Cover	144,000	CY	$ 3.50	$ 504,000.00
Regrade Area near TP-3	109,000	CY	$ 4.25	$ 463,000.00
Regrade Road to TP-3 Area	13,400	CY	$ 2.50	$ 34,000.00
Road Base for Road to TP-3 Area	1	LS	$ 13,000.00	$ 13,000.00
Gas Collection Layer	38,300	CY	$ 55.00	$ 2,107,000.00
PVC Geomembrane (40-mil) Installed	1,136,500	SF	$ 0.65	$ 739,000.00
Secondary PVC Geomembrane (40-mil) Installed on 2-Acre Waste Management Area	87,120	SF	$ 0.65	$ 57,000.00
Clean Sand Drainage Layer (top offsite)	38,300	CY	$ 55.00	$ 2,107,000.00
Vegetation Support and General Fill Layer	253,000	CY	$ 3.50	$ 886,000.00
Stormwater Channel (rip-rap)	4,040	LF	$ 15.40	$ 62,000.00
Seed/Mulch/Fertilize	27	AC	$ 2,000.00	$ 54,000.00
Passive Gas Vents	29	EA	$ 1,000.00	$ 29,000.00
Apply Stockpiled Topsoil	25,000	CY	$ 3.50	$ 88,000.00
Electrical Leak Location Survey	27	AC	$ 1,500.00	$ 41,000.00
CM, CQA, and Engineering	1	LS	$ 225,000.00	$ 225,000.00
Subtotal				**$ 19,058,000.00**
Contingency (15%)				**$ 2,859,000.00**
Total				**$ 21,917,000.00**

Notes

1. Unit cost from local contractors, vendors, recent projects and professional judgment

2. Costs reflect a balance of cut and fill on-site.
3. Clean sand drainage layer thickness is assumed to be 1.0 feet.
4. Vegetative support layer thickness is assumed to be 2.0 feet, except 3.0 feet in activity areas.
5. 15% General Contingency for Unit Cost Variations, and Limits of Design Level
6. Food waste composting area is assumed to be 2 acres and waste beneath the area will be removed and placed on existing landfill before construction of the facility.
7. Bulk density of MSW assumed as 0.73 tons/cy (54 lbs/ft^3)

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CONCEPTUAL COST ESTIMATE
TETON COUNTY LANDFILL CLOSURE ALTERNATIVE 3B

Item	Total Quantity	Units	Unit Cost	Closure Cost
Mobilization/Demobilization General Contractor	1	LS	$ 200,000.00	$ 200,000.00
Survey	1	LS	$ 90,000.00	$ 90,000.00
Strip Topsoil and Stockpile	25,000	CY	$ 3.50	$ 88,000.00
Excavate and Shape Existing Waste	21,000	CY	$ 1.50	$ 32,000.00
Excavate and Shape Existing Waste for Waste Management Areas	212,900	CY	$ 3.00	$ 639,000.00
Road Base for Road to Waste Management Areas	1	LS	$ 51,500.00	$ 52,000.00
Excavate Clean Borrow Soil from Cover	144,000	CY	$ 3.50	$ 504,000.00
Regrade Area near TP-3	109,000	CY	$ 4.25	$ 463,000.00
Regrade Road to TP-3 Area	13,400	CY	$ 2.50	$ 34,000.00
Road Base for Road to TP-3 Area	1	LS	$ 13,000.00	$ 13,000.00
Gas Collection Layer	38,300	CY	$ 55.00	$ 2,107,000.00
PVC Geomembrane (40-mil) Installed	1,136,500	SF	$ 0.65	$ 739,000.00
Secondary PVC Geomembrane (40-mil) Installed on 2-Acre Waste Management Area	87,120	SF	$ 0.65	$ 57,000.00
Clean Sand Drainage Layer (top offsite)	38,300	CY	$ 55.00	$ 2,107,000.00
Vegetation Support and General Fill Layer	253,000	CY	$ 3.50	$ 886,000.00
Stormwater Channel (rip-rap)	4,800	LF	$ 15.40	$ 74,000.00
Seed/Mulch/Fertilize	27	AC	$ 2,000.00	$ 54,000.00
Passive Gas Vents	29	EA	$ 1,000.00	$ 29,000.00
Apply Stockpiled Topsoil	25,000	CY	$ 3.50	$ 88,000.00
Electrical Leak Location Survey	27	AC	$ 1,500.00	$ 41,000.00
CM, CQA, and Engineering	1	LS	$ 225,000.00	$ 225,000.00
Subtotal				**$ 8,522,000.00**
Contingency (15%)				**$ 1,278,000.00**
Total				**$ 9,800,000.00**

Notes
1. Unit cost from local contractors, vendors, recent projects and professional judgment
2. Costs reflect a balance of cut and fill on-site.
3. Clean sand drainage layer thickness is assumed to be 1.0 feet.
4. Vegetative support layer thickness is assumed to be 2.0 feet, except 3.0 feet in activity areas.
5. 15% General Contingency for Unit Cost Variations, and Limits of Design Level
6. Food waste composting area is assumed to be 2 acres and waste beneath the area will be removed and placed on existing landfill before construction of the facility.

SUMMARY OF ADVANTAGES AND DISADVANTAGES OF CONCEPTUAL CLOSURE ALTERNATIVES
TETON COUNTY LANDFILL, TETON COUNTY, WYOMING

Alternatives	Advantages	Disadvantages
Alternative 1 (Total MSW Removal)		
■ Remove the MSW from County and USFS property and dispose at another permitted landfill. ■ Regrade to return USFS area to "natural" grades, and allow for continued solid waste management activities on County property. ■ Regrade area near TP-3 to allow for composting. Control stormwater and continue to monitor groundwater. ■ Revegetate areas on USFS and County property as appropriate.	■ Would reduce environmental liability at the current site. ■ Would allow unlimited activities to be conducted on County property (i.e. buildings for composting, recycling, etc.). ■ Would not require ongoing landfill gas monitoring as source of landfill gas would be removed. ■ Ongoing O & M costs (no cover maintenance, landfill gas monitoring) would be less than capping alternatives. ■ Would remove original source of groundwater contamination	■ Capital cost very high, significantly higher than capping alternatives. ■ High cost uncertainty due to uncertainty in waste volumes and the potential for special/hazardous wastes (with higher handling and disposal fees) to be excavated. ■ Higher potential environmental liability at receiving landfill site. ■ Would require continued groundwater monitoring.

SUMMARY OF ADVANTAGES AND DISADVANTAGES OF CONCEPTUAL CLOSURE ALTERNATIVES
TETON COUNTY LANDFILL, TETON COUNTY, WYOMING

Alternatives	Advantages	Disadvantages
Alternatives 2A and 2B (Capping; Composting on USFS Property or near TP-3)		
■ Strip existing cover, regrade and provide new cap on top of MSW on both County and NFS property. ■ Regrade area on USFS Property of near TP-3 to allow for composting. ■ Regrade County property as needed for continued solid waste management activities. ■ Control landfill gas using passive vents and monitor at boundary of site. ■ Control stormwater and continue to monitor groundwater. ■ Revegetate cap areas on USFS and County property as appropriate. ■ Creates 2-acre MSW free area near Transfer Station ■ Provide 2-acre double-lined cap area for MSW management activities near Transfer Station ■ Alternative 2A hauls off excess MSW, Alternative 2B grades on-site	■ Capital cost low compared to total MSW removal alternative. ■ Would allow for current solid waste management activities to continue on top of cap. ■ The geomembrane liner in cap would limit infiltration of precipitation and ongoing sources of groundwater contamination. ■ Less disruption to site activities than total MSW removal alternative. ■ Grades for final cap are in the 10% to 25% range and provide for stable cap conditions and low erosion potential ■ Alternative 2B cost-effective as regrading would be allowed on USFS property. ■ Composting in the area of TP-3 could be conducted in an enclosed building (Alternative 2A) with minimal concern for settlement and landfill gas accumulation.	■ Higher potential liability at current site. ■ In the unlikely event of significant displacement along the Hoback fault during post-closure, the geomembrane in the cap might require repair. ■ Will require ongoing landfill gas and groundwater monitoring. Depending on effectiveness of passive landfill gas venting system, some active landfill gas removal may be necessary. ■ O & M costs associated with landfill gas monitoring and maintenance of cap would be higher than for total MSW removal alternative. ■ Activities on top of cap requiring an enclosed building would be precluded. ■ Would provide less space for unrestricted activities compared to Alternatives 3A and 3B.

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SUMMARY OF ADVANTAGES AND DISADVANTAGES OF CONCEPTUAL CLOSURE ALTERNATIVES
TETON COUNTY LANDFILL, TETON COUNTY, WYOMING

Alternatives	Advantages	Disadvantages
Alternatives 3A and 3B-(Capping; Composting Near TP-3)		
■ Strip existing cover, regrade and provide new cap on top of MSW on both County and USFS property. ■ Regrade area near TP-3 to allow for composting and other solid waste management activities. ■ Regrade County property as needed for capping. ■ Control landfill gas using passive vents and monitor at boundary of site. ■ Control stormwater and continue to monitor groundwater. ■ Revegetate cap areas on NFS and County property as appropriate. ■ Regrade and remove waste to allow an approximately 5-acre area near Transfer Station to be MSW free to allow for solid waste activities. ■ Provide a double-liner cap in an approximate 2-acre capped area to allow for passive waste management activities such as stockpiling near Transfer Station. ■ Alternative 3A hauls off excess MSW, Alternative 3B regrades on-site.	■ Capital cost low compared to total MSW removal alternative. ■ Would allow for current solid waste management activities to continue on top of cap. ■ The geomembrane liner in cap would limit infiltration of precipitation and ongoing sources of groundwater contamination. ■ Less disruption to site activities than total MSW removal alternative. ■ Grades for final cap are in the 10% to 25% range and provide for stable cap conditions and low erosion potential ■ Composting in the area of TP-3 could be conducted in an enclosed building with minimal concern for settlement and landfill gas accumulation. ■ Creates more space for unrestricted activities (buildings, composting).	■ Higher potential liability at current site. ■ In the unlikely event of significant displacement along the Hoback fault during post-closure, the geomembrane in the cap might require repair. ■ Will require ongoing landfill gas and groundwater monitoring. Depending on effectiveness of passive landfill gas venting system, some active landfill gas removal may be necessary. ■ O & M costs associated with landfill gas monitoring and maintenance of cap would be higher than for total MSW removal alternative. ■ Activities on top of cap requiring an enclosed building would be precluded. ■ Higher slopes for cap near southern end of property. ■ Alternative 3A high cost if grading not allowed on USFS property.

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FIGURES

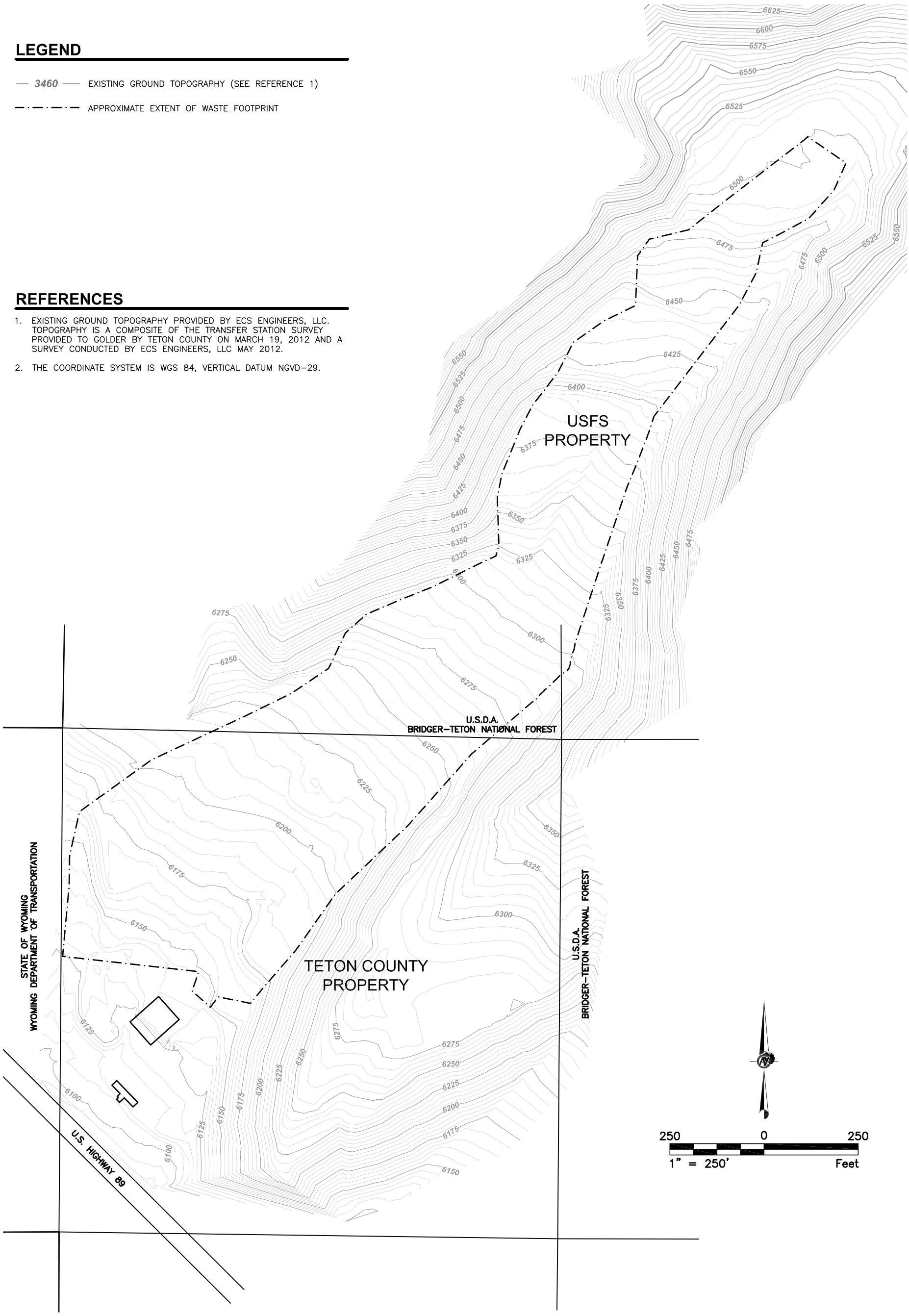
LEGEND

— 3460 — EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)

APPROXIMATE EXTENT OF WASTE FOOTPRINT

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY ECS ENGINEERS, LLC. TOPOGRAPHY IS A COMPOSITE OF THE TRANSFER STATION SURVEY PROVIDED TO GOLDER BY TETON COUNTY ON MARCH 19, 2012 AND A SURVEY CONDUCTED BY ECS ENGINEERS, LLC MAY 2012.
2. THE COORDINATE SYSTEM IS WGS 84, VERTICAL DATUM NGVD–29.



PROJECT
TETON COUNTY LANDFILL
CLOSURE ALTERNATIVES EVALUATION
JACKSON, WYOMING

TITLE
EXISTING CONDITIONS

Golder Associates

PROJECT No. 123–81604	FILE No. 12381604A007
TETON COUNTY	SCALE AS SHOWN / REV. A

FIGURE 1

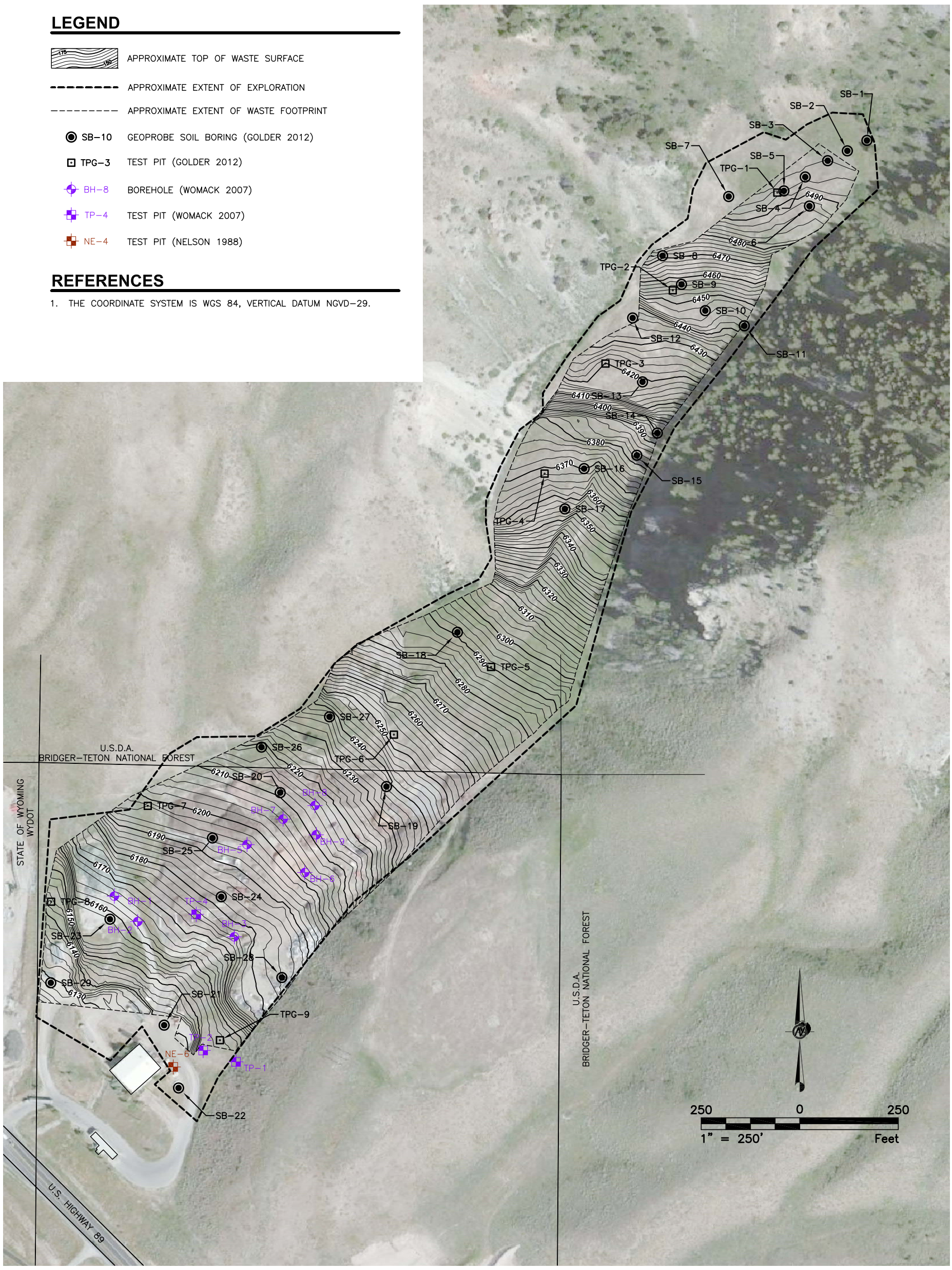
Drawing File: N:\12\123-81604_B Report\ 12381604B007.dwg | Layout: 11x17 Portrait | Modified: Jul 23, 2012 15:56 jparisi | Plotted: 08/20/12 10:40am jparisi

LEGEND

- APPROXIMATE TOP OF WASTE SURFACE
- APPROXIMATE EXTENT OF EXPLORATION
- APPROXIMATE EXTENT OF WASTE FOOTPRINT
- SB–10 GEOPROBE SOIL BORING (GOLDER 2012)
- TPG–3 TEST PIT (GOLDER 2012)
- BH–8 BOREHOLE (WOMACK 2007)
- TP–4 TEST PIT (WOMACK 2007)
- NE–4 TEST PIT (NELSON 1988)

REFERENCES

1. THE COORDINATE SYSTEM IS WGS 84, VERTICAL DATUM NGVD–29.



PROJECT	TETON COUNTY LANDFILL CLOSURE ALTERNATIVES EVALUATION JACKSON, WYOMING
TITLE	**APPROXIMATE TOP OF WASTE SURFACE**

Golder Associates

TETON COUNTY

PROJECT No.	123–81604	FILE No.	12381604B013
SCALE	AS SHOWN	REV.	A

FIGURE 2

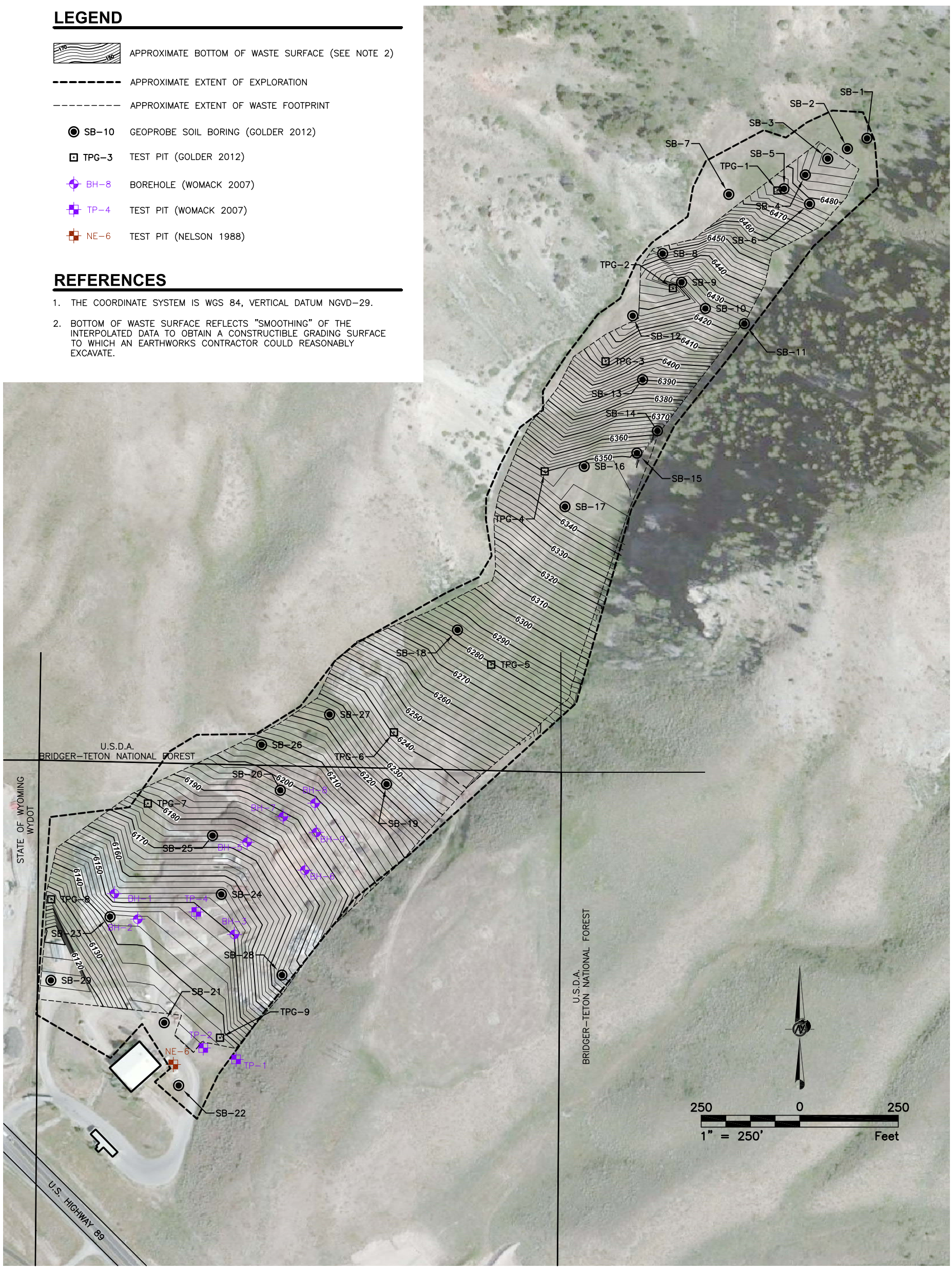
Drawing File: N:\12\123-81604_B Report\ 12381604B013.dwg | Layout: 11x17 Portrait | Modified: Jul 23, 2012 15:57 jparisi | Plotted: 08/20/12 10:36am jparisi

LEGEND

- APPROXIMATE BOTTOM OF WASTE SURFACE (SEE NOTE 2)
- APPROXIMATE EXTENT OF EXPLORATION
- APPROXIMATE EXTENT OF WASTE FOOTPRINT
- SB-10 GEOPROBE SOIL BORING (GOLDER 2012)
- TPG-3 TEST PIT (GOLDER 2012)
- BH-8 BOREHOLE (WOMACK 2007)
- TP-4 TEST PIT (WOMACK 2007)
- NE-6 TEST PIT (NELSON 1988)

REFERENCES

1. THE COORDINATE SYSTEM IS WGS 84, VERTICAL DATUM NGVD-29.
2. BOTTOM OF WASTE SURFACE REFLECTS "SMOOTHING" OF THE INTERPOLATED DATA TO OBTAIN A CONSTRUCTIBLE GRADING SURFACE TO WHICH AN EARTHWORKS CONTRACTOR COULD REASONABLY EXCAVATE.



PROJECT	TETON COUNTY LANDFILL CLOSURE ALTERNATIVES EVALUATION JACKSON, WYOMING
TITLE	**APPROXIMATE BOTTOM OF WASTE SURFACE**
Golder Associates	PROJECT No. 123-81604 · FILE No. 12381604B012 · SCALE AS SHOWN · REV. A · TETON COUNTY · **FIGURE 3**

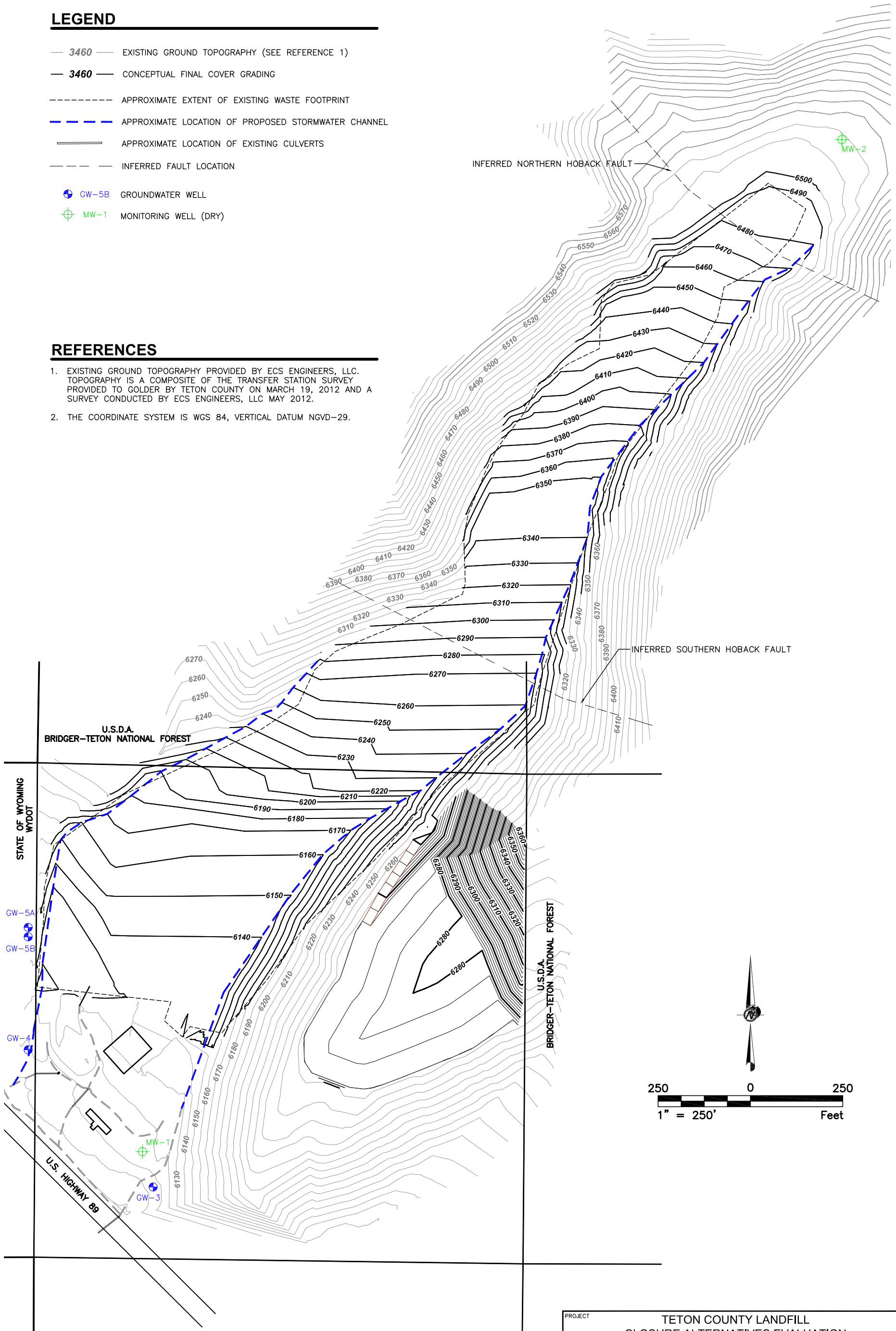
Drawing File: N:\12\123-81604_B Report\ 12381604B012.dwg | Layout: 11x17 Portrait | Modified: Jul 23, 2012 15:59 jparisi | Plotted: 08/20/12 10:37am jparisi

LEGEND

- 3460 — EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- 3460 — CONCEPTUAL FINAL COVER GRADING
- APPROXIMATE EXTENT OF EXISTING WASTE FOOTPRINT
- APPROXIMATE LOCATION OF PROPOSED STORMWATER CHANNEL
- APPROXIMATE LOCATION OF EXISTING CULVERTS
- INFERRED FAULT LOCATION
- GW-5B GROUNDWATER WELL
- MW-1 MONITORING WELL (DRY)

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY ECS ENGINEERS, LLC. TOPOGRAPHY IS A COMPOSITE OF THE TRANSFER STATION SURVEY PROVIDED TO GOLDER BY TETON COUNTY ON MARCH 19, 2012 AND A SURVEY CONDUCTED BY ECS ENGINEERS, LLC MAY 2012.
2. THE COORDINATE SYSTEM IS WGS 84, VERTICAL DATUM NGVD-29.



PROJECT
TETON COUNTY LANDFILL
CLOSURE ALTERNATIVES EVALUATION
JACKSON, WYOMING

TITLE
CONCEPTUAL FINAL GRADING PLAN ALTERNATIVE 1

Golder Associates

PROJECT No. 123-81604	FILE No. 12381604B008
TETON COUNTY	SCALE AS SHOWN / REV. A

FIGURE 4

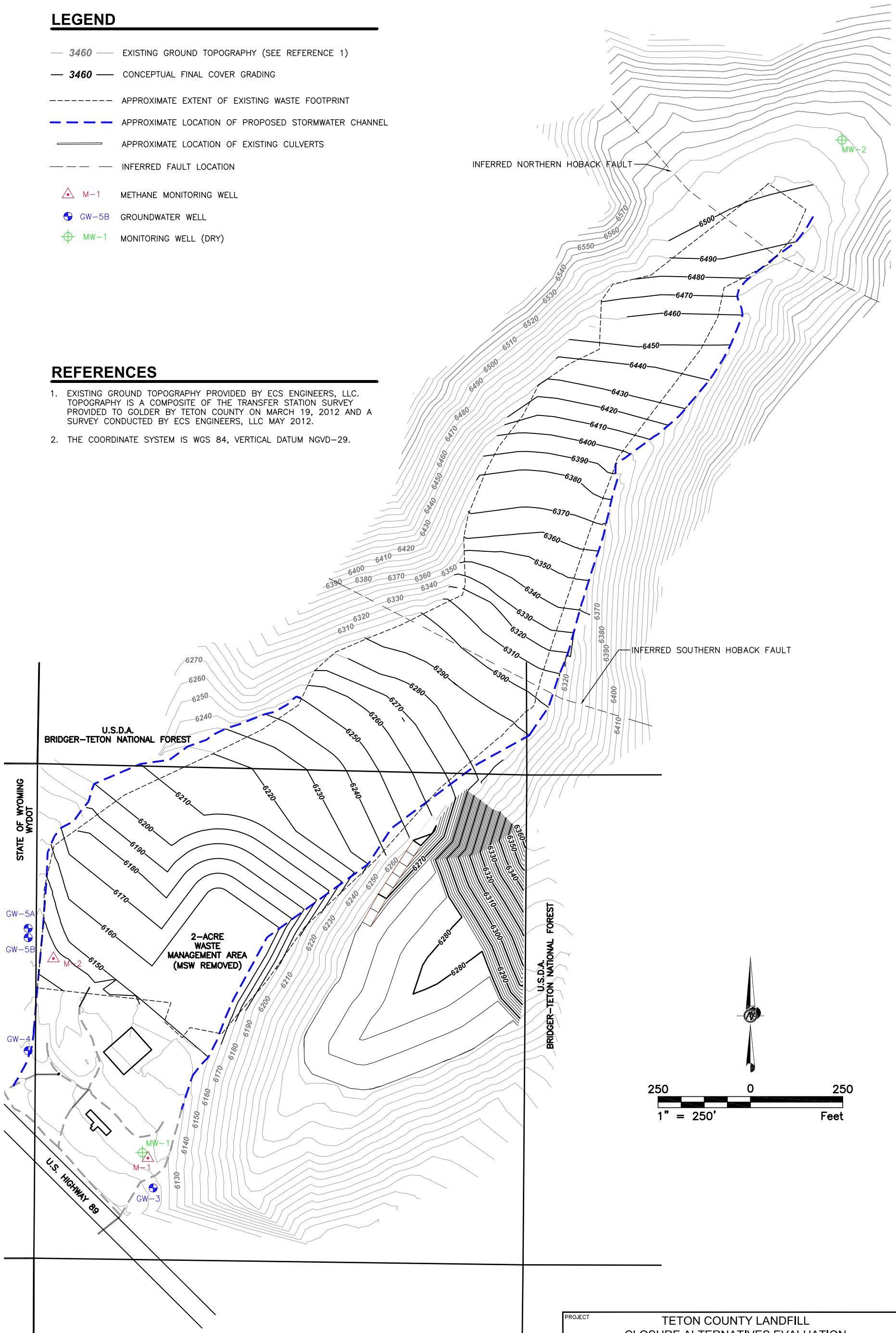
Drawing File: N:\12\123-81604_B Report\ 12381604B008.dwg | Layout: 11x17 Portrait | Modified: Aug 20, 2012 10:39 jporisi | Plotted: 08/20/12 10:39am jporisi

LEGEND

- 3460 — EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- **3460** — CONCEPTUAL FINAL COVER GRADING
- APPROXIMATE EXTENT OF EXISTING WASTE FOOTPRINT
- APPROXIMATE LOCATION OF PROPOSED STORMWATER CHANNEL
- APPROXIMATE LOCATION OF EXISTING CULVERTS
- INFERRED FAULT LOCATION
- M-1 METHANE MONITORING WELL
- GW-5B GROUNDWATER WELL
- MW-1 MONITORING WELL (DRY)

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY ECS ENGINEERS, LLC. TOPOGRAPHY IS A COMPOSITE OF THE TRANSFER STATION SURVEY PROVIDED TO GOLDER BY TETON COUNTY ON MARCH 19, 2012 AND A SURVEY CONDUCTED BY ECS ENGINEERS, LLC MAY 2012.
2. THE COORDINATE SYSTEM IS WGS 84, VERTICAL DATUM NGVD-29.



PROJECT
TETON COUNTY LANDFILL
CLOSURE ALTERNATIVES EVALUATION
JACKSON, WYOMING

TITLE
CONCEPTUAL FINAL GRADING PLAN
ALTERNATIVE 2A

Golder Associates

PROJECT No. 123-81604	FILE No. 12381604B016
TETON COUNTY	SCALE AS SHOWN / REV. A

FIGURE 5A

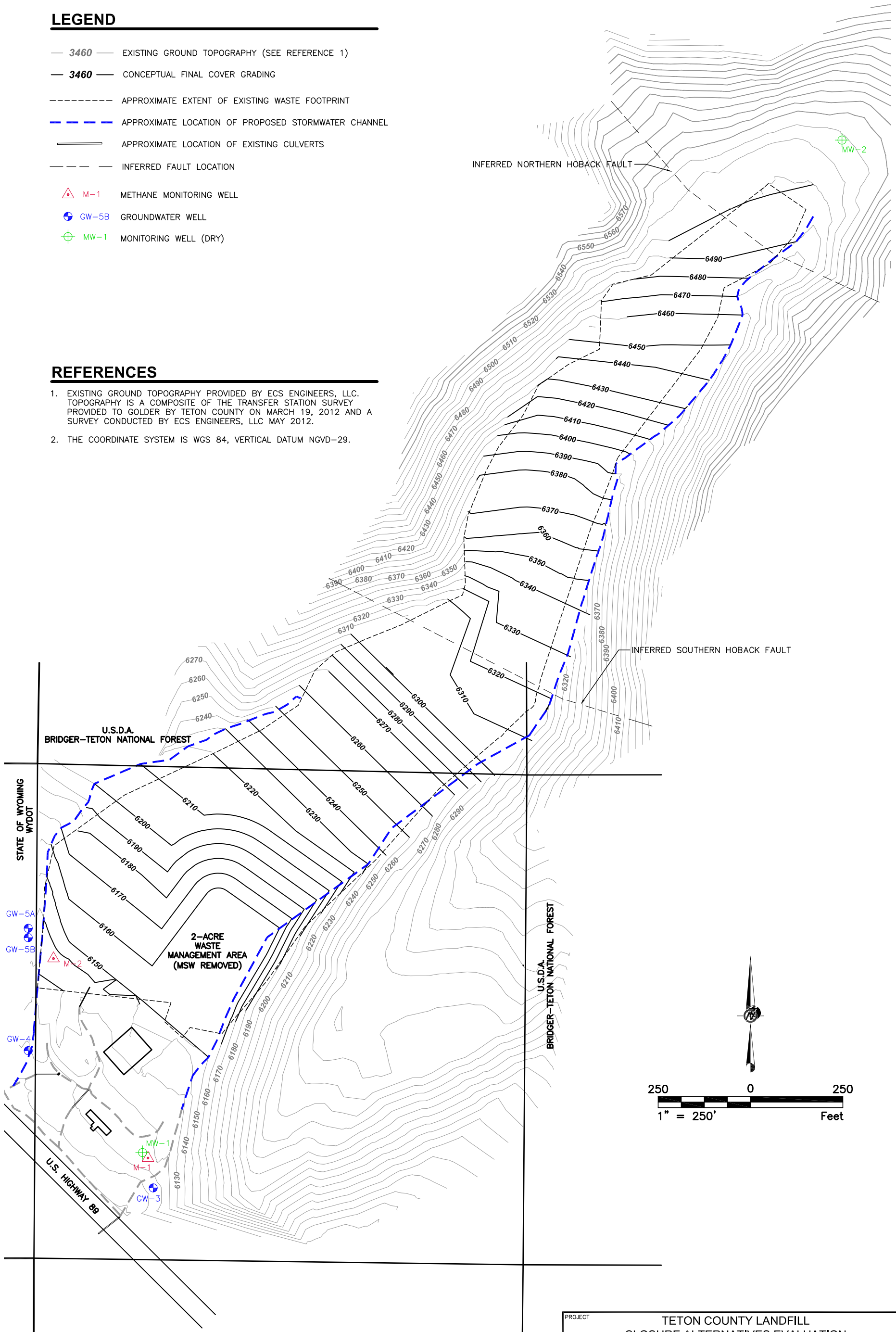
Drawing File: N:\12\123-81604_B Report\ 12381604B019.dwg | Layout: 11x17 Portrait | Modified: Aug 20, 2012 10:28 jparisi | Plotted: 08/20/12 10:29am jparisi

LEGEND

- 3460 — EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- **3460** — CONCEPTUAL FINAL COVER GRADING
- APPROXIMATE EXTENT OF EXISTING WASTE FOOTPRINT
- APPROXIMATE LOCATION OF PROPOSED STORMWATER CHANNEL
- APPROXIMATE LOCATION OF EXISTING CULVERTS
- INFERRED FAULT LOCATION
- M-1 METHANE MONITORING WELL
- GW-5B GROUNDWATER WELL
- MW-1 MONITORING WELL (DRY)

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY ECS ENGINEERS, LLC. TOPOGRAPHY IS A COMPOSITE OF THE TRANSFER STATION SURVEY PROVIDED TO GOLDER BY TETON COUNTY ON MARCH 19, 2012 AND A SURVEY CONDUCTED BY ECS ENGINEERS, LLC MAY 2012.
2. THE COORDINATE SYSTEM IS WGS 84, VERTICAL DATUM NGVD-29.



PROJECT
TETON COUNTY LANDFILL
CLOSURE ALTERNATIVES EVALUATION
JACKSON, WYOMING

TITLE
CONCEPTUAL FINAL GRADING PLAN ALTERNATIVE 2B

Golder Associates

PROJECT No. 123-81604 | FILE No. 12381604B018
SCALE AS SHOWN | REV. A

TETON COUNTY

FIGURE 5B

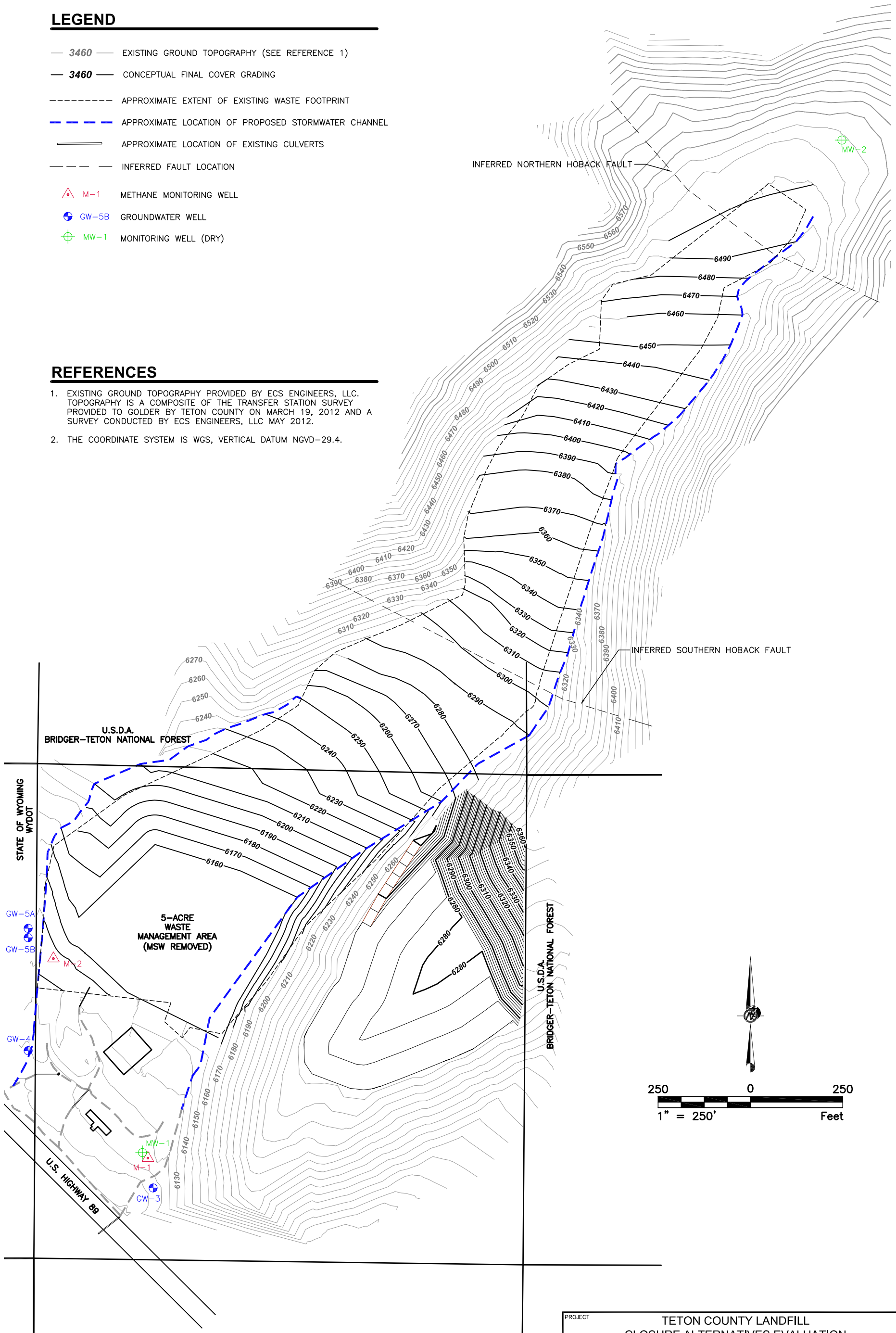
Drawing File: N:\12\123-81604_B Report\ 12381604B018.dwg | Layout: 11x17 Portrait | Modified: Jul 24, 2012 10:04 jparisi | Plotted: 08/20/12 10:32am jparisi

LEGEND

- 3460 — EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- **3460** — CONCEPTUAL FINAL COVER GRADING
- APPROXIMATE EXTENT OF EXISTING WASTE FOOTPRINT
- APPROXIMATE LOCATION OF PROPOSED STORMWATER CHANNEL
- APPROXIMATE LOCATION OF EXISTING CULVERTS
- INFERRED FAULT LOCATION
- M-1 METHANE MONITORING WELL
- GW-5B GROUNDWATER WELL
- MW-1 MONITORING WELL (DRY)

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY ECS ENGINEERS, LLC. TOPOGRAPHY IS A COMPOSITE OF THE TRANSFER STATION SURVEY PROVIDED TO GOLDER BY TETON COUNTY ON MARCH 19, 2012 AND A SURVEY CONDUCTED BY ECS ENGINEERS, LLC MAY 2012.
2. THE COORDINATE SYSTEM IS WGS, VERTICAL DATUM NGVD-29.4.



PROJECT
TETON COUNTY LANDFILL
CLOSURE ALTERNATIVES EVALUATION
JACKSON, WYOMING

TITLE
CONCEPTUAL FINAL GRADING PLAN ALTERNATIVE 3A

Golder Associates

PROJECT No. 123-81604	FILE No. 12381604B015
TETON COUNTY	SCALE AS SHOWN / REV. A

FIGURE 6A

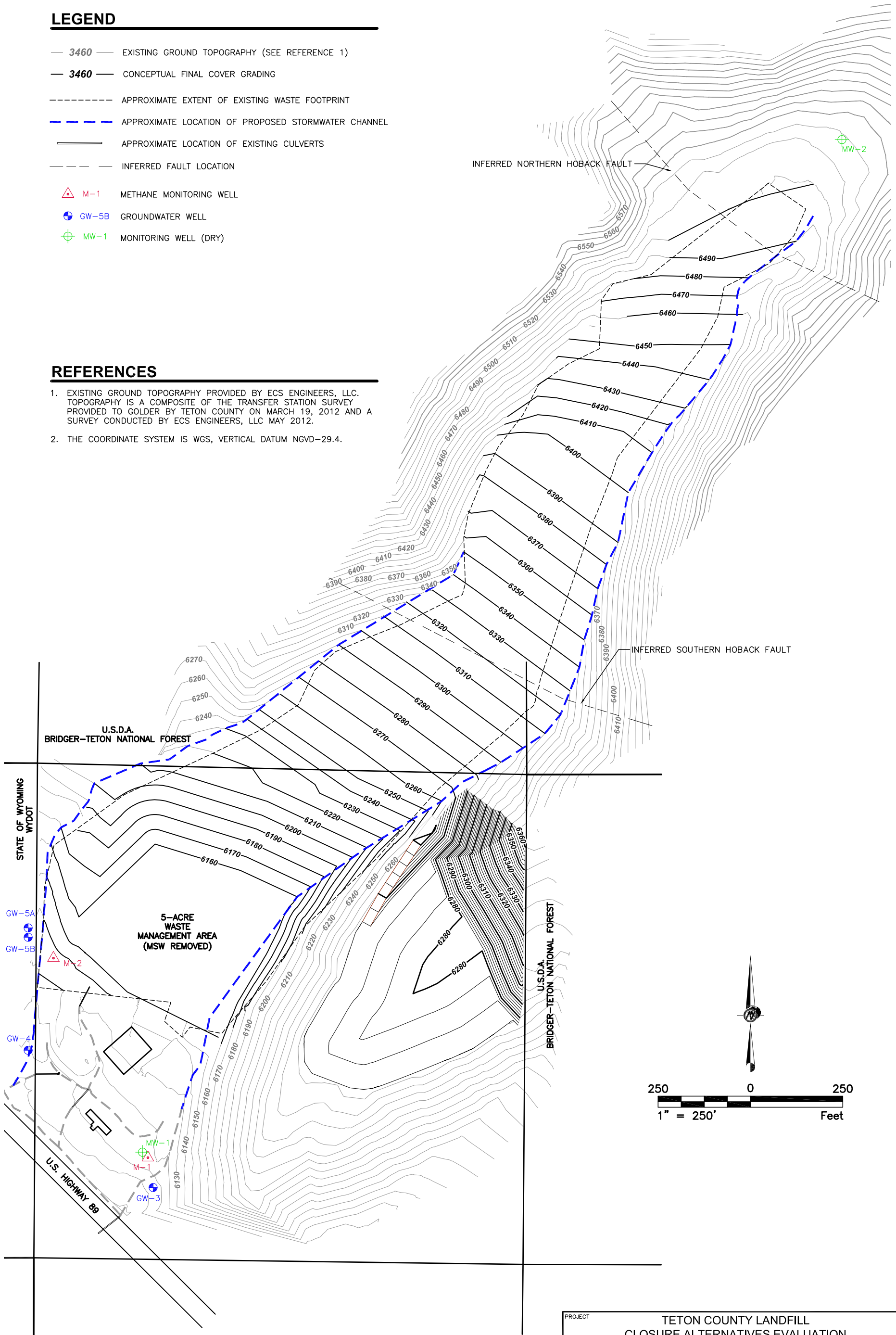
Drawing File: N:\12\123-81604_B Report\ 12381604B015.dwg | Layout: 11x17 Portrait | Modified: Jul 24, 2012 10:07 jparisi | Plotted: 08/20/12 10:34am jparisi

LEGEND

- 3460 — EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- **3460** — CONCEPTUAL FINAL COVER GRADING
- APPROXIMATE EXTENT OF EXISTING WASTE FOOTPRINT
- APPROXIMATE LOCATION OF PROPOSED STORMWATER CHANNEL
- APPROXIMATE LOCATION OF EXISTING CULVERTS
- INFERRED FAULT LOCATION
- M-1 METHANE MONITORING WELL
- GW-5B GROUNDWATER WELL
- MW-1 MONITORING WELL (DRY)

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY ECS ENGINEERS, LLC. TOPOGRAPHY IS A COMPOSITE OF THE TRANSFER STATION SURVEY PROVIDED TO GOLDER BY TETON COUNTY ON MARCH 19, 2012 AND A SURVEY CONDUCTED BY ECS ENGINEERS, LLC MAY 2012.
2. THE COORDINATE SYSTEM IS WGS, VERTICAL DATUM NGVD-29.4.



PROJECT
TETON COUNTY LANDFILL
CLOSURE ALTERNATIVES EVALUATION
JACKSON, WYOMING

TITLE
CONCEPTUAL FINAL GRADING PLAN
ALTERNATIVE 3B

Golder Associates

PROJECT No. 123-81604	FILE No. 12381604B017
TETON COUNTY	SCALE AS SHOWN / REV. A

FIGURE 6B

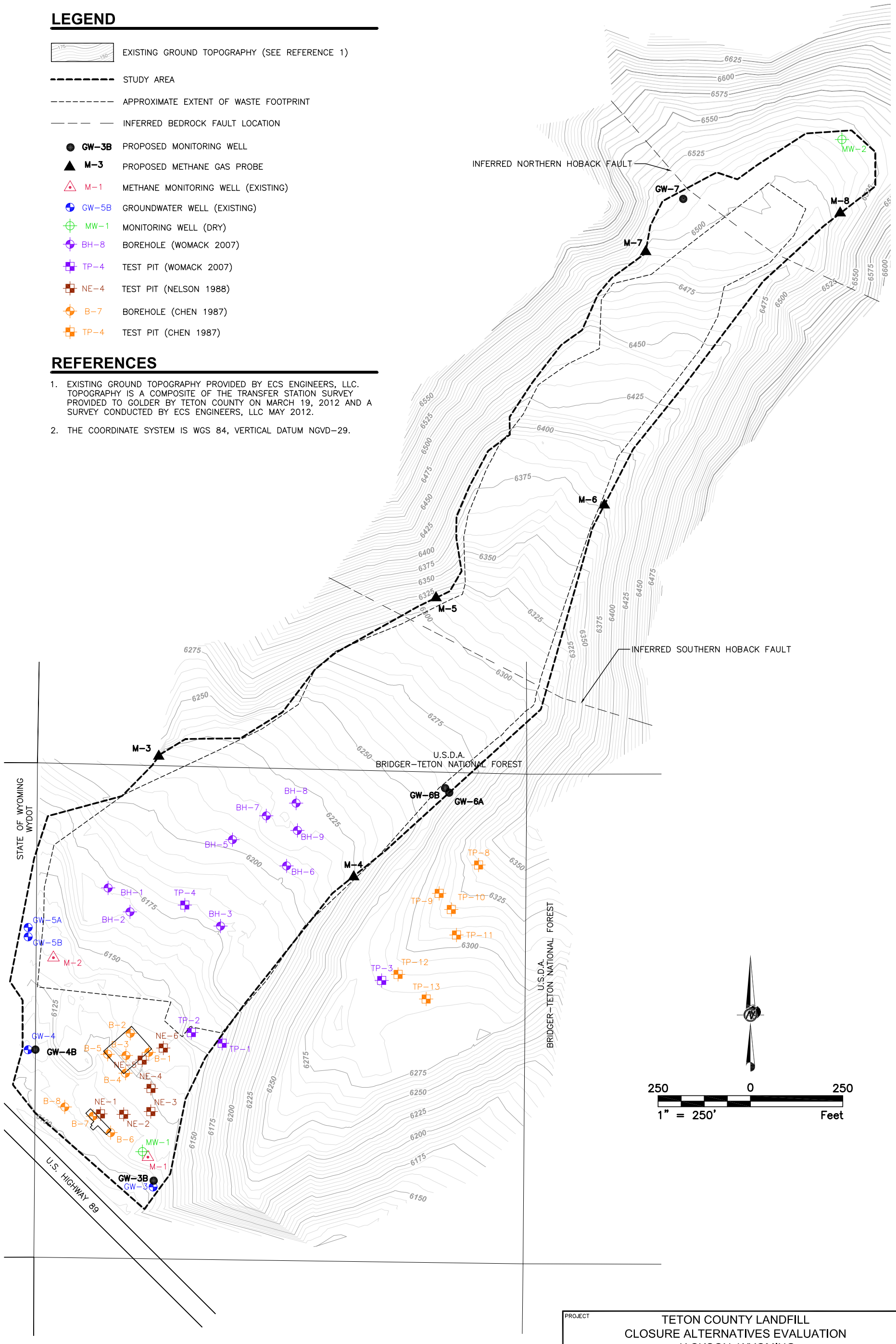
Drawing File: N:\12\123-81604_B Report\ 12381604B017.dwg | Layout: 11x17 Portrait | Modified: Jul 24, 2012 10:10 jparisi | Plotted: 08/20/12 10:32am jparisi

LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- STUDY AREA
- APPROXIMATE EXTENT OF WASTE FOOTPRINT
- INFERRED BEDROCK FAULT LOCATION
- GW-3B PROPOSED MONITORING WELL
- M-3 PROPOSED METHANE GAS PROBE
- M-1 METHANE MONITORING WELL (EXISTING)
- GW-5B GROUNDWATER WELL (EXISTING)
- MW-1 MONITORING WELL (DRY)
- BH-8 BOREHOLE (WOMACK 2007)
- TP-4 TEST PIT (WOMACK 2007)
- NE-4 TEST PIT (NELSON 1988)
- B-7 BOREHOLE (CHEN 1987)
- TP-4 TEST PIT (CHEN 1987)

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY ECS ENGINEERS, LLC. TOPOGRAPHY IS A COMPOSITE OF THE TRANSFER STATION SURVEY PROVIDED TO GOLDER BY TETON COUNTY ON MARCH 19, 2012 AND A SURVEY CONDUCTED BY ECS ENGINEERS, LLC MAY 2012.
2. THE COORDINATE SYSTEM IS WGS 84, VERTICAL DATUM NGVD-29.



PROJECT
TETON COUNTY LANDFILL
CLOSURE ALTERNATIVES EVALUATION
JACKSON, WYOMING

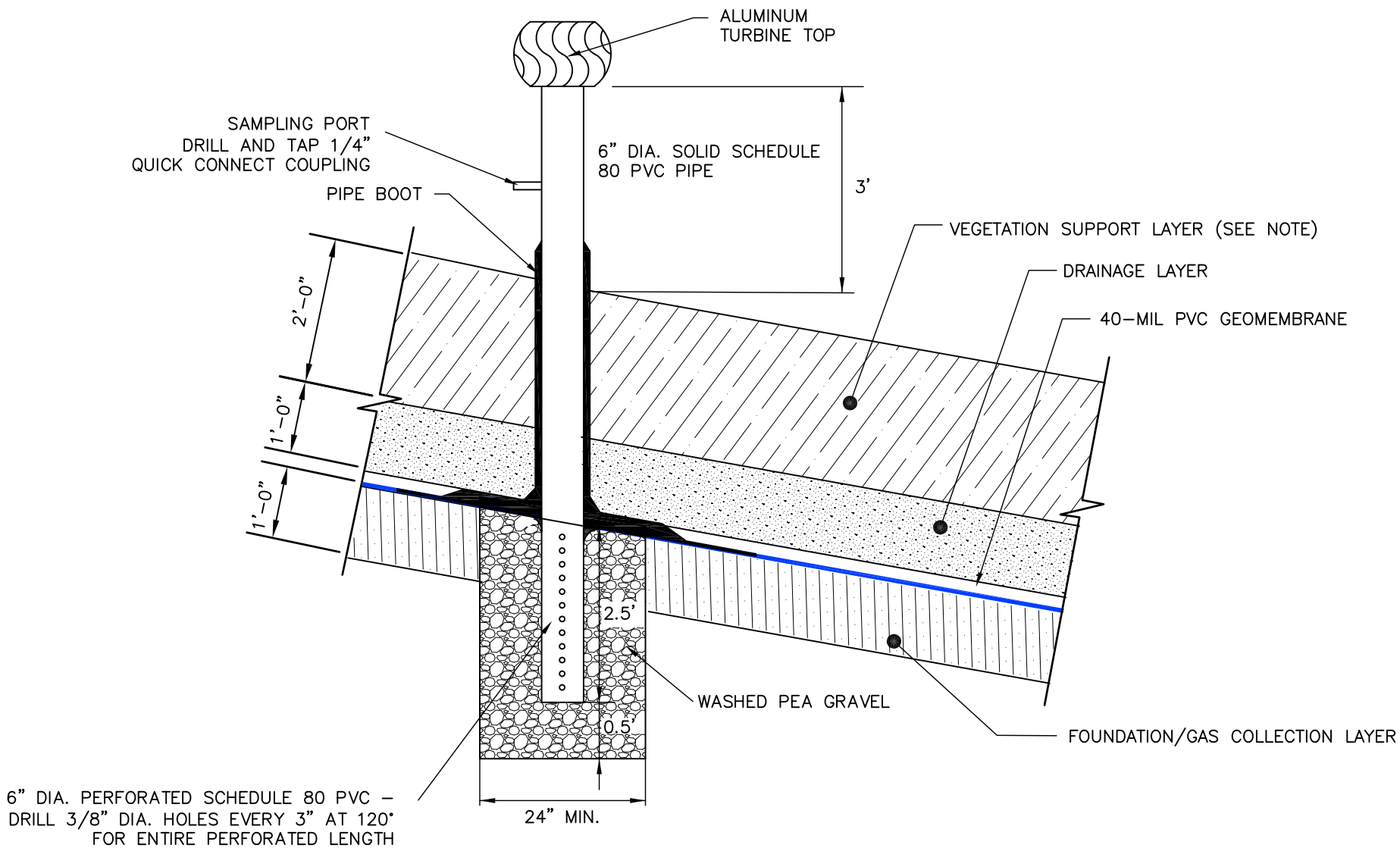
TITLE
PROPOSED SUBSURFACE INVESTIGATION LOCATIONS

Golder Associates

PROJECT No. 123-81604	FILE No. 12381604B014
TETON COUNTY	SCALE AS SHOWN / REV. A

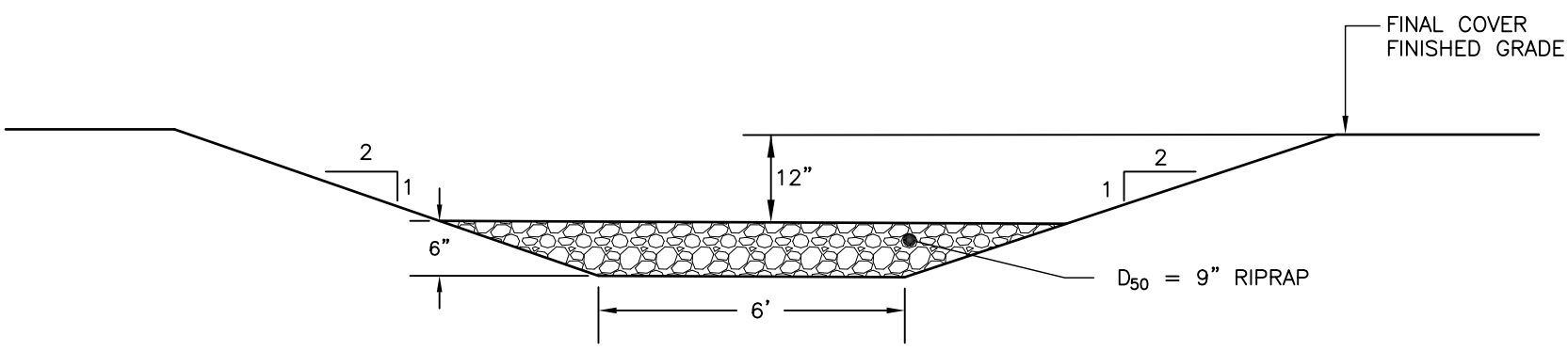
FIGURE 7

Drawing File: N:\12\123-81604_B Report\ 12381604B014.dwg | Layout: 11x17 Portrait | Modified: Jun 27, 2012 13:33 JParks | Plotted: 08/20/12 10:35am jparisi



1/8 TYPICAL FINAL COVER DETAIL (W/ PASSIVE GAS VENT)

SCALE: NTS
NOTE: 2 FEET MINIMUM, 3 FEET IN ACTIVITY AREAS.



2/8 TYPICAL STORMWATER CHANNEL

SCALE: NTS

PROJECT
TETON COUNTY LANDFILL
CLOSURE ALTERNATIVES EVALUATION
JACKSON, WYOMING

TITLE
TYPICAL DETAILS

Golder Associates

PROJECT No. 123-81604
TETON COUNTY

FILE No. 12381604B010
SCALE AS SHOWN REV. A

FIGURE 8

Drawing File: N:\12\123-81604_B Report\ 12381604B01.dwg | Layout: 11x17 Portrait | Modified: Jun 27, 2012 13:47 JParks | Plotted: 08/20/12 10:38am jparisi

APPENDIX A

SITE ASSESSMENT

SITE ASSESSMENT SUMMARY

SITE ASSESSMENT SUMMARY

TETON COUNTY LANDFILL
TETON COUNTY, WYOMING

Submitted To: Teton County
320 South King Street
Jackson, WY 83001

Submitted By: Golder Associates Inc.
44 Union Boulevard, Suite 300
Lakewood, CO 80228

August 2012

Project No. 123-81604

A world of capabilities delivered locally

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Figure A-3 Approximate Top of MSW Surface

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Attachment A-2 Geoprobe Logs
Attachment A-3 Lab Test Results
Attachment A-4 Survey Report

1.0 INTRODUCTION

Golder conducted a Site Assessment of the Teton County Landfill (Landfill), including portions on Teton County (County) property (approximately 13 acres) and portions on United States Forest Service (USFS) (approximately 18 acres) property. The Site Assessment was intended to further understanding of the location, depth, quantity and character of municipal solid waste (MSW) landfilled at the Site in order to assist with developing and evaluating closure alternatives for the site. Because much of the Landfill is bounded by Horsethief Canyon and the lateral extent of MSW is generally apparent, emphasis during the Site Assessment was placed on assessing the thickness of cover soils and the MSW depth so that material quantities could be developed for closure alternatives.

The following work was conducted as part of the Site Assessment:

- Excavated test pits to examine existing cap thickness, MSW depth, MSW composition, and thickness of daily cover soil layers and final soil cover;
- Advance borings using "direct-push" (geoprobe) methodology to delineate existing final cover thickness and MSW depth; and
- Conduct a topographic survey of the USFS property and spot-check the existing topography provided by the County for the Teton County property.

2.0 OVERVIEW

Before the site investigation was performed, Golder reviewed historical aerial photographs during previous periods of waste disposal (1962, 1964, 1978, and 1988) and previous geotechnical investigation results from Landfill areas to help delineate disposal areas and focus subsurface exploration locations. The Site Assessment was performed from May 7 to May 11, 2012. A full-time Golder field engineer was on-site to coordinate the field work, observe and log the subsurface investigations, and locate the test pits and geoprobe borings for subsequent use in estimating MSW volumes and areas for capping. Test-pitting was conducted on May 7, and nine test pits were excavated (five test pits were located on the USFS property and four were located on the County property). Geoprobing was conducted from May 8 through 10 and 29 holes were advanced (20 holes were located on the USFS property and nine were located on the County property). Topographic surveying activities took place on May 9 and 10. Locations of the test pits and geoprobe borings are shown on Figure A-1 along with the topography provided by the survey.

3.0 TEST PITS

Tests pits were excavated using an excavator operated by Yellow Iron, Inc., a subcontractor to Golder for this work. Approximate test pit dimensions were 4' wide x 15' long x 20' deep. Test pits provided a good visual assessment of the characteristics of MSW and daily cover soils and a clear indication of existing final cover soil depth. Because the maximum reach of the excavator is limited (approximately 20 feet), test pits could not reliably establish the thickness of waste for MSW that was deposited greater than approximately 20 feet below ground surface.

The test-pitting encountered a wide a variety of MSW types (e.g., paper, plastic, wood, metal, cardboard, tires, fabrics, glass, auto parts, etc), densities, and conditions across the Landfill. Material excavated at TPG-1 consisted of mostly inert MSW that was intermixed with soil and there was more soil than MSW present. Material from TPG-2 was very wet, soft, organic and odorous material, deposited in a thick, 15-foot, continuous layer. TPG-3 material had dry MSW intermixed with soil buried under 10 feet of cover. TPG-4 appeared to be located in a scrap metal pile with large metallic objects mixed with dry soil. TPG-5 did not encounter MSW. TPG-6 exhibited 1 foot of soil cover over a continuous layer of mostly moist MSW. TPG-7 had interspersed layers of MSW and soil. TPG-8 was very similar to TPG-2 with wet, continuous MSW. TPG-9 had a 3-foot layer of tires over dry MSW intermixed with soil.

Detailed descriptions are provided on the test pit logs in Attachment A-1. Locations of the test pits are shown on Figure A-1.

4.0 GEOPROBES

Geoprobes were advanced using a geoprobe-specific rig operated by Saberprobe LLC, a subcontractor to Golder. The diameter of the geoprobe probe rod is 2.25 inches. The probe rod was advanced through the MSW and into “natural” ground (with hole depths ranging from 5’ to 40’). Geoprobing is a good method to establish the thickness of MSW and cover soil layers as the nature of the resistance to probe advancement varies significantly between MSW and natural soil materials. Geoprobe borings were profiled by monitoring the resistance during advancement of the probe and selected sampling to correlate the actual materials encountered to the resistance readings. Geoprobe borings were used in conjunction with test pits to assess cover thickness and MSW depth.

The geoprobe logs are provided in Attachment A-2. Locations of the geoprobe boreholes are shown on Figure A-1.

5.0 SURVEY

A topographic survey on USFS property was conducted as a part of this assessment. The survey was conducted with an accuracy of 0.1 feet horizontally and 0.2 feet vertically to a 95% confidence interval. The survey report is provided as Attachment A-4. As a part of this effort, spot checks of the existing topographic survey for the Teton County portion of the Landfill were conducted and it was found that the existing survey available from Nelson Engineering is sufficient for the Alternatives Evaluation. Updated topography for the USFS property portion of the Landfill was required because the historic topographical data for that portion of the site was not accurate enough for the conceptual Alternatives Evaluation. The updated topography for the Landfill is shown on Figure A-1. The estimated surfaces for the top of MSW and bottom of MSW using the data from the Site Assessment and previous investigations are shown on Figures A-2 and A-3, respectively.

6.0 LAB TESTING

Samples were taken from the cover material and natural soil beneath the landfill. Atterberg limits testing was conducted on the soils to obtain a general characterization of the materials. Based on the results of Golder's sampling and analysis, the cover soils at Teton are generally non-plastic or low plasticity silts and sands with occasional larger gravel and cobble size pieces. The bottom soils (beneath the MSW) are similar to the cover soils but with a slightly lower plasticity overall.

The laboratory test results are provided in Attachment A-3.

7.0 CONCLUSIONS

The major results of the Site Assessment are depths of cover and thickness of MSW at 38 additional locations on the property and the development of an accurate topographic map for the entire Landfill area. Using these new data in conjunction with the data from existing reports provided a basis for estimating the top of MSW and bottom MSW as shown on Figures A-2 and A-3. These data have been used in the Alternatives Evaluation to estimate the amount of soil in the current final cover and the volume of MSW in the landfill.

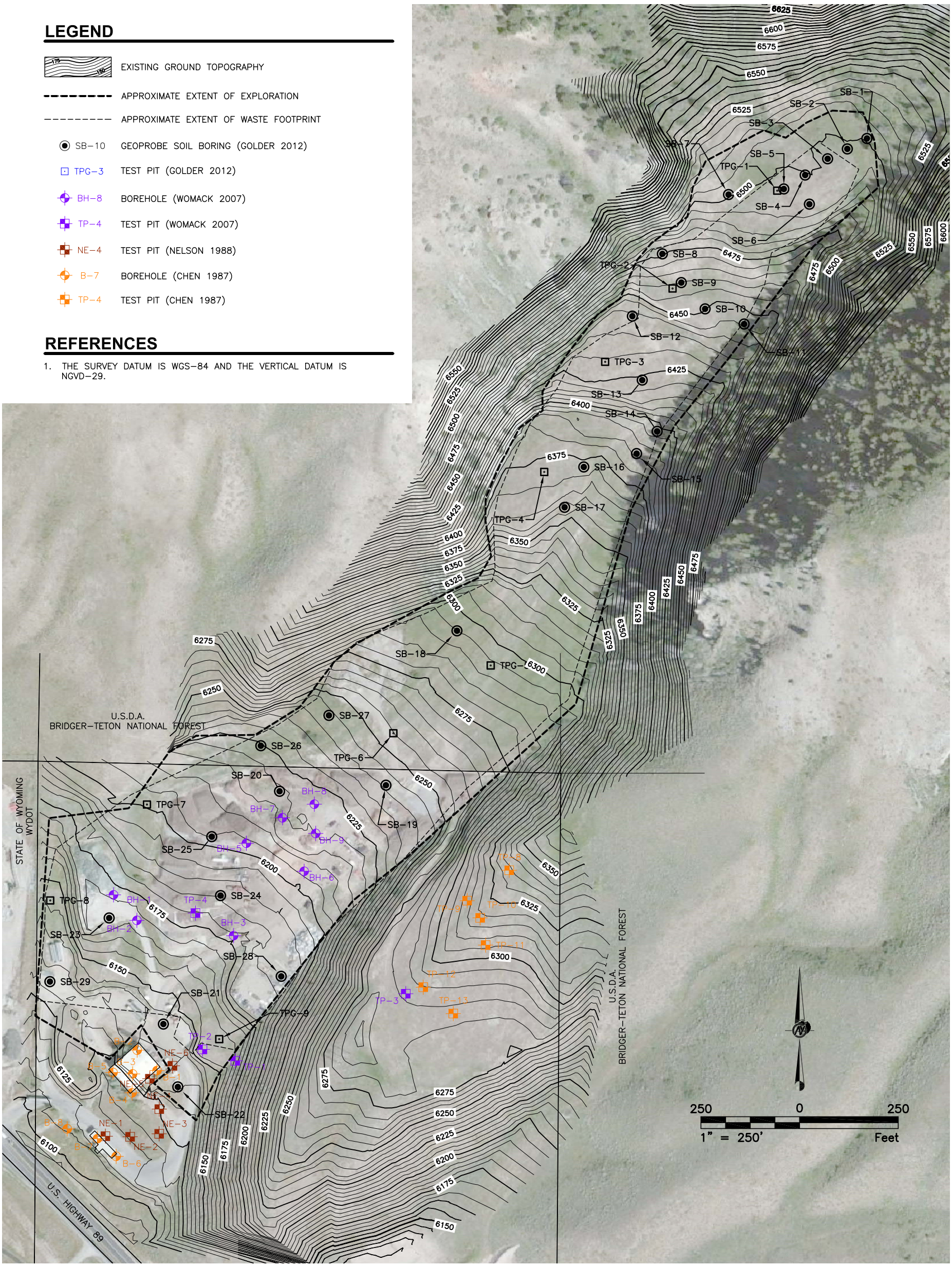
FIGURES

LEGEND

- EXISTING GROUND TOPOGRAPHY
- APPROXIMATE EXTENT OF EXPLORATION
- APPROXIMATE EXTENT OF WASTE FOOTPRINT
- SB-10 GEOPROBE SOIL BORING (GOLDER 2012)
- TPG-3 TEST PIT (GOLDER 2012)
- BH-8 BOREHOLE (WOMACK 2007)
- TP-4 TEST PIT (WOMACK 2007)
- NE-4 TEST PIT (NELSON 1988)
- B-7 BOREHOLE (CHEN 1987)
- TP-4 TEST PIT (CHEN 1987)

REFERENCES

1. THE SURVEY DATUM IS WGS-84 AND THE VERTICAL DATUM IS NGVD-29.

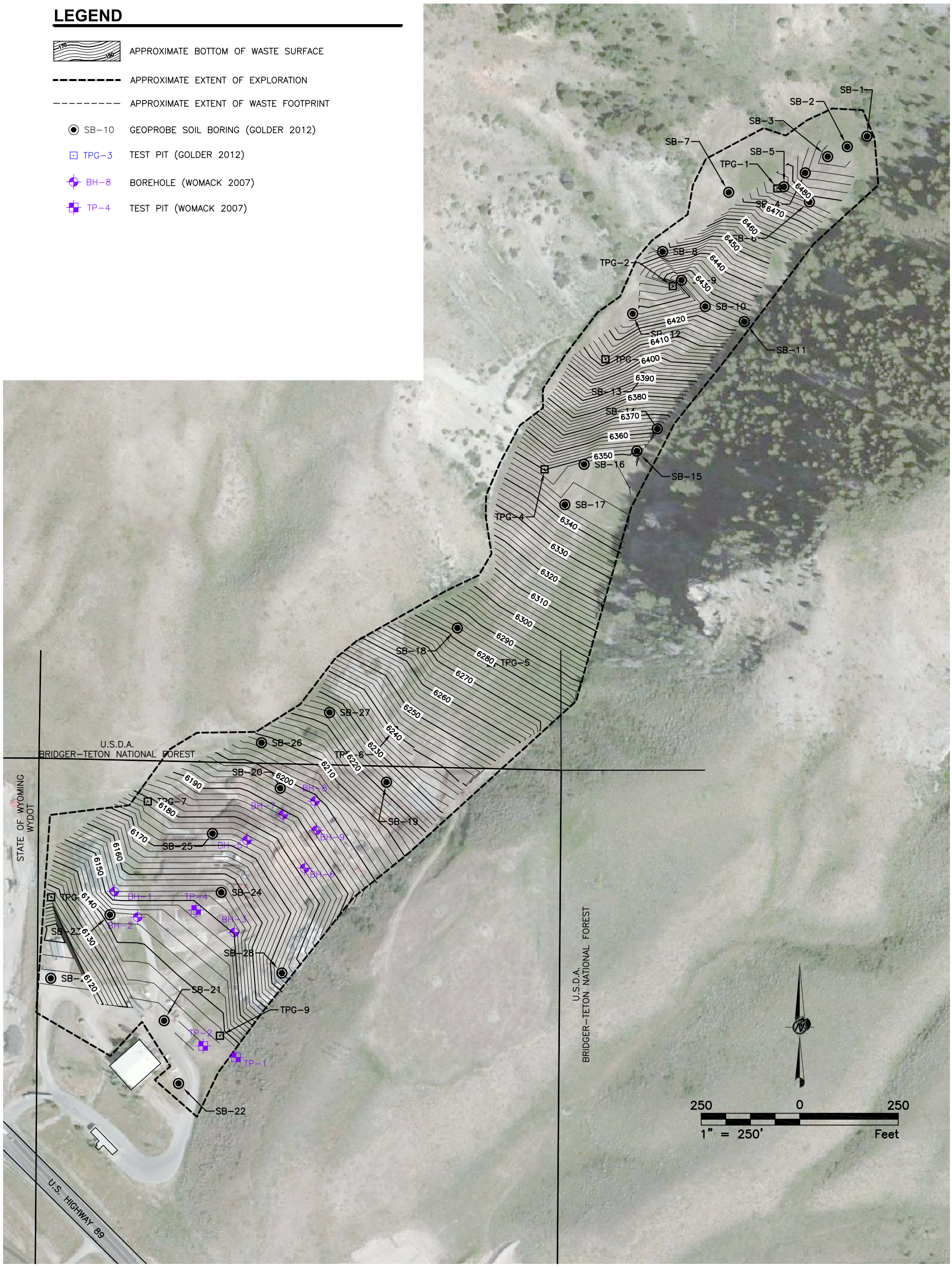


PROJECT	TETON COUNTY LANDFILL SITE ASSESSMENT TETON COUNTY, WYOMING	
TITLE	**EXISTING TOPOGRAPHY**	
Golder Associates	PROJECT No. 123-81604	FILE No. 12381604A001 SCALE AS SHOWN REV. A
		FIGURE A-1

Drawing File: N:\12\123-81604_A GEX\ 12381604A001.dwg | Layout: 11x17 Portrait | Modified: Jun 22, 2012 15:39 JParks | Plotted: 08/20/12 3:06pm JParks

LEGEND

- APPROXIMATE BOTTOM OF WASTE SURFACE
- APPROXIMATE EXTENT OF EXPLORATION
- APPROXIMATE EXTENT OF WASTE FOOTPRINT
- SB-10 GEOPROBE SOIL BORING (GOLDER 2012)
- TPG-3 TEST PIT (GOLDER 2012)
- BH-8 BOREHOLE (WOMACK 2007)
- TP-4 TEST PIT (WOMACK 2007)

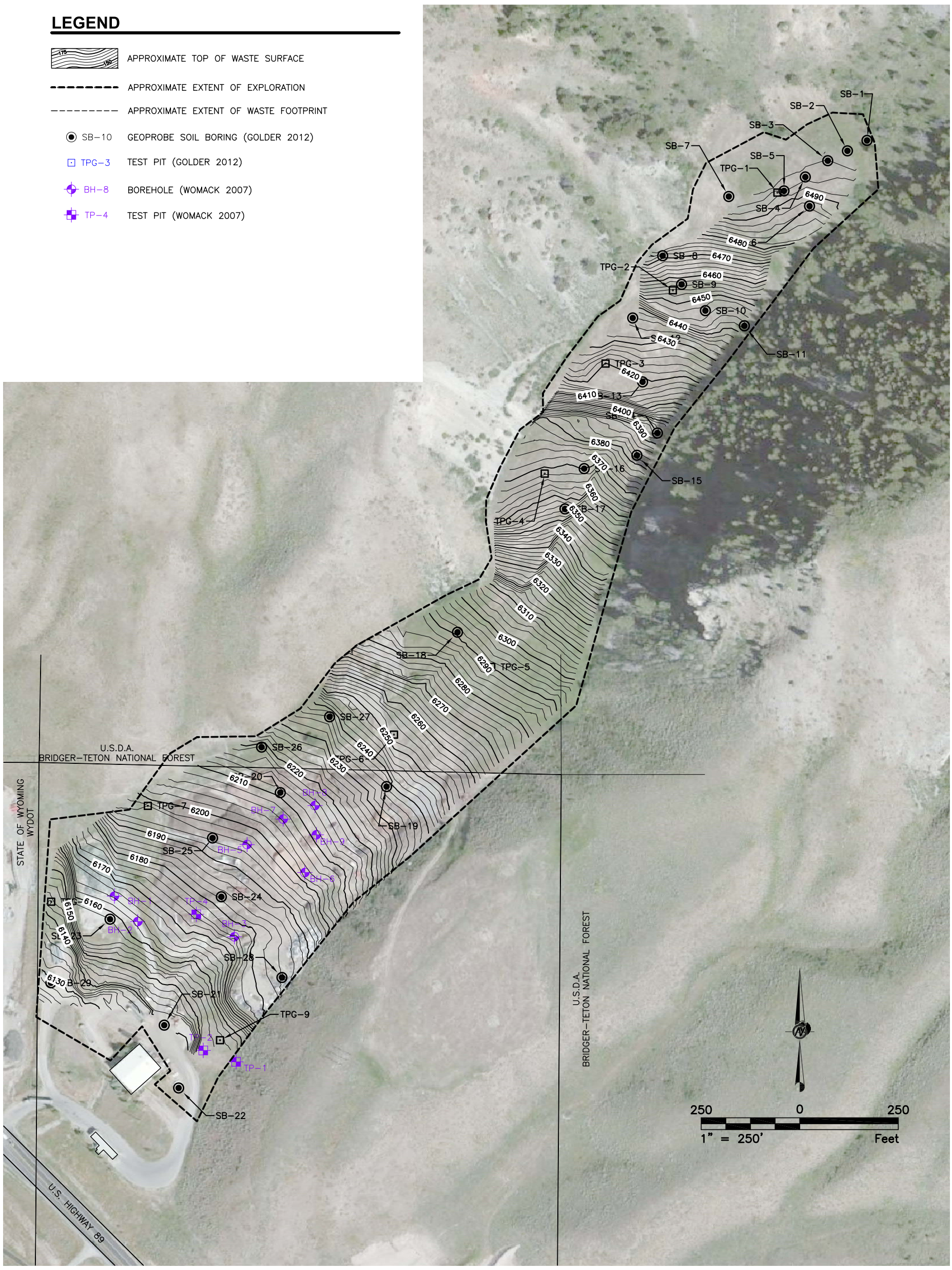


PROJECT	TETON COUNTY LANDFILL SITE ASSESSMENT TETON COUNTY, WYOMING		
TITLE	**APPROXIMATE BOTTOM OF MSW SURFACE**		
Golder Associates	PROJECT No. 123-81604	FILE No. 12381604A002	
		SCALE AS SHOWN	REV. A
		FIGURE A-2	

Drawing File: N:\12\123-81604_A GEX\ 12381604A002.dwg | Layout: 11x17 Portrait | Modified: Jun 22, 2012 13:03 JParks | Plotted: 08/20/12 3:08pm JParks

LEGEND

- APPROXIMATE TOP OF WASTE SURFACE
- APPROXIMATE EXTENT OF EXPLORATION
- APPROXIMATE EXTENT OF WASTE FOOTPRINT
- SB-10 GEOPROBE SOIL BORING (GOLDER 2012)
- TPG-3 TEST PIT (GOLDER 2012)
- BH-8 BOREHOLE (WOMACK 2007)
- TP-4 TEST PIT (WOMACK 2007)



PROJECT	TETON COUNTY LANDFILL SITE ASSESSMENT TETON COUNTY, WYOMING
TITLE	**APPROXIMATE TOP OF MSW SURFACE**

Golder Associates

PROJECT No.	123-81604	FILE No.	12381604A003
		SCALE AS SHOWN	REV. A

FIGURE A-3

Drawing File: N:\12\123-81604_A GEX\ 12381604A003.dwg | Layout: 11x17 Portrait | Modified: Jun 22, 2012 13:05 JParks | Plotted: 08/20/12 3:10pm JParks

ATTACHMENT A-1
TEST PIT LOGS

FIELD TEST PIT LOG

Temp:	40ºF	Weather:	Sunny, clear	Engineer:	Jean Parks	Operator:	Don	Test Pit:	TPG-1
Equipment:	Excavator Volvo EC210B			Contractor	Yellow Iron			Date	05/07/12
Location	Jackson, WY			N	2448488.41	E	1388352.102	Job No.	123-81604
				Elevation	6499’				

0

Compact, sandy silt
1’- SAMPLE

5

Insulation pieces

8’- Cover and MSW interface transition

10

Softer, easier to dig

Wires, bottles, tire, clinking as dirt set out, bottles, cans

15

Layers of crushed glass (intermixed)

17’- Possibly through MSW

20

TD = 20’

Layer	Thickness (FT)
Cover	8 – 10’
Waste	10’
Daily Cover	Interspersed

Sample Descriptions and Excavation Notes

FIELD TEST PIT LOG

Temp:	40ºF	Weather:	Breezy	Engineer:	Jean Parks	Operator:	Don	Test Pit:	TPG-2
Equipment:	Excavator Volvo EC210B			Contractor	Yellow Iron			Date	05/07/12
Location	Jackson, WY			N	2448223.191	E	1388104.299	Job No.	123-81604
				Elevation	6459’				

Depth	Description
0	Clay **1.5’- SAMPLE**
5	5’- MSW, very pungent odor, dark, organic, moist Dripping wet, liquid running down sides of test pit
10	~100% MSW, very little cover Lots of bags 14’ - Soil, intermixed w/ MSW
15	21’- End of MSW TD = 22FT
20	

Layer	Thickness (FT)
Cover	5 -6’
Waste	15 – 17’
Daily Cover	Not present

Sample Descriptions and Excavation Notes

FIELD TEST PIT LOG

Temp:	40ºF	Weather:	Breezy	Engineer:	Jean Parks	Operator:	Don	Test Pit:	TPG-3
Equipment:	Excavator Volvo EC210B			Contractor	Yellow Iron			Date	05/07/12
Location	Jackson, WY			N	2448052.438	E	1387918.433	Job No.	123-81604
				Elevation	6430’				

0

Silty with larger gravel to cobble sized pieces

Dry, light Brown

5

Fill? (no layering)

Up to 8” -10” rounded cobbles

10’- Bags [sparse], intermixed MSW and soil

10

15’- Soil

15

Sparse MSW
16’- Greater percentage of MSW

Dry

Caving in, close to bottom of MSW
20’- SAMPLE

20

Layer	Thickness (FT)
Cover	10’
Waste	9’-10’
Daily Cover	Rare, mixed

Sample Descriptions and Excavation Notes

FIELD TEST PIT LOG

Temp:	40ºF	Weather:	Breezy	Engineer:	Jean Parks	Operator:	Don	Test Pit:	TPG-4
Equipment:	Excavator Volvo EC210B			Contractor	Yellow Iron			Date	05/07/12
Location	Jackson, WY			N	2447898.078	E	1387639.366	Job No.	123-81604
				Elevation	6372’				

Depth (FT)	Description
0	Silty sand Moist in sections 4’- Metal, fencing, large pieces, tricky digging, mixed with soil, wires, sheet metal, car lift
5	Soil (little odor)
10	Wood (burned?), moist soil
15	Wood, difficult to dig out **20’- SAMPLE** 22’-end
20	

Layer	Thickness (FT)
Cover	4’
Waste	~ 18’
Daily Cover	Intermixed

Sample Descriptions and Excavation Notes

FIELD TEST PIT LOG

Temp:	40ºF	Weather:	Breezy	Engineer:	Jean Parks	Operator:	Don	Test Pit:	TPG-5
Equipment:	Excavator Volvo EC210B			Contractor	Yellow Iron			Date	05/07/12
Location	Jackson, WY			N	2447762.278	E	1387149.008	Job No.	123-81604
				Elevation	6294’				

0

Silty, light brown, cohesive, dry
[same as previous test pits (ie test pits 3 & 4)]

5

6’- Slightly moist

10

Cobbles (large)
Little bits of wood

15

TD = 19’

20

Layer	Thickness (FT)
Cover	19' +
Waste	None
Daily Cover	N/A

Sample Descriptions and Excavation Notes

FIELD TEST PIT LOG

Temp:	40ºF	Weather:	Warm, Breezy	Engineer:	Jean Parks	Operator:	Don	Test Pit:	TPG-6
Equipment:	Excavator Volvo EC210B			Contractor	Yellow Iron			Date	05/07/12
Location	Jackson, WY			N	2447515.667	E	1386977.283	Job No.	123-81604
				Elevation	6255’				

Depth (FT)	Description
0	Cover MSW, moist, intermixed
5	Wood, textiles, bottles, ~70% MSW, insulation, hubcap Loose, not odorous
10	14’-Soil
15	TD = 16’
20	

Layer	Thickness (FT)
Cover	1’
Waste	13’
Daily Cover	Mixed in

Sample Descriptions and Excavation Notes

FIELD TEST PIT LOG

Temp:	45ºF	Weather:	Warm. calm	Engineer:	Jean Parks	Operator:	Don	Test Pit:	TPG-7
Equipment:	Excavator Volvo EC210B			Contractor	Yellow Iron			Date	05/07/12
Location	Jackson, WY			N	2446891.182	E	1386796.62	Job No.	123-81604
				Elevation	6201’				

0	Dark, cohesive, moist, silty
5	5-6’ MSW, dry to slightly moist, insulation, well mixed with soil
	Soil
	MSW mixed with soil
10	Darker, wetter
	Cans, bottles, textiles, bags, blocky rocks in soil/MSW mix
15	~50% MSW
20	TD = 22’

Layer	Thickness (FT)
Cover	5-6’
Waste	>16’
Daily Cover	Mixed

Sample Descriptions and Excavation Notes

FIELD TEST PIT LOG

Temp:	45ºF	Weather:	Breezy	Engineer:	Jean Parks	Operator:	Don	Test Pit:	TPG-8
Equipment:	Excavator Volvo EC210B			Contractor	Yellow Iron			Date	05/07/12
Location	Jackson, WY			N	2446646.121	E	1386553.531	Job No.	123-81604
				Elevation	6148’				

0	Silty, light brown, slightly moist
5	6’- MSW ~100% Bags, textiles, loose, slightly moist
10	Darker, wetter Glass, wood, little to no soil, paper, carpet
15	18’- soil mixed in (~20% soil) 19”- Back to ~100% MSW TD = 22’
20	

Layer	Thickness (FT)
Cover	6’
Waste	>16’
Daily Cover	None

Sample Descriptions and Excavation Notes

FIELD TEST PIT LOG

Temp:	60ºF	Weather:	Calm, Warm	Engineer:	Jean Parks	Operator:	Don	Test Pit:	TPG-9
Equipment:	Excavator Volvo EC210B			Contractor	Yellow Iron			Date	05/07/12
Location	Jackson, WY			N	2447074.377	E	1386202.193	Job No.	123-81604
				Elevation	6159’				

0

Dark brown, slightly moist, cobbles and larger pieces

4’- Tires (with soil) – no rims, just rubber

5

7’- Lots of tires with soil with large cobbles

10

Wood debris

15

MSW and tires and soil, dry

Plastic, textiles, paper, wood

20

TD = 22’

Layer	Thickness (FT)
Cover	4’
Waste	3’ Tires, 15’ MSW
Daily Cover	Mixed

Sample Descriptions and Excavation Notes

ATTACHMENT A-2
GEOPROBE LOGS

LOG OF GEOPROBE SB-01

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,716 E: 1,388,484
GS ELEVATION: ~ 6501 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Top soil				
2	Loamy Very hard at bottom, rock				Cover Thickness = 0' Waste Thickness = 0' Daily Cover Thickness = N/A
4	Geoprobe hole discontinued at 4 ft depth				
6					
8					
10					
12					
14					
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-02

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,666 E: 1,388,458
GS ELEVATION: ~ 6500 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Top soil				
2	Moist, dark CL (loose probably fill)				Cover Thickness = 0' Waste Thickness = 0' Daily Cover Thickness = N/A
4					
	Placed fill or natural				
6					
	Natural, hard rock				
8	Geoprobe hole discontinued at 8 ft depth				
10					
12					
14					
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-03

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,616 E: 1,388,433
GS ELEVATION: ~ 6500 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover, loamy, loose				
2					Cover Thickness = 4' Waste Thickness = 6' Daily Cover Thickness = N/A
4					
	Through the cover, into MSW				
6					
	Soft - Glass - Rubber Loose				
8					
10	Got hard, natural Hard and uniform				
12	Geoprobe hole discontinued at 12 ft depth				
14					
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-04

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,559 E: 1,388,392
GS ELEVATION: ~ 6500 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover, rocky, loamy, moist				
2					Cover Thickness = 5.5' Waste Thickness = 9.5' Daily Cover Thickness = N/A
4					
	Cover				
6	Wood				
	MSW, loose, moist interspersed (~20% MSW)				
8					
10					
12					
14					
	Through to native Hard, uniform				
16	Geoprobe hole discontinued at 16 ft depth				
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-05

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,505 E: 1,388,356
GS ELEVATION: ~ 6499 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Rocks, cover resistance slow progress, lots of rocks				
2					Cover Thickness = 5' Waste Thickness = 18' Daily Cover Thickness = Mixed
4	Cover				
6	Waste Loose, nonuniform				
8					
10					
12					
14					
16					
18					
20	Poor recovery ML, light color moist				
22					
24					
26	Uniform natural				
28	Geoprobe hole discontinued at 28 ft depth				
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-06

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,570 E: 1,388,318
GS ELEVATION: ~ 6500 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Rocky cover sandy silt				
2					Cover Thickness = 13' Waste Thickness = 8' Daily Cover Thickness = N/A
4					
6					
8	Moist, cohesive Nonuniform Poor recovery				
10					
12	Loose				
14	Waste, wood Wet				
16					
18	Organics, wet, fiber				
20					
22	Uniform, hard Natural				
24	Geoprobe hole discontinued at 24 ft depth				
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-07

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,365 E: 1,388,342
GS ELEVATION: ~ 6019 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Smooth push				
2	Hard Smooth, dark organic				Cover Thickness = 0' Waste Thickness = 0' Daily Cover Thickness = N/A
4					
6	Natural				
8	Geoprobe hole discontinued at 8 ft depth				
10					
12					
14					
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-08

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,197 E: 1,388,192
GS ELEVATION: ~ 6476 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				
2					Cover Thickness = 5' Waste Thickness = 23' Daily Cover Thickness = None
4					
6					
8	MSW				
10					
12					
14	Uniform to hard				
	Sample - MSW				
16					
18					
20					
22					
24	Sample - MSW				
26					
28					
30	Sample - natural, rocky				
32					
34	Geoprobe hole discontinued at 34 ft depth				
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-09

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,245 E: 1,388,119
GS ELEVATION: ~ 6460 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				Cover Thickness = 3.5' Waste Thickness = 32.5' Daily Cover Thickness = None
2					
4	MSW, dark, bags				
6					
8					
10					
	Paper?				
12					
14					
16					
18	Hard				
20					
	Sample - MSW (~100%), dripping with free fluid				
22					
24	Sample - pulled up TV Guide in MSW, dates MSW to early 1980's				
26					
28					
30					
32	Refusal				
34					
36					
	Geoprobe hole discontinued at 36.5 ft depth				
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-10

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/8/12

COORDS: N: 2,448,306 E: 1,388,053
GS ELEVATION: ~ 6450 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				
2					Cover Thickness = 3' Waste Thickness = 23' Daily Cover Thickness = Mixed, 1' visually confirmed
4	Waste, dark ~100% MSW				
6					
8					
10					
12					
14	~ 50% MSW				
16					
18					
20					
22					
24					
26	Uniform Natural				
28					
30					
32	Sample Geoprobe hole discontinued at 32 ft depth				
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-11

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,448,405 E: 1,388,014
GS ELEVATION: ~ 6446 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				
2	MSW, dark, organic				Cover Thickness = 2' Waste Thickness = 19' Daily Cover Thickness = N/A
4					
6	Fiber				
8					
10					
12					
14					
	Hard layer - cardboard paper				
16					
18	Change, hard-uniform				
20	Sample - natural				
22					
24	Geoprobe hole discontinued at 24 ft depth				
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-12

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,448,121 E: 1,388,034
GS ELEVATION: ~ 6439 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Natural, soft uniform				
2					Cover Thickness = 0' Waste Thickness = 0' Daily Cover Thickness = N/A
4	Good recovery				
	Same				
6	SAMPLE - Sample # 5 - GP-12 @ 6'		5	GRAB	
8	Geoprobe hole discontinued at 8 ft depth				
10					
12					
14					
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-13

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,448,146 E: 1,387,872
GS ELEVATION: ~ 6424 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				
2					Cover Thickness = 5' Waste Thickness = 29' Daily Cover Thickness =1' ? Occational
4					
6	MSW				
8					
10					
12					
14					
16					
18					
20	Harder, probably still MSW				
22					
24	Sample - MSW				
26					
28					
30					
32	Sample - Natural				
34					
36	Geoprobe hole discontinued at 36 ft depth				
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-14

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,448,184 E: 1,387,742
GS ELEVATION: ~ 6398 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover light brown				
2					Cover Thickness = 17' Waste Thickness = 19' Daily Cover Thickness = N/A
4					
6	Cover, loose				
8					
10					
12					
14	Cover, wet, silt				
16	Darker ~ 80% MSW				
18					
20					
22					
24					
26					
28					
30					
32	Wet, muddy rods				
34	Sample - Hard, crushed rock Plugged sampler				
36					
38	Geoprobe hole discontinued at 38 ft depth				
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-15

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,448,132 E: 1,387,686
GS ELEVATION: ~ 6386 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0					
	Hard, rocks				
2					Cover Thickness = 0' Waste Thickness = 0' Daily Cover Thickness = N/A
4					
	Looser				
6					
	Clay, light brown				
8					
	Transition to sandy				
10	SAMPLE - Sample # 6 - GP-15 @ 10'		6	GRAB	
12	Geoprobe hole discontinued at 12 ft depth				
14					
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-16

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,447,998 E: 1,387,652
GS ELEVATION: ~ 637 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0					
2					Cover Thickness = 3' Waste Thickness = 24' Daily Cover Thickness = N/A
4	Styrafoam				
	Trash				
6					
8	Poor compaction big city trash				
10					
12					
14					
16					
18					
20	Probe falling, hard-void-hard				
22					
24					
26					
28	Feeling uniform				
30					
32					
	Geoprobe hole discontinued at 33 ft depth				
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-17

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,447,950 E: 1,387,550
GS ELEVATION: ~ 6358 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Rocky fill				
2					Cover Thickness = 4' (16') Waste Thickness = 9' Daily Cover Thickness = N/A
4					
	Some intermittent trash ~5-10% MSW				
6					
8	Wood				
10					
12					
14	Feels natural				
16	Geoprobe hole discontinued at 16 ft depth				
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-18

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,447,677 E: 1,387,237
GS ELEVATION: ~ 6296 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover, rocky, moist clay				
2					Cover Thickness = 5' (16') Waste Thickness = 7' Daily Cover Thickness = N/A
4					
6	MSW ~30%				
8					
10	Hard				
12					
14					
16	Geoprobe hole discontinued at 16 ft depth				
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-19

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,447,497 E: 1,386,846
GS ELEVATION: ~ 6241 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover/fill moist, silty				
2					Cover Thickness = 6' (12') Waste Thickness = 4' Daily Cover Thickness = N/A
4					
6	Intermixed MSW ~20%				
8					
10					
12	Geoprobe hole discontinued at 12 ft depth				
14					
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-20

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,447,227 E: 1,386,830
GS ELEVATION: ~ 6220 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Fill/cover				
2					Cover Thickness = 9' (12') Waste Thickness = 2' Daily Cover Thickness = N/A
4					
6					
8	Hard				
	~10% MSW, moist fill				
10					
12	Geoprobe hole discontinued at 12 ft depth				
14					
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-21

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/9/12

COORDS: N: 2,446,933 E: 1,386,240
GS ELEVATION: ~ 6144 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				
2					Cover Thickness = 0' Waste Thickness = 0' Daily Cover Thickness = N/A
	Gravel rocky silt				
4					
6	Fill/cover				
8					
	Cover				
10					
12					
14					
16	Geoprobe hole discontinued at 16 ft depth				
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-22

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/10/12

COORDS: N: 2,446,969 E: 1,386,081
GS ELEVATION: ~ 6136 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover/ fill				
2					Cover Thickness = 0' Waste Thickness = 0' Daily Cover Thickness = N/A
4	Cover/ fill				
6					
8	Cover/ fill				
10					
12	Cover/ fill				
14					
16	Geoprobe hole discontinued at 16 ft depth				
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-23

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/10/12

COORDS: N: 2,446,795 E: 1,386,509
GS ELEVATION: ~ 6168 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover/ fill				
2					Cover Thickness = 10' Waste Thickness = 15' Daily Cover Thickness = N/A
4					
6					
8					
10	MSW				
12					
14	Hard, blast through "serious trash"				
16					
18					
20	Loose, falling, grabby soil on extration				
22					
24	Sample - Wet muddy Rock Rocky, bent inner sampler				
26					
28	Geoprobe hole discontinued at 28 ft depth				
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-24

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/10/12

COORDS: N: 2,447,078 E: 1,386,566
GS ELEVATION: ~ 6188 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0					
2					Cover Thickness = 5' Waste Thickness = 29' Daily Cover Thickness = N/A
4					
	MSW				
6					
8					
10					
12					
14					
16	Poorly compacted				
18					
20	VERY poorly compacted				
22					
24	Voids, easy push				
26					
28					
30					
32					
34					
	Uniform, natural				
36	Sample				
38					
40	Geoprobe hole discontinued at 40 ft depth				

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-25

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/10/12

COORDS: N: 2,447,055 E: 1,386,715
GS ELEVATION: ~ 6205 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				
2					Cover Thickness = 10' Waste Thickness = 16' Daily Cover Thickness = N/A
4					
6					
8					
10	Waste				
12					
14					
16					
18					
20					
22					
24					
26	Natural				
28	Geoprobe hole discontinued at 28 ft depth				
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-26

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/10/12

COORDS: N: 2,447,180 E: 1,386,946
GS ELEVATION: ~ 6223 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				Cover Thickness = 6' Waste Thickness = 16' Daily Cover Thickness = N/A
2					
4					
6	MSW				
8					
10	Loose MSW ~60%				
12					
14					
	Hard garbage				
16					
	Hard garbage				
18					
	SAMPLE - Sample # 7 - GP-26 @ 19'		7	GRAB	
20					
	Geoprobe hole discontinued at 21 ft depth				
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

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TETON GEOPROBES GEOPROBE LOGS.GPJ 30DED11 AMULSAR.GDT 6/22/12

LOG OF GEOPROBE SB-27

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/10/12

COORDS: N: 2,447,352 E: 1,387,023
GS ELEVATION: ~ 6244 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				Cover Thickness = 8' Waste Thickness = 12' Daily Cover Thickness = N/A
2					
4					
6					
8	Hard, MSW, got through				
10					
12					
	MSW				
14					
16					
18					
	Through trash				
20					
22					
24	Geoprobe hole discontinued at 24 ft depth				
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-28

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/10/12

COORDS: N: 2,447,231 E: 1,386,361
GS ELEVATION: ~ 6186 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0	Cover				
2					Cover Thickness = 4' Waste Thickness = 10' Daily Cover Thickness = N/A
4	MSW				
6					
8					
10					
12	Geoprobe hole discontinued at 12 ft depth				
14					
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

LOG OF GEOPROBE SB-29

PROJECT: Teton County Landfill
LOCATION: Jackson, WY
PROJECT NO.: 123-81604

DRILL RIG: Geoprobe
DRILLING METHOD: Geoprobe
DRILLING DATE: 5/10/12

COORDS: N: 2,446,661 E: 1,386,478
GS ELEVATION: ~ 6142 ft
INCLINATION: Vertical

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	MSW	SAMPLES: NUMBER	SAMPLES: TYPE	REMARKS
0					
2					Cover Thickness = 5' Waste Thickness = 29' Daily Cover Thickness = N/A
4					
	MSW Voids, loose				
6					
8					
10	MSW, very wet				
12					
14	MSW, 100%				
16					
18	MSW 100% Wet muddy				
20					
22	MSW ~80% (some soil)				
24					
26	MSW dripping				
28					
30					
32					
34	Geoprobe hole discontinued at 32 ft depth				
36					
38					
40					

DRILLER: Saberprobe
LOGGED BY: CETB
CHECKED BY: JP

Golder Associates

ATTACHMENT A-3

LAB TEST RESULTS

TETON/COUNTY LANDFILL ASSESSMENT
SUMMARY OF SOIL DATA

Sample Type	Sample Number	Sample Depth (ft)	USCS Soil Classification	Delivered Moisture (%)	Atterberg Limits			Grain Size Distribution			Specific Gravity	Moisture/Density Relationship Standard Proctor		Additional Tests Comments (See Notes)
					LL	PL	PI	% Finer 3/4"	% Finer #4	% Finer #200		Dry Density (pcf)	Moisture (%)	
Bag	1 TP-01	1'	CL	--	30	21	9	83	72	55	--	--	--	
Bag	2 TP-02	1.5'	CL	--	30	18	12	100	100	92	--	--	--	
Bag	3 TP-03	20'	GM	--	NP	NP	NP	95	33	13	--	--	--	
Bag	4 TP-04	20'	SC-SM	--	23	19	4	95	83	24	--	--	--	
Bag	5 GP-12	6'		--	24	18	6	--	--	--	--	--	--	
Bag	6 GP-15	10'		--	NP	NP	NP	--	--	--	--	--	--	
Bag	7 GP-26	19'	ML	--	NP	NP	NP	100	100	94	--	--	--	

NOTES:

LL= LIQUID LIMIT
PL= PLASTIC LIMIT
PI= PLASTIC INDEX
SL= SHRINKAGE LIMIT
UW= UNIT WEIGHT
P or Red Indicates Pending test result(s)
* Over size corrected value per ASTM D4718

T = TRIAXIAL TEST
U = UNCONFINED COMPRESSION TEST
C = CONSOLIDATION TEST
DS = DIRECT SHEAR TEST
PERM = PERMEABILITY

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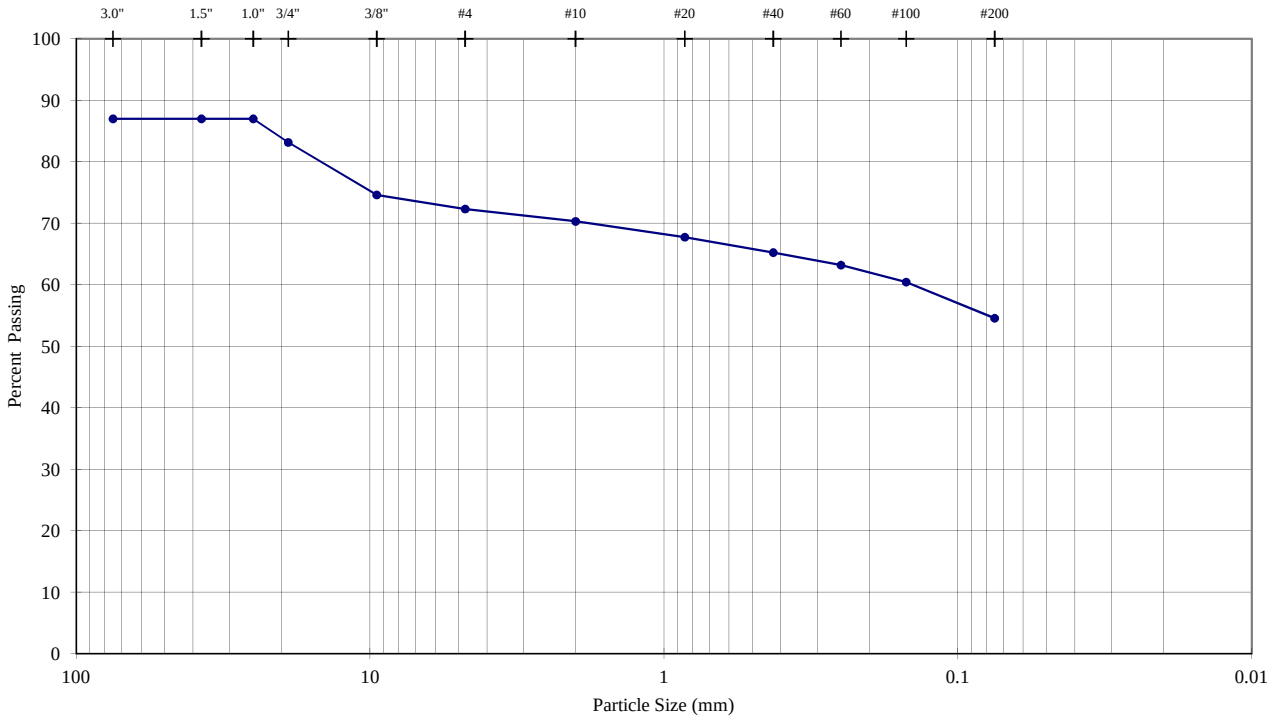
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

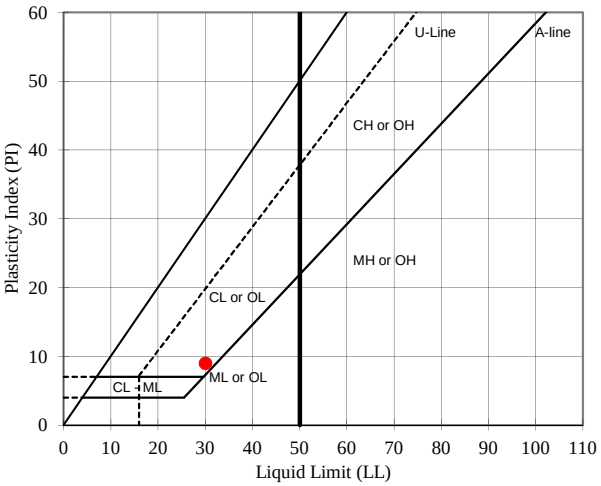
PROJECT NAME: **Teton/County Landfill Support/WY**
SAMPLE ID: **TP-01** Depth (ft): **1**
TYPE: **Bag**



Sieve Analysis (Initial Separation on No. 4 Sieve)

Sieve	Particle Size (mm)	% Passing
3.0"	75.0	**87.0**
1.5"	37.5	**87.0**
1.0"	25.0	**87.0**
3/4"	19.0	**83.2**
3/8"	9.5	**74.6**
#4	4.8	**72.3**
#10	2.00	**70.3**
#20	0.85	**67.7**
#40	0.43	**65.2**
#60	0.25	**63.2**
#100	0.15	**60.4**
#200	0.075	**54.6**

Description	Percentage
Coarse Gravel	**3.83**
Fine Gravel	**10.84**
Coarse Sand	**2.00**
Medium Sand	**5.08**
Fine Sand	**10.67**
Silt or Clay Fines	**54.57**



LL	PL	PI
30	**21**	**9**

Sample Description

Moist, reddish brown sandy, gravelly SILTY CLAY, trace organics

As-Received Moisture Content (%): --

USCS Group Symbol: CL

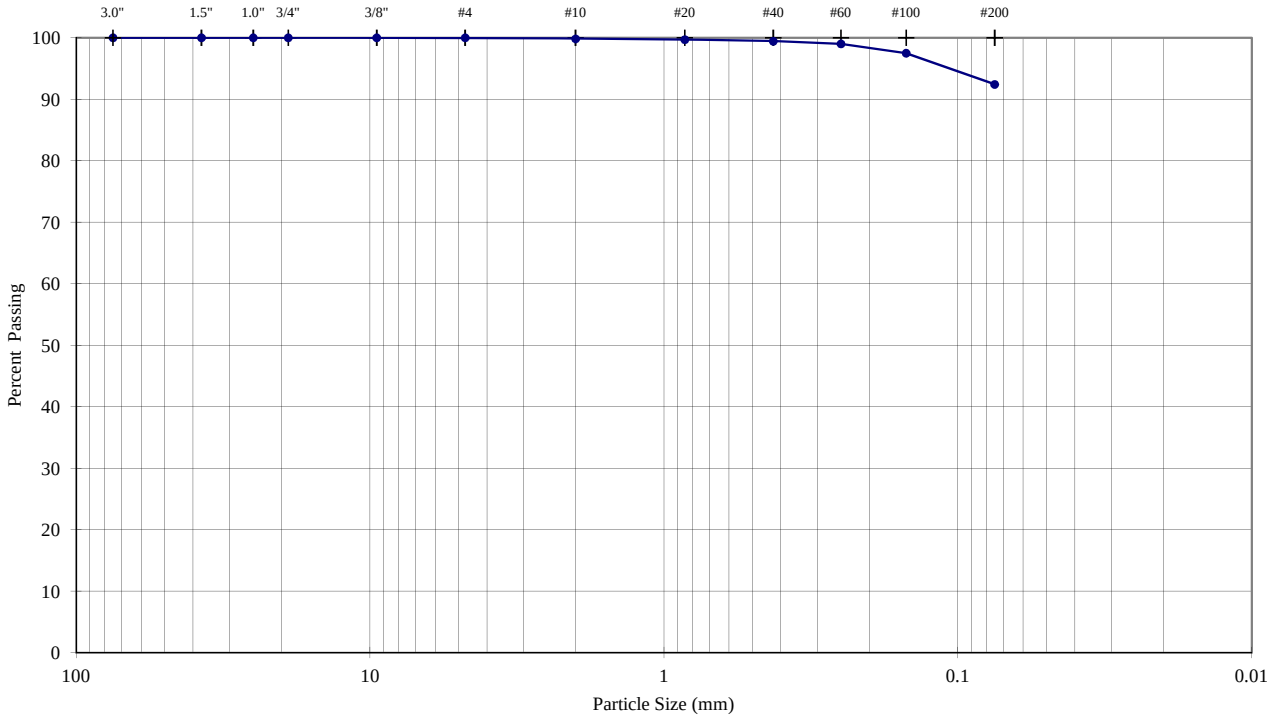
Notes: 0g of particles up to plus 75mm maximum size were removed from particle size analysis sample prior to testing
Particle size analysis sample was not mechanically dispersed; hydrometer test was not performed
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	AM
DATE	6/25/2012
REVIEW	PRH

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

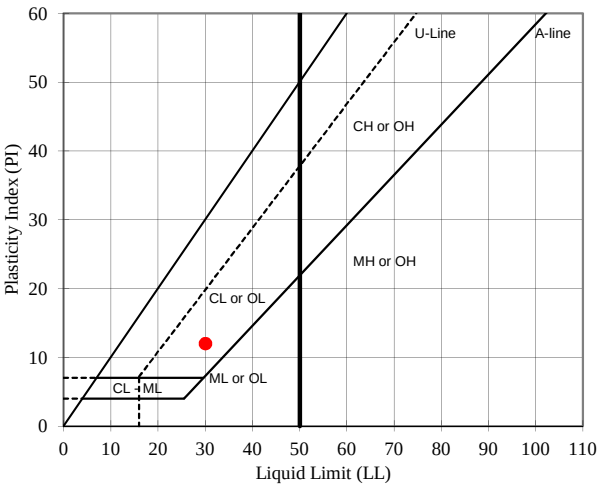
PROJECT NAME: **Teton/County Landfill Support/WY**
SAMPLE ID: **2 TP-02** Depth (ft): **1.5**
TYPE: **Pail**



Sieve Analysis

Sieve	Particle Size (mm)	% Passing
3.0"	75.0	**100.0**
1.5"	37.5	**100.0**
1.0"	25.0	**100.0**
3/4"	19.0	**100.0**
3/8"	9.5	**100.0**
#4	4.8	**100.0**
#10	2.00	**99.8**
#20	0.85	**99.7**
#40	0.43	**99.4**
#60	0.25	**99.0**
#100	0.15	**97.5**
#200	0.075	**92.4**

Description	Percentage
Coarse Gravel	**0.00**
Fine Gravel	**0.00**
Coarse Sand	**0.18**
Medium Sand	**0.39**
Fine Sand	**7.01**
Silt or Clay Fines	**92.42**



LL	PL	PI
30	**18**	**12**

Sample Description

Moist, reddish brown SILTY CLAY, some sand with trace organics

As-Received Moisture Content (%)

--

USCS Group Symbol

CL

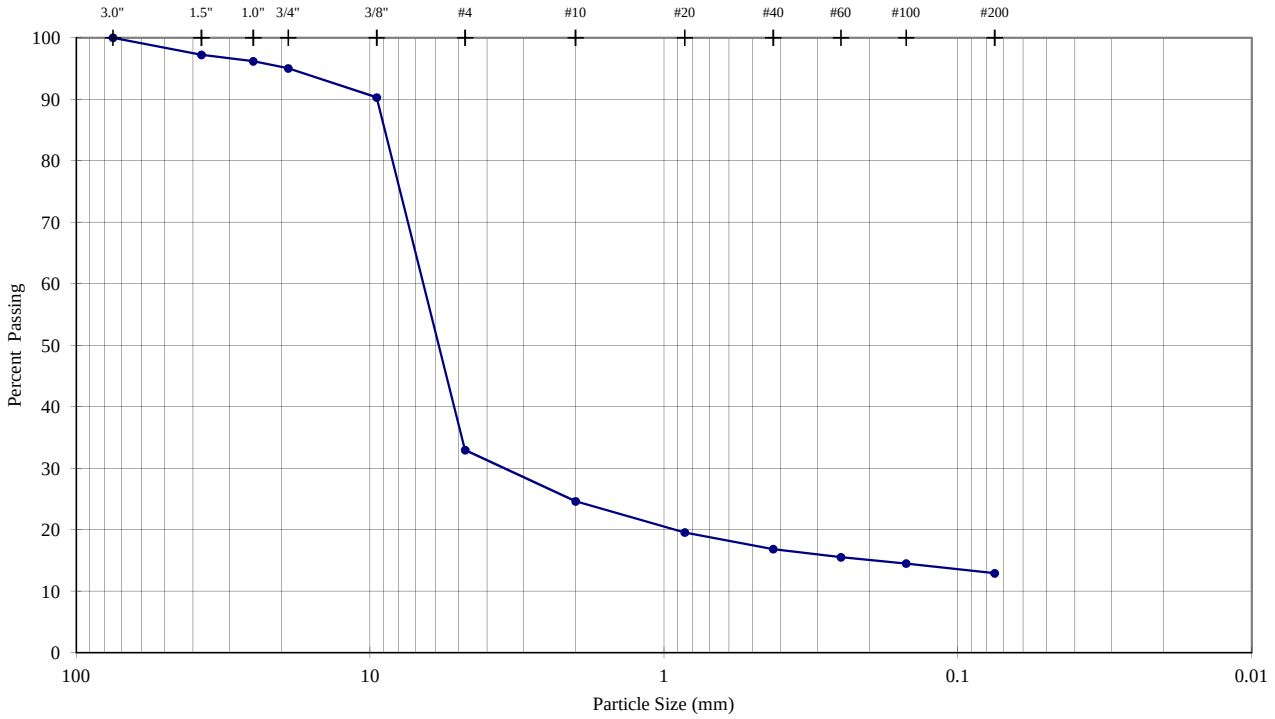
Notes: 0g of particles up to 4.8mm maximum size were removed from particle size analysis sample prior to testing
No initial separation of the sample was performed
Particle size analysis sample was not mechanically dispersed; hydrometer test was not performed
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	PA
DATE	6/7/2012
REVIEW	PRH

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

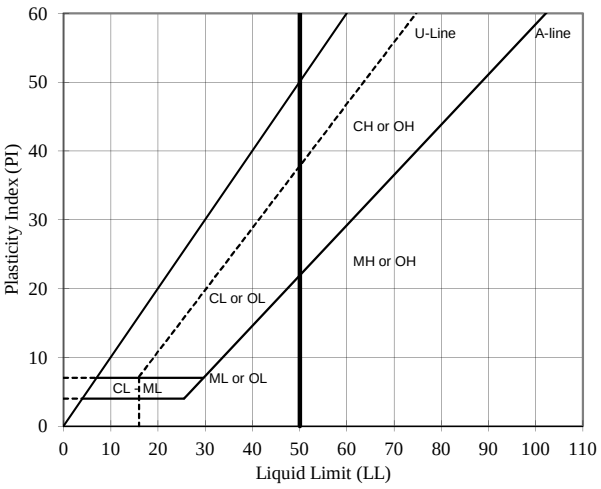
PROJECT NAME: **Teton/County Landfill Support/WY**
SAMPLE ID: **TP-03** Depth (ft): **20**
TYPE: **Bag**



Sieve Analysis (Initial Separation on No. 4 Sieve)

Sieve	Particle Size (mm)	% Passing
3.0"	75.0	**100.0**
1.5"	37.5	**97.2**
1.0"	25.0	**96.2**
3/4"	19.0	**95.0**
3/8"	9.5	**90.3**
#4	4.8	**33.0**
#10	2.00	**24.6**
#20	0.85	**19.6**
#40	0.43	**16.9**
#60	0.25	**15.5**
#100	0.15	**14.5**
#200	0.075	**12.9**

Description	Percentage
Coarse Gravel	**4.98**
Fine Gravel	**62.06**
Coarse Sand	**8.33**
Medium Sand	**7.77**
Fine Sand	**3.93**
Silt or Clay Fines	**12.93**



LL	PL	PI
NP	**NP**	**NP**

Sample Description

Moist, dark yellowish brown sandy SILTY GRAVEL

As-Received Moisture Content (%): --

USCS Group Symbol: GM

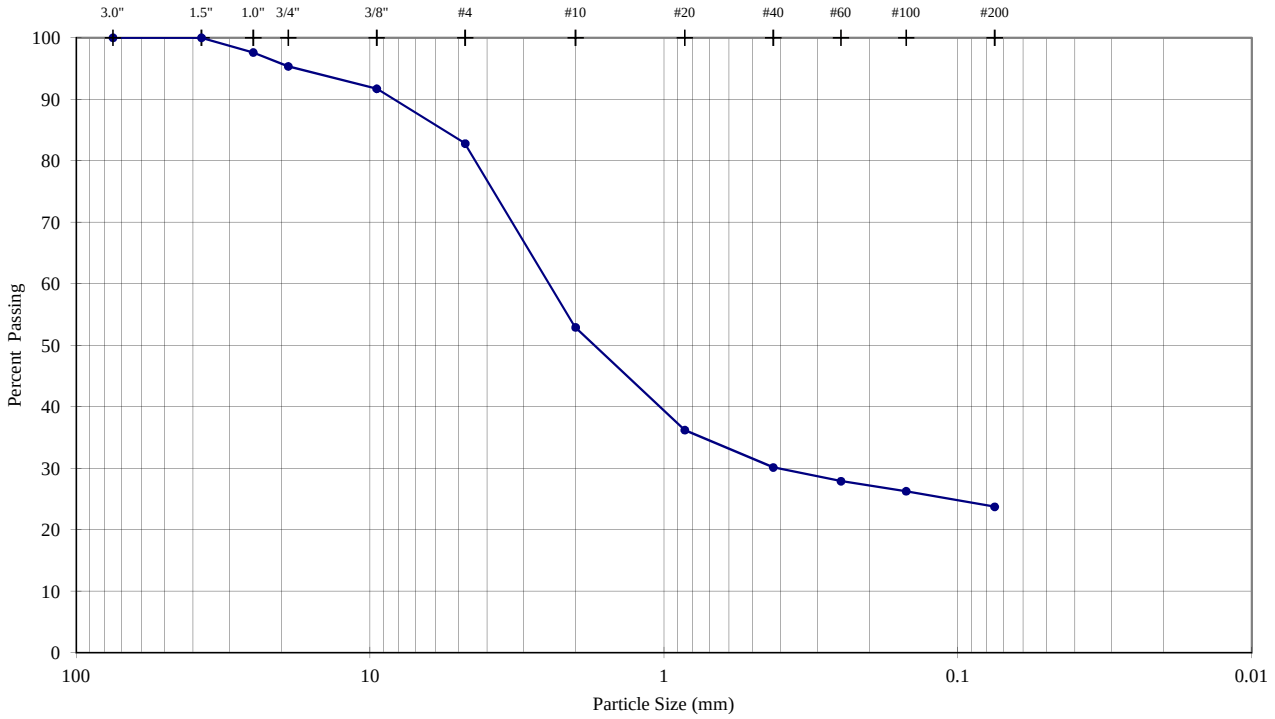
Notes: 0g of particles up to 75mm maximum size were removed from particle size analysis sample prior to testing
Particle size analysis sample was not mechanically dispersed; hydrometer test was not performed
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	AM
DATE	6/25/2012
REVIEW	PRH

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

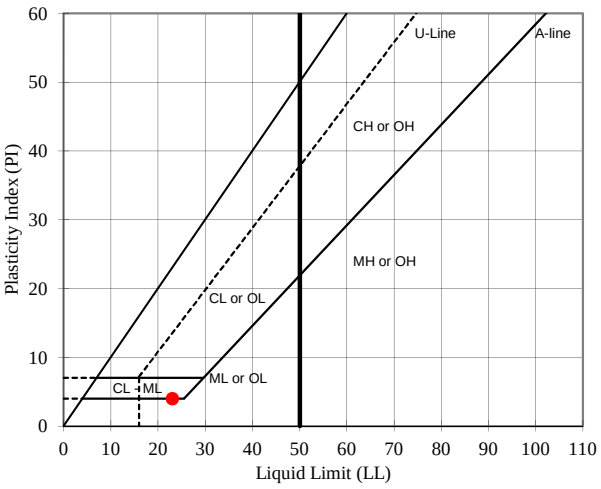
PROJECT NAME: **Teton/County Landfill Support/WY**
SAMPLE ID: **TP-04** Depth (ft): **20**
TYPE: **Bag**



Sieve Analysis (Initial Separation on No. 4 Sieve)

Sieve	Particle Size (mm)	% Passing
3.0"	75.0	**100.0**
1.5"	37.5	**100.0**
1.0"	25.0	**97.6**
3/4"	19.0	**95.4**
3/8"	9.5	**91.7**
#4	4.8	**82.8**
#10	2.00	**52.9**
#20	0.85	**36.2**
#40	0.43	**30.1**
#60	0.25	**27.9**
#100	0.15	**26.3**
#200	0.075	**23.7**

Description	Percentage
Coarse Gravel	**4.65**
Fine Gravel	**12.55**
Coarse Sand	**29.89**
Medium Sand	**22.77**
Fine Sand	**6.40**
Silt or Clay Fines	**23.74**



LL	PL	PI
23	**19**	**4**

Sample Description

Moist, dark yellowish brown silty clayey sand with gravel

As-Received Moisture Content (%): --

USCS Group Symbol: SC-SM

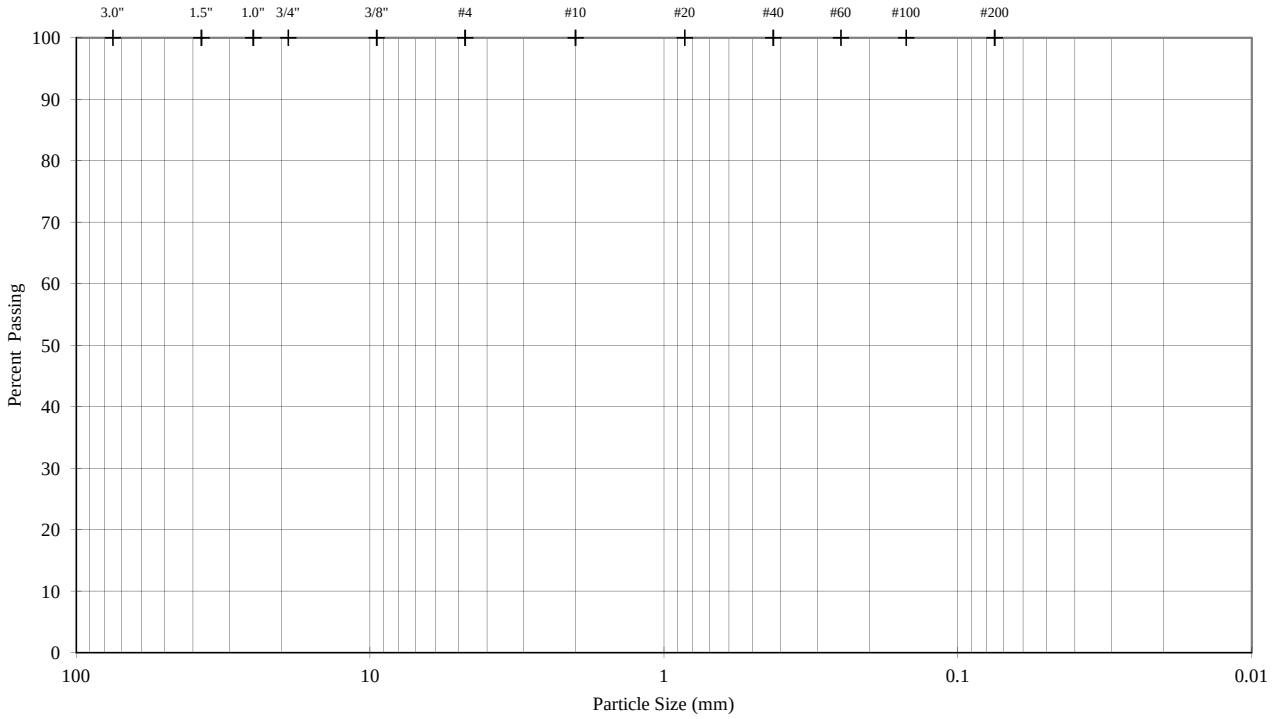
Notes: 0 g of particles up to 37.5 mm maximum size were removed from particle size analysis sample prior to testing
Particle size analysis sample was not mechanically dispersed; hydrometer test was not performed
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	AM
DATE	6/25/2012
REVIEW	PRH

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

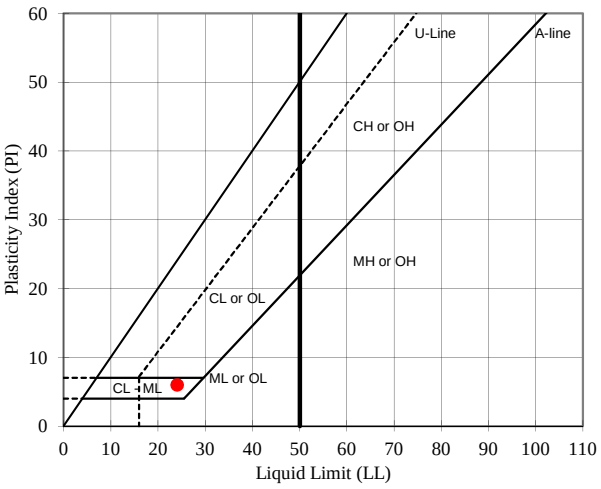
PROJECT NAME: **Teton/County Landfill Support/WY**
SAMPLE ID: **5 GP-12** Depth (ft): **10**
TYPE: **Pail**



Sieve Analysis

Sieve	Particle Size (mm)	% Passing
3.0"	75.0	--
1.5"	37.5	--
1.0"	25.0	--
3/4"	19.0	--
3/8"	9.5	--
#4	4.8	--
#10	2.00	--
#20	0.85	--
#40	0.43	--
#60	0.25	--
#100	0.15	--
#200	0.075	--

Description	Percentage
Coarse Gravel	--
Fine Gravel	--
Coarse Sand	--
Medium Sand	--
Fine Sand	--
Silt or Clay Fines	--



LL	PL	PI
24	**18**	**6**

Sample Description

--

As-Received Moisture Content (%)

#DIV/0!

USCS Group Symbol

--

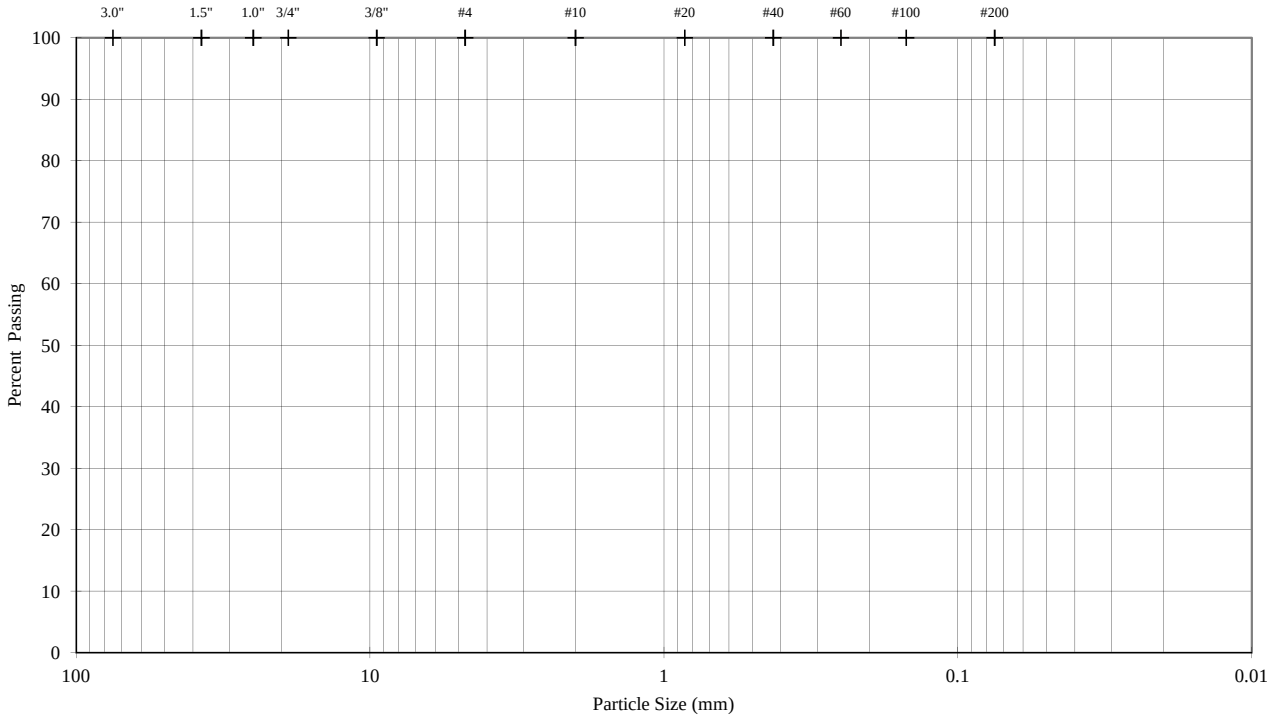
Notes: Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	PA
DATE	6/6/2012
REVIEW	PRH

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

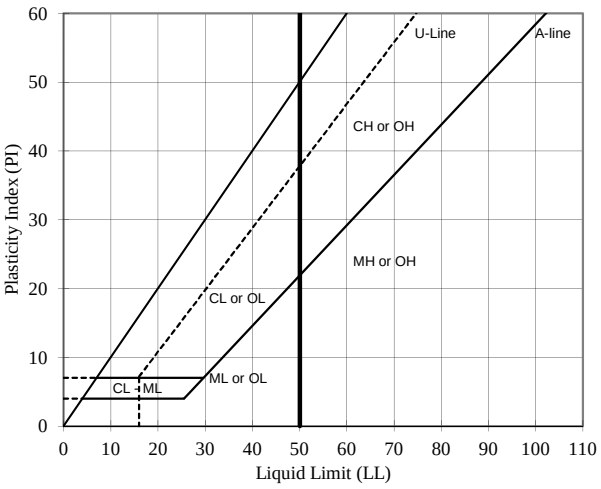
PROJECT NAME: **Teton/County Landfill Support/WY**
SAMPLE ID: **6 GP-15** Depth (ft): **10**
TYPE: **Pail**



Sieve Analysis

Sieve	Particle Size (mm)	% Passing
3.0"	75.0	--
1.5"	37.5	--
1.0"	25.0	--
3/4"	19.0	--
3/8"	9.5	--
#4	4.8	--
#10	2.00	--
#20	0.85	--
#40	0.43	--
#60	0.25	--
#100	0.15	--
#200	0.075	--

Description	Percentage
Coarse Gravel	--
Fine Gravel	--
Coarse Sand	--
Medium Sand	--
Fine Sand	--
Silt or Clay Fines	--



LL	PL	PI
NP	**NP**	**NP**

Sample Description

--

As-Received Moisture Content (%)

--

USCS Group Symbol

--

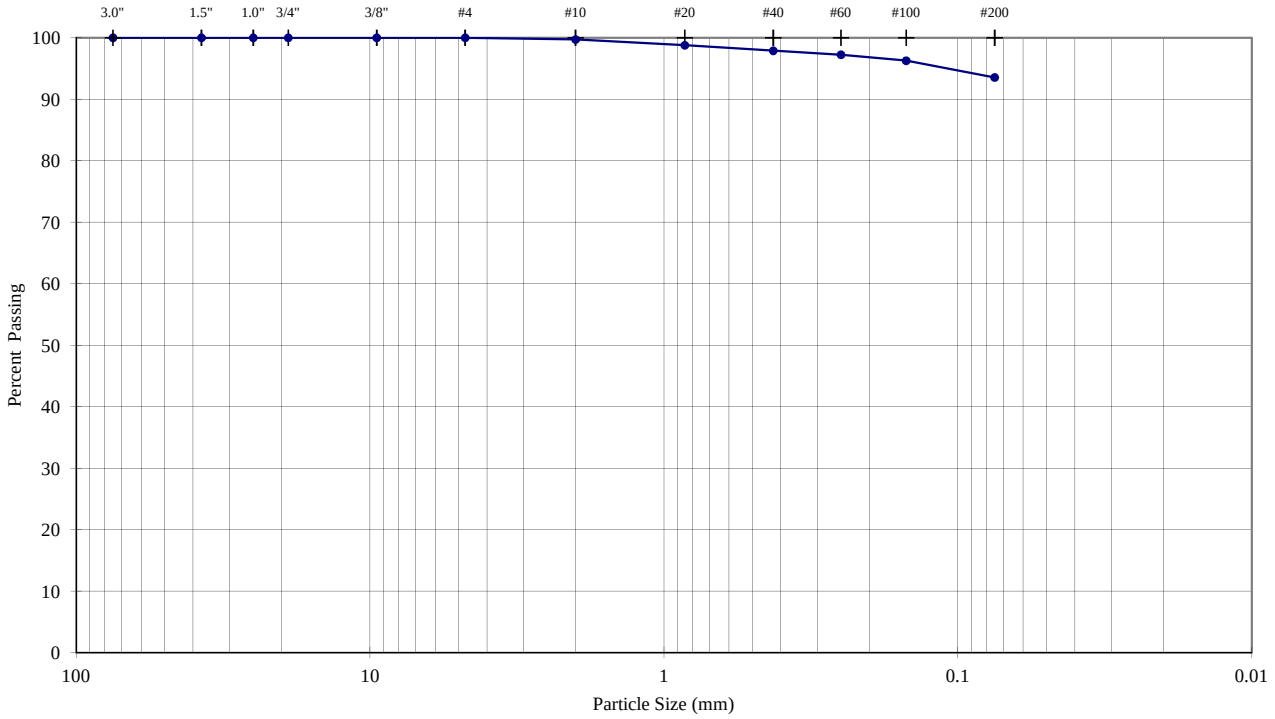
Notes: Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Sample was non-plastic

TECH	JAM
DATE	6/3/2012
REVIEW	PRH

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

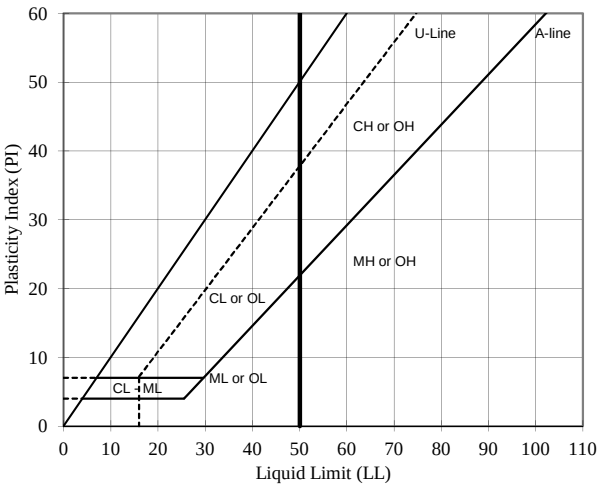
PROJECT NAME: **Teton/County Landfill Support/WY**
SAMPLE ID: **7 GP-26** Depth (ft): **19**
TYPE: **Bag**



Sieve Analysis

Sieve	Particle Size (mm)	% Passing
3.0"	75.0	**100.0**
1.5"	37.5	**100.0**
1.0"	25.0	**100.0**
3/4"	19.0	**100.0**
3/8"	9.5	**100.0**
#4	4.8	**100.0**
#10	2.00	**99.7**
#20	0.85	**98.8**
#40	0.43	**97.9**
#60	0.25	**97.2**
#100	0.15	**96.3**
#200	0.075	**93.6**

Description	Percentage
Coarse Gravel	**0.00**
Fine Gravel	**0.00**
Coarse Sand	**0.28**
Medium Sand	**1.83**
Fine Sand	**4.34**
Silt or Clay Fines	**93.55**



LL	PL	PI
NP	**NP**	**NP**

Sample Description

Dry, light gray SILT, some sand

As-Received Moisture Content (%)

--

USCS Group Symbol

ML

Notes: 0g of particles up to 4.8mm maximum size were removed from particle size analysis sample prior to testing
No initial separation of the sample was performed
Particle size analysis sample was not mechanically dispersed; hydrometer test was not performed
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	PA
DATE	6/7/2012
REVIEW	PRH

ATTACHMENT A-4

SURVEY REPORT

Project Number: 120026

Teton County Landfill Closure

Survey Report

Prepared for Golder and Associates, Inc

Prepared by ECS, LLC on behalf of Solid Waste Professionals

Date: June 18, 2012

Purpose

This report has been prepared to document the methods, accuracies and results of a topographic survey and mapping of the Teton County Landfill performed May 9-10, 2012 by ECS LLC.

Scope

The project consisted of four major tasks:

1. Establish horizontal and vertical control in conformance with the "TC Transfer Station Existing Topo" drawing (Topo) provided to ECS by the client.
2. Extend 5' contour interval mapping to contain the additional 53 acres to the northeast of the existing site.
3. Locate geophysical test pits and borings conducted by Golder and Associates.
4. Locate current location of material piles on the Teton County Landfill property.

Datum and Projection

The survey was calibrated to survey monuments provided in the "TC Transfer Station Existing Topo.DWG" provided by Teton County. That drawing purports to be based on "NAD83 Wyoming West State Plane Coordinates with a ground scale factor of 1.0003 applied to the distances. The vertical datum is NGVD-29 TC-GIS".

The calibration resulted in the following Datum and Projection:

Datum - WGS 84

Projection - Local site according to "TC Transfer Station Existing Topo.DWG"

Vertical Datum – NGVD-29

Units – US Survey Feet

Procedure

The survey was carried out using Trimble Real-time Kinematic Geographic Positioning System (RTK) and Robotic Total Station survey equipment in proper adjustment. The grid coordinates (Northing, Easting and Elevation) of several survey control points were extracted from the existing Topo as a basis for the survey. A "field calibration" was performed by measuring the latitude, longitude and height of 5 control points with RTK and collating the relationship with the extracted grid coordinates. A maximum residual of 0.036' horizontally and 0.043' vertically was noted. The results can be found in Table 1.

Additional topographic information was measured using the RTK and robotic equipment in "Rapid" point and "Continuous" topo modes with an accuracy of 0.1' horizontally and 0.2' vertically to a 95% confidence level. Measurements were made to new topographic locations, all test holes and borings and existing topography. The results of which were compiled through "Autodesk Civil 3D" and merged with the existing Topo.

Numerous discrete points such as road edges, junction boxes and building corners were measured as a quality control check on the accuracy of the survey data with respect to the existing Topo. A random sampling of these points proved that the methods and procedures used during this survey delivered a satisfactory product.

Conclusion

The survey meets ASPRS Accuracy Standards for Large Scale Maps dated March 1990.

Table 1
Teton LF Control Point Report

Point ID	Northing	Easting	Elevation	Latitude (Global)	Longitude (Global)	Height (Global)	Horizontal Residual	Vertical Residual	Description
1	1386169.828	2446674.008	6130.71	N43°24'06.40027"	W110°45'11.23322"	6110.741	0.036	-0.040	5/8" REBAR BM
3	1386678.315	2447806.074	6341.19	N43°24'11.52041"	W110°44'55.96787"	6321.648	0.027	-0.005	SPIKE
11	1385571.834	2446743.157	6075.39	N43°24'00.50265"	W110°45'10.22457"	6055.522	0.006	0.043	Concrete ROW Monument
22	1385549.941	2447929.68	6168.78	N43°24'00.39131"	W110°44'54.15731"	6149.255	0.033	-0.020	GLO Brass Cap
23	1386875.761	2447939.955	6333.02	N43°24'13.48133"	W110°44'54.17887"	6313.552	0.010	0.022	GLO Brass Cap
100	1388371.42	2448317.118	6507.903	N43°24'28.27987"	W110°44'49.25202"	6488.590	NA	NA	Set ECS 5/8" REBAR & Aluminum Cap
102	1388072.87	2448316.001	6450.974	N43°24'25.33243"	W110°44'49.23106"	6431.700	NA	NA	Set ECS 5/8" REBAR & Aluminum Cap

APPENDIX B

DRAFT NATURE AND EXTENT OF CONTAMINATION WORK PLAN

(THIS APPENDIX HAS MOVED TO APPENDIX B OF THE ENVIRONMENTAL ASSESSMENT)

APPENDIX C

HOBACK FAULT TECHNICAL MEMO

TECHNICAL MEMORANDUM

Date:	July 13, 2012	**Project No.:**	123-81604.0002
To:	Mark McClain	**Company:**	Golder Associates Inc., Denver
From:	Alan Hull, Ph.D., C.E.G., Principal, Seismic Hazard Practice Leader Donald Lowry, C.E.G., Senior Project Geologist		
cc:		**Email:**	mmcclain@golder.com
RE:	**ACTIVITY ASSESSMENT FOR HOBACK FAULT, TETON LANDFILL, TETON COUNTY, WYOMING**		

The technical memorandum provides an office-based analysis of the history and development of potential Quaternary surface displacements of the Hoback fault within and surrounding the Teton Landfill.

1.0 INTRODUCTION

The Teton Landfill is an existing waste disposal facility constructed within Horsethief Canyon, about 3 km (1.8 miles) northwest of Game Creek, within Teton County in west-central Wyoming. The Hoback Fault is a southwest-dipping normal-slip fault located within Neogene rocks that have been uplifted and folded. Existing geological mapping within and surrounding the Teton Landfill site indicates that the Hoback fault probably extends through the landfill footprint. Renewed movement of this part of the Hoback fault could generate surface fault rupture along the fault trace to generate large, coseismic differential displacements and very strong ground shaking.

Part of the Golder Associates Inc. (Golder) engineering workplan includes analyses of the Teton Landfill include an assessment of the potential for any large differential displacements within the landfill footprint. Accordingly, Golder has undertaken this office-based analysis of readily available information on the record of Quaternary (last 1.8 million years) surface fault movements along the Hoback fault. Our analyses included:

- a review of published geological maps and reports that describe the location and geological evolution of the Hoback fault;
- access to the U.S. Geological Survey Quaternary Fault and Fold Database for the Hoback fault (Pierce 1999); and
- preparation and review of this technical memorandum.

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2.0 THE HOBACK FAULT

In this section we present a brief summary of the geological evolution of the Hoback fault, including the available evidence for Quaternary surface displacement.

2.1 Geological Development of the Hoback Fault

The Hoback fault is a northwest-southeast-striking, and southwest-dipping normal fault that formed in as part of the crustal deformation and mountain formation associated with Laramide Orogeny that initiated in the Late Cretaceous, 70 to 80 million years ago, and ended 35 to 55 million years ago. Geologic mapping and interpretation suggests that regional thrust faults active during the formation and movement of the Hoback Fault include the Bear Thrust, the Cliff Creek Thrust--both northeast-verging thrust faults-- and the southwest-verging Cache Creek Fault (Olson and Schmitt 1987). Figures 1 is schematic regional fault maps illustrating the location and sense of movement of the major regional faults. Figure 2 is a northwest-southeast cross-section showing the inferred relationships of these major faults.

Formation and initial displacement along the Hoback fault began during the Late Miocene as suggested by deposition of conglomerates that comprise the upper member of the Camp Davis Formation of Love (1977). The Camp Davis Formation (Love 1977) consists of about 1,500 m (5,000 feet) of conglomerate and agglomerate materials (Love 1956) that were shed from the growing Hoback fault scarp.

The Camp Davis Formation comprises three distinct units: the lower, middle and upper members. Fission-track zircon ages of grains within the lower member of the Camp Davis Formation were reported by Love and Ver Ploeg, (1993) to range from 9.2 to 5.0 Million years (Ma). The lower member consists of 76 m (250 feet) of cliff-forming conglomerate with limestone and dolomite clasts within a gray sandy limestone matrix. The middle member is a 61 m (200foot) thick sequence of white, gray and pink limestone capped by a chocolate-colored claystone, interbedded with a poorly consolidated conglomerate. The upper member is more than 1,200 m (4,000 feet) of red conglomerate, coarsest near the top of the unit (Love 1956).

2.2 Evidence for Quaternary Surface Fault Rupture

The timing of movement of the Hoback fault can be described through the age and development of the type of sediments and geological structures of the Camp Davis Formation. The lack of crystalline rocks in sediments of the lower member suggests that movement of the Hoback fault occurred prior to the major uplift of the Teton Fault block (Late Miocene) (Horberg et al. 1949). The location of the lower member 1.6 km (one mile) from the Hoback fault and the thin beds of the lower and middle members suggest that motion of the Hoback fault probably postdate the deposition of the lower and middle members of the Camp Davis formation. The extensive thickness and the coarse nature of alluvial deposits of the upper member suggest that growth of the Hoback fault and rapid erosion of the fault scarp occurred during its deposition. Movement of the Hoback fault continued after the deposition of the Camp Davis Formation,

and concurrent with the main Teton faulting event that north of the Hoback River tilted the Camp Davis Formation to the east (Horberg et al. 1949).

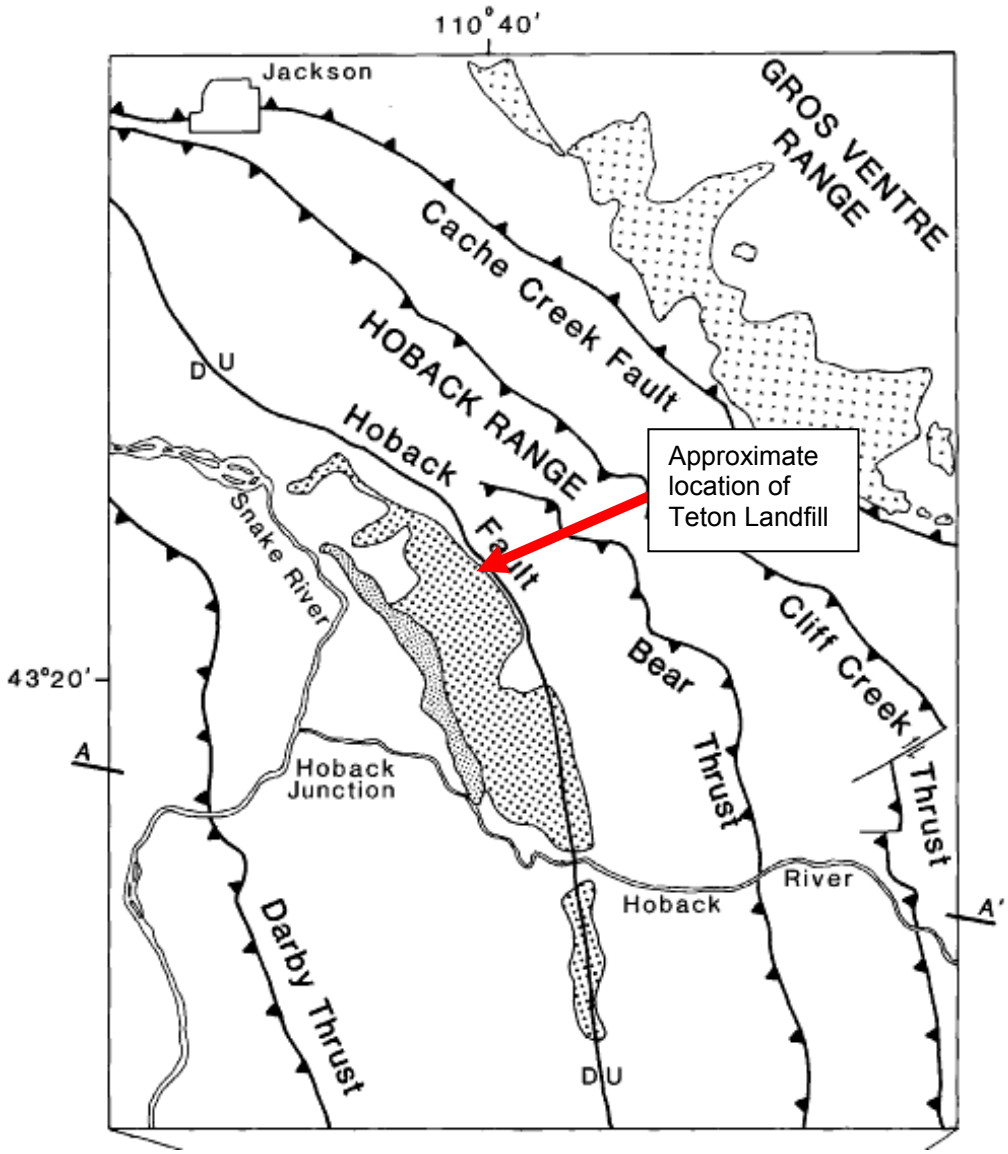

Figure 1: Map showing relationship between the Hoback Fault and regional thrust faults active during the late Miocene (Olson and Schmitt 1987).

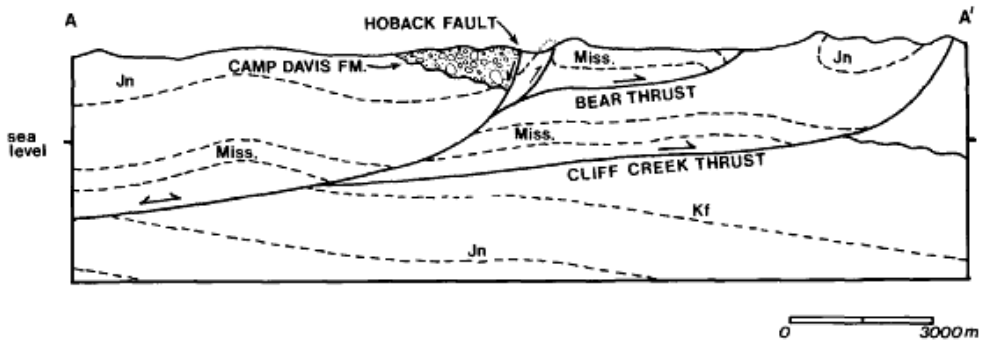

Figure 2: Cross section A-A' (see Figure 1) showing relationship of the regional thrust faulting and the normal Hoback Fault. A portion of the Bear Thrust shows evidence of reactivation, possibly in response to the formation of the Teton Range (Olson and Schmitt 1987).

South of the Hoback River about 16 km (10 miles) southeast of the Teton Landfill, beds of the upper member of the Camp Davis Formation bury the Hoback fault trace (Horberg et al. 1949). Burial by Neogene sediments indicates that at this location the Hoback fault has no evidence for Quaternary displacement. North of the Hoback River, scarps are present along 0.8 km (0.5 miles) of the Hoback fault at Game Creek (Love 1956). These scarps, which are as much as 10 m (33 feet) high, suggest multiple surface rupturing events. The scarps are preserved on Bull Lake glacial terrain that was deposited about 140,000 years ago. Thus, it seems geologically reasonable that this section of the Hoback fault has late Quaternary (<130 ka) displacement, although this location is more than 130 km (81 miles) to the southeast of the Teton Landfill site.

The Hoback Fault is considered a Class B fault by the U.S. Geological Survey (Pierce 1998). The fault trace is not shown in their Quaternary Fault and Fold Database, although Peirce (1998) provides information on the nature and displacement history of the Hoback fault. A Class B fault is one in which geologic evidence demonstrates the existence of Quaternary deformation, but either (1) the fault might not extend deeply enough to be a potential source of significant earthquakes, or (2) the currently available geologic evidence is more than sufficient to assign the feature to Class C but insufficient to assign it to Class A.

Peirce (1998) provides on a Class B fault classification for the Hoback fault because:

- evidence for the presence if Quaternary displacement is generally absent;
- the total length of known fault scarps is very limited; and
- a landslide origin for these inferred fault scarps has been postulated, and because of the very limited lengths of preserved scarps.

3.0 CONCLUSIONS

Available evidence suggests that the Hoback fault was active principally during the late Miocene and, though its sense of movement is normal, it was formed in response to and structurally above the more prominent thrust faults formed during regional contraction from the Late Cretaceous to the late Miocene. The fault probably formed by reactivation of part of the Bear Thrust (Figure 1). There is no evidence for Quaternary surface faulting south of the Hoback River. North of the Hoback River, several small scarps up to 10 m high (33 feet) are preserved on a glacial terrace with an estimated Late Quaternary age (140,000 years). The scarps are preserved over a length of about 800 m (0.5 km), although they may have a landslide rather than a tectonic origin.

The absence of positive and conclusive evidence for Quaternary displacement along the Hoback fault has lead to its Class B fault classification, and the exclusion of the fault trace within the U.S. Geological Quaternary Fault and Fold Database. Geologic and geomorphic information indicates a very low probability for future surface fault rupture along the section of the Hoback fault mapped within the footprint of the Teton Landfill.

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APPENDIX B
DRAFT NATURE AND EXTENT OF CONTAMINATION WORK PLAN FOR THE TETON COUNTY LANDFILL

WORK PLAN

NATURE AND EXTENT OF CONTAMINATION WORK PLAN FOR THE TETON COUNTY LANDFILL

TETON COUNTY, WYOMING

DRAFT

Submitted To: Teton County
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Jackson, WY 83001

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June 2012

Project No. 123-81604

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1.0 INTRODUCTION

Golder Associates Inc. (Golder) has been retained by Teton County (the County) to prepare this Work Plan for conducting a "Nature and Extent of Contamination" evaluation (Nature & Extent) for the Teton County Landfill (the Landfill or the Site). This Nature & Extent Work Plan has been prepared coincident with, but reported separately from, the closure Alternatives Evaluation.

The primary objective of the Work Plan is development of a plan to determine the nature and extent of a release from the Landfill in accordance with applicable Wyoming Department of Environmental Quality (WDEQ) Solid Waste Rules and Regulations. The WDEQ requires characterization of the nature and extent of a release when one or more Appendix B constituents are detected in groundwater monitoring wells at statistically significant levels above the WDEQ groundwater protection standards (GPS)(established by the Administrator).

1.1 Background

The subject property is located approximately seven miles south of the Town of Jackson along Highway 26/89/189/191, in an area known as Horsethief Canyon (Figure 1). The property encompasses approximately 40.5 acres owned by Teton County in the SW1/4 of the NW1/4 of Section 27, Township 40 North, Range 116 West, in Teton County, Wyoming and an adjacent 17.8-acre United States Forest Service (USFS) parcel to the north of the 40.5 acre parcel, hereinafter called the Site. Approximately 37.7 of the 40.5 acres lie northeast of the highway right-of-way and contain the Teton County Landfill and the Transfer Station. The southeast corner of the noted 37.7 acres lies in an adjacent canyon and encompasses a portion of a public shooting range. The balance of the 40.5-acre parcel, in the southwest corner of Section 27, is used as a right-of-way for Highway 26/89/189/191 (approximately 2.79 acres) and to access adjacent parcels (approximately 0.05 acres).

There are two permanent structures on the 40.5-acre tract: a scale house and a municipal solid waste transfer station. In addition, a compost facility currently operates on the Site. Internal roads are gravel surfaced.

The Site was used as a community landfill beginning during the 1960's and possibly 1950's, and continuing into the 1980's. In 1989, all landfill operations ceased and portions of the Site, which had been used as a municipal solid waste landfill, were capped with approximately 18 inches of compacted soils and six inches of topsoil, as per applicable state closure standards at that time (WDEQ, 1975). Methane gas and groundwater monitoring wells have been installed on the Site.

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Four groundwater monitoring wells (GW-3, GW-4, GW-5A, and GW-5B) were installed in mid-2007 (Figure 2), and all have 20 foot-long well screens. Well pair GW-5A and GW-5B were completed to depths of 179 and 100 feet below ground surface (bgs), respectively. Wells GW-3 and GW-4 were installed to depths of 197 and 165 bgs, respectively.

These four wells have been sampled quarterly for WDEQ Appendix A (Detection Monitoring) constituents since June 2008. Golder has included summary data collected since June 2008, but the specific reports for 2008 and 2009 and select dates thereafter have not been reviewed in detail for this report. Based on these data, only well GW-5B has exhibited detections of volatile organic compounds (VOCs). Well GW-5B is situated upgradient of wells GW-3 and GW-4, which are near the southerly (hydraulically downgradient) property boundary (Figure 2). The first semi-annual groundwater Assessment Monitoring sampling event was conducted in October 2011 (Alder, 2011d).

1.2 Work Plan Components

The main Work Plan Components are organized as follows:

- Section 2: Background evaluation of existing data and reports provided to Golder
- Section 3: Develop a preliminary Conceptual Site Model (CSM)
- Section 4: Identify data gaps and develop a work plan to address these gaps
- Section 5: Data Evaluation and Nature and Extent Reporting

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2.0 BACKGROUND EVALUATION OF EXISTING DATA AND REPORTS

The following list of reports or documents were provided by the County and reviewed as part of the background evaluation:

- *Subsurface Study for the Proposed Teton County Solid Waste Transfer Station to be Located Approximately Seven Miles South of Jackson, Wyoming*, by Chen & Associates, dated December 11, 1987.
- Nelson Engineering, set of 43 drawings for *Solid Waste Transfer Station Project*, Teton County, Wyoming, dated March 1988.
- Landfill Transfer Audit Teton County Horsethief Canyon Sanitary Landfill / Transfer Station prepared for Teton County by Environmental Engineering Solutions of Lander, Wyoming, dated January 20, 2006.
- *Geotechnical Site Investigation Report, Teton County Composting Facility, Teton County, Wyoming* prepared for Jorgensen Associates of Jackson, Wyoming by Womack & Associates, Inc. of Jackson, Wyoming, dated May 21, 2007.
- *Horsethief Canyon Landfill Groundwater Monitoring Report January 2010 WDEQ-SHWD #10.616*, prepared for Teton County Integrated Solid Waste and Recycling by Inberg-Miller Engineers of Casper, Wyoming, dated March 16, 2010.
- *Environmental Monitoring Report Second Quarter/April 2010 Sampling Event Horsethief Canyon Landfill WDEQ-SHWD #10.616*, prepared for Teton County Integrated Solid Waste and Recycling by Inberg-Miller Engineers of Casper, Wyoming, dated May 24, 2010.
- *Environmental Monitoring Report Fourth Quarter/October 2010 Sampling Event Horsethief Canyon Landfill WDEQ-SHWD #10.616*, prepared for Teton County Integrated Solid Waste and Recycling by Alder Watershed Consulting LLC of Jackson, Wyoming, dated November 29, 2010.
- *Environmental Monitoring Report First Quarter/January 2011 Sampling Event Horsethief Canyon Landfill WDEQ-SHWD #10.616*, prepared for Teton County Integrated Solid Waste and Recycling by Alder Watershed Consulting LLC of Jackson, Wyoming, dated January 28, 2011.
- *Environmental Monitoring Report Second Quarter/April 2011 Sampling Event Horsethief Canyon Landfill WDEQ-SHWD #10.616*, prepared for Teton County Integrated Solid Waste and Recycling by Alder Environmental LLC of Jackson, Wyoming, dated May 25, 2011.
- *Environmental Monitoring Report 3rd Quarter/July 2011 Sampling Event Horsethief Canyon Landfill WDEQ-SHWD #10.616*, prepared for Teton County Integrated Solid Waste and Recycling by Alder Environmental LLC of Jackson, Wyoming, dated August 10, 2011.
- *Environmental Monitoring Report 4th Quarter/October 2011 Sampling Event Horsethief Canyon Landfill WDEQ-SHWD #10.616*, prepared for Teton County Integrated Solid Waste and Recycling by Alder Environmental, LLC of Jackson, Wyoming, dated December 19, 2011.
- *Environmental Monitoring Report 2nd Quarter/April 2012 Sampling Event Horsethief Canyon Landfill WDEQ-SHWD #10.616*, prepared for Teton County Integrated Solid Waste and Recycling by Alder Environmental, LLC of Jackson, Wyoming, dated June 8, 2012

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The following summarizes the key aspects of these reports that are relevant to this Nature & Extent Work Plan. The locations of test pits, boreholes, and monitoring wells installed during these investigations are shown on Figure 2.

Chen 1987 Proposed Solid Waste Transfer Station Report

Chen & Associates dug six test pits (TP-8 through TP-13) to a maximum depth of about 20 feet and advanced eight exploratory borings (B-1 through B-8) to a maximum depth of about 35 feet on October 19 through 21, 1987. Groundwater was not encountered in either the test pits or soil borings. An open ended "permeability" test was conducted in an offset borehole advanced to 16 feet adjacent to borehole B-8, that resulted in an "in-place permeability" of 5.0 x 10^{-7} centimeters per sec (cm/sec).

The test pits were located in the proposed borrow area on the ridge east/southeast of the landfill. The soils in the borrow area consisted of topsoil over clayey silt and the clayey silt contained a clayey to silty gravel layer varying between 1 to 6.5 feet in depth in each test pit. The boreholes were located in the vicinity of the solid waste transfer station and scale house in the southern portion of the Site, and were included on the Nelson Engineering 1988 drawings, as further discussed below.

Nelson Engineering 1988 Set of 43 Drawings

Nelson Engineering Drawing No. 5 of 43 showed locations and details of six test pits that they advanced in August 1987 to a maximum depth of about 17 feet, plus the eight boreholes B-1 through B-8) advanced by Chen & Associates in October 1987. Nelson's test pits were identified as N.E. 1 through N.E. 6 (hereafter referred to as NE-1 through NE-6). These test pits were located in the vicinity of the solid waste transfer station and scale house in the southern portion of the Site. Landfill waste was encountered in the test pits at several locations to a maximum depth of 12 feet below ground surface. Several of the test pits (NE-2, NE-3, and NE-4) and boreholes (B-2, and B-5 though B-8) were reported to have encountered a unit described as sandstone-siltstone bedrock at minimum depths of 14 and 27 feet, respectively. In these boreholes, this unit was immediately overlain by clayey to silty gravel.

EES 2006 Landfill Transfer Audit

A detailed discussion of the mapped geology was provided identifying that Horsethief Canyon is covered by Quaternary aged alluvial fan deposits and loess. These deposits are described as being underlain by varying thickness of Quaternary breccia deposits. The geology and structure of the canyon is dominated by the northwest-southeast trending Hoback Fault system, which generally transects the upper portion of the canyon and the Landfill. The bedrock on the southwest down-thrown side of the fault reportedly consists of the Cretaceous Aspen Shale formation containing shales, claystones, siltstones, and sandstones with thin beds of chert (variety porcellanite), bentonite, and coal. The bedrock on the northeast up-thrown side of the fault reportedly consists of near vertical deposits of limestone of the Mississippian Madison Limestone formation.

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The Audit identified that a water supply well was installed in 1988 at about 1000 feet south/southeast of the southeast corner of the Site on land administered by the USFS. The well was drilled to a depth of 295 feet and screened from 220 to 231 and 247 to 259 feet. The top of the first water bearing unit was encountered at a depth of 184 feet.

Two monitoring wells were installed in 1990 with MW-1 being located near the mouth of Horsethief Canyon and MW-2 being in the upper reaches of the canyon. Both were drilled to a depth of 110 feet. The well screens were set for MW-1 from 30 to 50 feet and MW-2 from 80 to 100 feet bgs, respectively. Both wells have remained dry.

Two methane monitoring wells were also installed in 1990 to depths of about 25 to 28 feet bgs. Methane Well Nos. 1 and 2 were screened from 8 to 28 and 5 to 25 feet, respectively. Methane Well No. 1 was located southeast of the transfer station, adjacent to dry well MW-1 and near the western portion of the Site. Methane Well No. 2 was located northwest of the transfer station, near the northern boundary of the Site. Beginning in March and April 2001, methane began to be detected in excess of 25% of the lower explosive limit (% LEL) in Methane Well Nos. 1 and 2, respectively. However, monitoring of the methane venting system for the scale house and transfer station, as well as the closest enclosed structure on the nearby public shooting range, has reportedly never detected methane at the % LEL level.

Womack 2007 Geotechnical Site Investigation Report

A discussion of the mapped geology was provided identifying that the mouth of the Horsethief Canyon is covered by Quaternary aged alluvial fan deposits consisting of gravel, silt, and clay. The bedrock ridges bordering the Site are mantled by windblown silt loess, while the side slopes consist of a colluvial mixture of loess and rock fragments. Bedrock was reported as being mapped as limestone and dolomite units.

Four test pits (TP-1 through TP-4) were advanced to a maximum depth of 9.8 feet and eight boreholes (BH-1 through BH-4) were advanced to a maximum depth of 41.5 feet. Landfill waste was encountered to a maximum depth of 40 feet below ground surface. The boreholes were terminated in predominately silty gravel to gravelly silt. Groundwater was not encountered during their advancement.

Inberg-Miller January 2010 (1st Quarter) Groundwater Monitoring Report

January 2010 consisted of the sixth groundwater sampling event for monitoring wells GW-3, GW-4, GW-5A, and GW-5B. Groundwater was encountered at depths between about 87 to 107 feet bgs and sloped to the south/southeast. Chlorinated VOCs were detected in well GW-5B, which were considered indicative of a landfill-related source. Of these VOCs, methylene chloride at 19 micrograms per liter (µg/L) exceeded the WDEQ GPS of 5 µg/L.

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Inberg-Miller April 2010 (2nd Quarter) Groundwater Monitoring Report

April 2010 was the seventh groundwater sampling event. Groundwater levels and the flow direction were very similar to the previous sampling event. A dedicated low-flow bladder pump was used to sample well GW-5B, but the other three wells had to be purged and sampled using bailers due to problems with their bladder pumps. Chlorinated VOCs were again detected in well GW-5B, but did not exceed the WDEQ GPS. Exceedances of the GPS were noted for arsenic and manganese in wells GW-3, GW-4, and GW-5A; chemical oxygen demand (COD) in wells GW-3, GW-4, and GW-5B; iron in well GW-3, thallium in well GW-5A; and bicarbonate and total dissolved solids (TDS) in well GW-5B.

Alder Watershed October 2010 (4th Quarter) Groundwater Monitoring Report

October 2010 was the ninth groundwater sampling event. Groundwater levels and the flow direction were very similar to the previous sampling events. The wells were sampled with dedicated low-flow bladder pumps, except for well GW-5A for which a bailer was used due to a pump-tubing related problem. Chlorinated VOCs were again detected in well GW-5B, of which methylene chloride exceeded the WDEQ GPS. Exceedances of the GPS were noted in well GW-3 for potassium and COD, in well GW-4 for potassium, and in well GW-5B for arsenic, iron, nickel, sodium, potassium, bicarbonate, TDS, and COD.

Alder Watershed January 2011 (1st Quarter) Groundwater Monitoring Report

January 2011 was the tenth groundwater sampling event. Groundwater levels and the flow direction were very similar to the previous sampling events. All wells were sampled with dedicated low-flow bladder pumps. Chlorinated VOCs were again detected in well GW-5B, of which methylene chloride exceeded the WDEQ GPS. GPS exceedances were also noted in well GW-5B for sodium, bicarbonate, and TDS.

Alder Environmental April 2011 (2nd Quarter) Groundwater Monitoring Report

April 2011 was the 11th groundwater sampling event. Groundwater levels and the flow direction were very similar to the previous sampling events. All wells were sampled with dedicated low-flow bladder pumps, except for well GW-5B due to a damaged pump. Chlorinated VOCs were again detected in well GW-5B, of which methylene chloride exceeded the WDEQ GPS. An exceedance of the WDEQ GPS was also noted in well GW-5B for TDS.

Alder Environmental July 2011 (3rd Quarter) Groundwater Monitoring Report

July 2011 was the 12th groundwater sampling event. Groundwater levels and the flow direction were very similar to the previous sampling events. All wells were sampled with dedicated low-flow bladder pumps. Chlorinated VOCs were again detected in well GW-5B, but no exceedances were noted. GPS exceedances were noted in well GW-5B for bicarbonate, COD, and TDS.

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Alder Environmental October 2011 (4th Quarter) Groundwater Monitoring Report

October 2011 was the 13th groundwater sampling event and the first semi-annual Assessment Monitoring event. Groundwater levels and the flow direction were very similar to the previous sampling events. All wells were sampled with dedicated low-flow bladder pumps. No Assessment Monitoring (WDEQ Chapter 2, Appendix B) constituents were detected. Chlorinated VOCs were again detected in well GW-5B, of which methylene chloride again exceeded the WDEQ GPS. GPS exceedances were noted in well GW-5B for bicarbonate, sodium, and TDS, and in well GW-3 for COD.

Alder Environmental April 2012 (2nd Quarter) Groundwater Monitoring Report

April 2012 was the 14th groundwater sampling event and the second semi-annual Assessment Monitoring event. Groundwater levels and the flow direction were very similar to the previous sampling events, except at well GW-5B, which was about 5 feet higher than all previous measuring events at that location. All wells were sampled with dedicated low-flow bladder pumps. No Assessment Monitoring (WDEQ Chapter 2, Appendix B) constituents were detected. Chlorinated VOCs were again detected in well GW-5B, of which methylene chloride again exceeded the WDEQ GPS. Newly detected VOCs included 1,2-dichloroethane, cis-1,2-dichloroethene, 1,2-dichloropropane, and vinyl chloride. GPS exceedances were noted in well GW-5B for cobalt, iron, nickel, magnesium, sodium, bicarbonate, TDS, and TOC and in well GW-3 for COD.

In summary, 15 chlorinated VOCs have been detected in groundwater at well GW-5B between June 2008 and April 2012, including benzene, chloroethane, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, dichlorodifluoromethane, 1,2-dichloropropane, methylene chloride, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, trichlorofluoromethane, and vinyl chloride. Minimum and maximum detected concentrations for these constituents, along with the maximum time range between 2008 and 2012 over which they have been detected, are summarized in Table 1 below. Some of these constituents appeared to be detected at later time periods (e.g., tetrachloroethene and trichloroethene in 2010, and their breakdown products 1,1-dichloroethene, cis-1,2-dichlorethene and vinyl chloride in late 2011 and/or early 2012).

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Table 1: VOC Maximum and Minimum Groundwater Concentrations in Well GW-5B

Constituent	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Detection Time Ranges[1]
Benzene[2]	0.3 J	0.7 J	10/2011 - 4/2012
Chloroethane[2]	0.6 J	2.2	8/2008 - 4/2012
Chloroform	1.4	3.5	6/2008 - 4/2012
1,1-Dichloroethane	4.4	27	6/2008 - 4/2012
1,2-Dichloroethane[2]	0.3 J	0.3 J	4/2012
1,1-Dichloroethene[2]	0.3 J	0.4 J	10/2011 - 4/2012
cis-1,2-Dichloroethene[2]	0.3 J	0.3 J	4/2012
Dichlorodifluoromethane	11	17	10/2011 - 4/2012
1,2-Dichloropropane[2]	0.5 J	0.5 J	4/2012
Methylene chloride	3.1	53	6/2008 - 4/2012
Tetrachloroethene	0.5 J	3.2	4/2010 - 4/2012
1,1,1-Trichloroethane	2.8	11	6/2008 - 4/2012
Trichloroethene[2]	0.3 J	1.5	7/2010 - 4/2012
Trichlorofluoromethane	5.2	16	6/2008 - 4/2012
Vinyl chloride[2]	0.3 J	0.3 J	4/2012

Notes: [1] Sampling dates are from June 2008 through April 2012; maximum detection time ranges shown.
[2] J qualified constituent concentration is between the method detection level and the reporting limit (1 µg/L for most constituents).

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3.0 PRELIMINARY CONCEPTUAL SITE MODEL

The following presents a summary of the known geology and hydrogeology in the vicinity of the Landfill.

Surficial Geology

The surficial geology of the Horsethief Canyon, which is a relatively long and narrow northeast-southwest trending canyon, appears to consist predominately of alluvial fan deposits consisting of gravel, silt, and clay. This canyon was historically filled with municipal trash and covered with locally-derived soil as described above. The bordering bedrock ridges are mantled by windblown silt loess, while the side slopes consist of a colluvial mixture of loess and rock fragments. Along the western side of the lower portion of the Canyon, the side slope consists of Quaternary lithified talus breccias, which consists predominately of angular fragments of Madison Limestone in a white to pink limy matrix (USGS, 1978). Several historic test pits and boreholes appear to have identified that this lithified talus breccia deposit extends beneath the surface fan deposits in some areas of the lower canyon.

Bedrock Geology

The bedrock geology at the Site is complicated by faulting. The upper portion of the Horsethief Canyon is mapped as being transected by the Hoback Fault (USGS, 1978; Love & Love, 2000), which is a normal fault that trends northwest-southeast and is located below the upper section of the Landfill. This fault appears to trend through a shallow valley on the west side of the main canyon. A small portion of the upper part of the Landfill appears to be located on the up-thrown side of the fault. There the bedrock geology is mapped as Upper to Middle Devonian Darby Formation for which the upper part is thinly bedded dull yellow dolomitic siltstone and shale, and the lower portion is brown fetid, vuggy, siliceous, brittle dolomite containing sparse thin limestone beds (USGS, 1978). These beds were mapped as generally steeply dipping to the southwest on the northwest side of the canyon and dipping to the north and northeast on the southwest side of the canyon.

The Darby Formation was apparently encountered at well MW-2 in the upper reach of the canyon at a depth to of about 8 feet (yellow shale) and appeared to be weathered (yellow clay and gravel or shale) from about 15 to 97 feet, at which depth competent limestone, then black rock, and then yellow shale were again encountered to the bottom of the hole at 110 feet. Thus, it appears that weathered and competent rocks were encountered in MW-2 at elevations of 6508 and 6419 feet above mean sea level (ft amsl), respectively.

The majority of the Landfill lies on the southwest, down-thrown side of this fault. There, the bedrock is mapped (from exposures on the adjacent ridges) as consisting predominately of the Upper and Lower Mississippian Madison Limestone, Main Part Formation, which in the upper part is a thinly bedded light to dark gray limestone and in the lower part is dolomitic to vuggy brown dolomite (USGS, 1978). This

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limestone unit contains many layers and lenses of black chert and generally dips steeply to the southwest. It is noted that this geologic mapping appears to be contradicted in Section 2.2.4 of the 2006 Land Transfer Report (EES, 2006), which indicated that the Cretaceous Aspen Shale was the bedrock unit on the down-thrown Hoback Fault system underlying the quaternary sediments. But it appears there may be a second, and perhaps primary, section of the Hoback Fault transecting the Horsethief Canyon further to the south (about mid way along the Landfill and adjacent to the southerly edge of the limestone) based on mapping on the Jackson Quadrangle (Love & Albee, 1972). The upper bedrock south of this section of the Hoback Fault is mapped as consisting of the generally flat bedded Cretaceous Aspen Shale (Love & Albee, 1972). This Hoback Fault forms the northern end of an approximately 17 mile wide graben, which contains Flat Creek and the Snake River.

Bedrock was not encountered at GW-3, GW-4, and GW-5A, located in the lower portion and mouth of the Horsethief Canyon (Figure 2), to depths of 181 feet at GW-5A (western side of the lower portion) and 165 and 197 feet at the mouth of the canyon (GW-4 and GW-3, respectively). These depths at wells GW-3, GW-4, and GW-5A correspond to elevations of 5907 ft, 5948 ft, and 5954 ft amsl, respectively. However, historic test pit and borehole geologic data near the Transfer Station and scale house buildings (Nelson, 1988) indicated that there may be shallow “sandstone-siltstone” bedrock at depths of about 14 to 27 feet below ground surface (test pits N.E. 2 through N.E. 4 and boreholes B-2, and B-5 through B-8). Nearby in well GW-3 bedrock was not encountered (i.e., >197 feet bgs). Well GW-3 is located physically between the southeasterly ridge and B-8 (and maybe B-7) at a distance of about 200 feet to the southeast and closer to the ridge. Thus, the lack of bedrock in well GW-3 may contradict the presence of this reported shallow “sandstone-siltstone” bedrock.

The presence of “sandstone-siltstone” bedrock near the transfer station and scale house buildings is inconsistent with the mapped Madison Limestone Main Member Formation further up the canyon, and may represent a younger geologic unit. This sandstone-siltstone description appears consistent with the Cretaceous Aspen Shale Formation, which contains shale, claystone, sandstone, and siltstone units and is reported as possibly being present in this area (EES, 2006; Love and Albee, 1972). It was noted that the adjacent southeast ridge is covered in aeolian or colluvium soils at this location, and no boreholes or test pits nearby have been advanced to rock other than the above-mentioned locations near the two buildings. Thus, the presence of this apparent “sandstone-siltstone” bedrock in this area has not been confirmed.

Further south along the Highway from the Horsethief Canyon, younger Miocene-age bedrock of the Camp Davis Formation is exposed in the ridge face near the highway as well as within the next major canyon to the south generally along Game Creek Road (Love and Love, 2000; USGS, 1978).

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Hydrogeology

Observed water levels in all of the monitoring wells varied by only about one to two feet with no significant trends between July 2007 and October 2011 (Alder, 2011d). Further, the levels do not appear to show seasonal influences. Thus, it is inferred that groundwater levels may be controlled by regional flow rather than local seasonally-influenced flow.

Well GW-5B is screened at a much shallower elevation (6035 feet above mean sea level (ft amsl)) than the other three wells (5907 to 5956 ft amsl). Well GW-5B appears to be the only "water table" well with a water level within the screened interval, compared to other three wells where the water levels in the wells are about 52 to 85 feet above the top of the screened interval. These can be seen graphically on Figures 3A and 3B, which are fence diagrams of the subsurface showing the four groundwater monitoring wells and recent water levels from October 2011.

When comparing groundwater levels between shallow and deep well pairs GW-5B and GW-5A, respectively, there appears to be a downward gradient of about 0.25 at this location. Gradients elsewhere on Site are unknown due to the lack of additional well pairs.

Based on the borehole logs for deep wells GW-3, GW-4, and GW-5A, it appears that the sediments were dry to moist until wet soil was encountered at the deeper interval screened. The soils in shallower well GW-5B were logged as being dry to slightly moist in the screened interval (80 to 100 feet bgs) and moist to very moist at 70 to 71 feet bgs, which is above the depths where groundwater has been consistently observed in this well (79 to 81.5 feet bgs).

Such observations of placing the screened interval at the first encountered wet soil during drilling in wells GW-3, GW-4 and GW-5A, followed by significantly higher water levels in the installed wells might imply confined conditions if there was a confining geologic unit present. However, the logged soils varied between gravelly silts or clayey silts and clayey silty gravels, with no obvious "confining layer". Alternatively, higher water levels might indicate that the overlying soils were relatively impermeable and slow to release water. Based on the observed groundwater in well GW-5B, there does not appear to be a perched water layer at this depth. Thus, impermeable soils may be a more reasonable explanation for the Site.

Due to having only one "water table" well and it being located near the mouth of the canyon, it appears that additional shallower wells may be necessary to delineate the extent of the relatively "shallow" subsurface impacts. Investigation of the shallow groundwater may be complicated by the presence of the Hoback Fault system, especially at the upper portion of the canyon. Thus, multi-level wells may be necessary to adequately characterize the hydrogeology.

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Known Contamination Distribution

Based on the available groundwater data, it appears that only shallow well GW-5B exhibits landfill-related VOC impacts. It is not known if the VOCs are being derived from landfill gases and/or aqueous leachate. Aqueous leachate is considered a likely possibility because there also have been elevated general chemistry laboratory-measured parameters in well MW-5B (calcium, magnesium, sodium, bicarbonate, sulfate, nitrate+nitrite, and TDS) when compared with deeper wells GW-3, GW-4, and GW-5A. The water-lever is relatively deep to be influenced by landfill gas. Also, field measured conductivity has been significantly higher in well MW-5B (nearly double) when compared with deeper wells GW-3, GW-4, and GW-5A. Many of these general chemistry parameters are influenced by geochemical redox conditions, which can be depth-dependant relative to the water table. Oxidation-Reduction Potential (ORP) was measured in July and October 2011, which showed reducing conditions at all four wells of which GW-3 was the most reducing. Therefore, it is not known if the observed general geochemical differences at well GW-5B are sourced from landfill leachate and/or influenced by general geochemical redox-conditions. Further evaluation is considered warranted.

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4.0 DATA GAP ANALYSIS AND FIELD INVESTIGATION PLAN

4.1 Data Gap Analysis

As discussed in the previous sections, there appears to be only one shallow "water table" well, GW-5B, where the water level is situated below the top of the well screen. Eight chlorinated VOCs have been consistently detected in well GW-5B at low levels, which have been attributed to a landfill-related source. Also, all of the monitoring wells containing groundwater are situated at or near the mouth of the canyon. Thus, the lack of shallow groundwater characterization is considered a data gap. Additionally, the lack of a shallow (water table) background well is considered a potential data gap.

Given that the screen interval in well GW-5B extends above the water table, there exists the possibility that VOC-containing landfill gases (if present at this location and depth) could partition from the soil gases into the groundwater at or near the well screen. Alternatively, the source of VOCs detected in GW-5B may be from a landfill leachate source because general chemistry parameters are also elevated when compared to the data from the deeper wells. To assist with evaluating the potential source of the VOCs in GW-5B, soil gas data may need to be collected from the well for evaluation using Henry's law to estimate partitioning between the detected VOCs in groundwater versus soil gas. Thus, the lack of soil gas VOC data at this well and elsewhere along the length of the Landfill is considered a data gap.

Since methane is known to be generated from the Landfill (based on data above the 25% LEL from the two methane monitoring wells) and VOCs have been detected in groundwater sampled from well MW-5B, there exists the possibility that VOC gases may also be present in some or all of the Landfill. It is our understanding that a soil gas survey for methane and VOCs has not been conducted to date. A soil gas survey may need to completely assess where to install additional methane gas probes/wells, after an initial round of probe installations, and define the extent of landfill gas.

4.2 Field Investigation Work Plan

This Field Investigation Work Plan summarizes the rationale for selection of the number, locations, and depths of the various borings to be advanced, as well as provides installation, development, testing and sampling details for proposed groundwater monitoring wells and gas monitoring probes.

The following field program components will be performed:

- Drill and install permanent monitoring wells clustered in shallow and deep pairs around the perimeter of the Landfill (including one shallow at GW-3);
- Develop the monitoring wells following installation in preparation for water level measurement, hydraulic conductivity testing, and water quality sampling;
- Test the monitoring wells to allow for estimation of hydraulic conductivity and groundwater flow velocity;

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- Collect one round of groundwater samples from the newly installed wells and well GW-5B for analysis of WDEQ Chapter 2 Appendix A Detection Monitoring and Appendix B Assessment Monitoring groundwater quality constituents; and
- Drill and install gas monitoring probes around the perimeter of the Landfill and collect one round of methane measurements from all probe locations on Site.

Depending upon the results from gas monitoring probes, it may be necessary to conduct a soil gas survey of the existing Landfill using temporary drive points advanced with a Geoprobe in order to collect soil gas VOC samples to further examine the nature and extent of landfill gas. It may also be appropriate to conduct a landfill gas partitioning study in one or more of the groundwater wells. This will be determined based upon VOC results in the new groundwater wells.

4.2.1 Rationale for Number and Location of Monitoring wells and Gas Probes

The intent of the field investigation is to obtain sufficient information to adequately characterize the spatial variability of the geology and hydrogeology and provide for an adequate distribution of groundwater and landfill gas monitoring points. The rationale for each of the monitoring wells and gas monitoring probes is presented below.

- **Monitoring Wells**: Five monitoring wells will be drilled and installed at four locations around the perimeter of the Landfill, as shown on Figure 4. One of the locations will consist of a pair of deep and shallow wells (GW-6A and GW-6B, respectively) to be located about half way up the canyon. Two shallow monitoring wells (to be labeled GW-3B and GW-4B) will be installed adjacent to existing wells GW-3 and GW-4 as water table wells. The final location will consist of a “background” water table well (GW-7) to be located in the upper valley just west of the landfill which appears to be the location of the northern section of the Hoback Fault. The presence of the underlying fault should increase the probability of being able to install a well in unconsolidated sediments above rock that may be saturated, unlike at dry monitoring well MW-1. Well MW-1 was installed to 100 feet bgs just north of the fault, where weathered rock was encountered at about 8 feet bgs and competent rock at about 97 feet bgs.

  The proposed deep monitoring well (GW-6A) at the pair location will be drilled and installed first, and will extend to depths of apparent groundwater (anticipated to be approximately 100 to 200 feet), unless bedrock is encountered at a shallower depth. If bedrock is encountered at a shallower depth, the deep well screen would be installed just above rock.

  The proposed four shallow monitoring wells (GW-3B, GW-4B, GW-6B and GW-7) will be drilled and completed to anticipated depths of approximately 80 to 120 feet unless water is encountered at shallower depths. It is noted that well GW-7 may be deeper and a maximum of 200 feet has been estimated at this location. Ideally, these shallow monitoring wells will be completed such that approximately 1/3 of the screen will extend above the first occurrence of observed groundwater (if observable in the clayey or silty soils). Historical water level fluctuations in the existing monitoring wells have been less than 2 feet. Therefore, the proposed methodology for selecting the screen intervals described above should allow for anticipated upward fluctuation to remain within the screen.

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These installations will be located to allow for use in the future detection groundwater monitoring network, if practical and approved by WDEQ. The GW-6 nest will be located along the lateral limit of the landfill, near the east side, but within the boundary of the County-owned portion of the site. This nest location is anticipated to be hydraulically down-gradient of the upper portion of the landfill, based on existing groundwater data in wells GW-3, GW-4, and GW-5B at the lower end of the canyon. However, it would be the most hydraulically up-gradient on the County-owned portion of the site. Thus, it would not be anticipated to be a true up-gradient background well.

- **Gas Monitoring Probes**: Six gas monitoring probes will be drilled and installed at approximately 1000-foot lateral spacings around the perimeter of the Landfill, as shown on Figure 4. The screened interval of these gas monitoring probes will extend from about 5 feet bgs to a depth that is approximately 5 feet lower than the base of waste placement nearby. Thus, it is anticipated that a maximum depth of 45 feet may be required. Gas monitoring probes will be targeted to have a minimum screen length of 20 feet, if feasible.

4.2.2 Drilling and Soil Sampling

Based on previous drilling performed at the Landfill, Golder anticipates drilling can be completed using rotary sonic for the monitoring wells and the same or hollow-stem auger (HSA) methods for the gas monitoring probes. Sonic boreholes will be 6-inches in diameter, while HSA boreholes (if this method is used for gas probes) will be drilled using either 3¼-inch or 4¼-inch internal diameter (ID) augers. Sonic drilling and monitoring well/gas probe construction will be performed by a qualified driller. The driller will be responsible for filing the appropriate registration forms for the monitoring wells (and gas probes, if required) with the Wyoming State Engineers Office, once the drilling program is complete.

Soil sampling during drilling will be performed as described below:

- All drilled borings are planned to be continuously sampled using the sonic rig core barrels from ground surface to total depth. This sampling frequency may be altered in the field based on drilling conditions at the discretion of the Golder field representative. Additionally, if a HSA drill rig is used for the gas probes, continuous split spoon soil samples will be collected and Standard Penetration Testing (SPT) “N-values” (blow counts) will be recorded during drilling to obtain geotechnical properties.
- The shallower boring for monitoring well installation paired with the deeper monitoring well at GW-6 will not be sampled except in the interval to be screened for confirmatory reasons.
- Each of the gas probe borings will be sampled continuously to identify changes in lithology.

Based on our current assumptions, it is estimated that approximately 870 feet of total drilling will be performed for the field program. Excess soil cuttings and samples that do not contain landfill waste will be spread on the ground surface at the site.

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A Golder hydrogeologist/engineer will be on site during drilling to prepare a stratigraphic log of each borehole as drilling progresses. The samples will be visually classified in general accordance with the Unified Soil Classification System (ASTM D2488). Material descriptions will include some or all of the following:

- Descriptive USCS classification in accordance with ASTM D2488;
- Consistency of cohesive materials or apparent density of non-cohesive materials;
- Moisture content assessment, e.g., moist, wet, saturated, etc.;
- Color;
- Depositional type (loess, alluvium, colluvium, breccia, etc.), if practical; and
- Other descriptive features (bedding characteristics, mineralization/oxidation, organic materials, macrostructure of fine-grained soils; e.g., root holes, fractures, etc.).

In addition to geologic information, the hydrogeologist/engineer will document the depth at which groundwater is first encountered and other potential water-bearing zones for the monitoring well borings, and approximate penetration rates for all borings. These items will be documented on either the borehole log, in a field book, or on a field form.

4.2.3 Drilling Equipment Decontamination

Steam cleaning of the rig and appropriate downhole equipment will be performed before drilling begins and between borings. Water used for steam cleaning will be obtained from a known and approved potable source. Golder has assumed that decontamination water will not need to be collected and containerized and will be allowed to run onto the ground surface. In order to minimize the risk of contamination, drilling/sampling equipment threads will be lubricated using hydrocarbon-free products.

4.2.4 Monitoring Well Installation

Monitoring wells will be completed through the sonic casing using 2-inch, flush-threaded, Schedule 40 polyvinyl chloride (PVC) screen and riser pipe. The screen in each monitoring well will be perforated with 0.010-inch slots and are assumed to be approximately 20 feet in length for consistency with prior installations. For the shallower completions, it is anticipated that 1/3 of the screen will extend above the first occurrence of observed water. A threaded PVC end cap will be placed at the bottom of each screen before it is placed in the borehole. PVC casing will be added to the screen as it is lowered in the borehole until the screen is set to the desired depth and the top of the casing extends at least two to three feet above the ground surface.

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Next, the annular space around the monitoring well screen and end cap will be backfilled with clean, washed, well-rounded silica sand (#10-20 or equivalent). The sand pack will be gravity-fed or tremmied into the annular space between the PVC and borehole wall until it extends approximately 2 feet above the top perforation of the screen. A minimum of 2 feet of medium bentonite chips will be gravity-fed or tremmied into the annular space above the screen and filter pack to provide a seal. The bentonite will be placed at a very slow rate and checked frequently with a weighted tape to avoid bridging. If the annular space in which the bentonite is placed is dry, distilled water or water from a known potable source will be added to hydrate the bentonite. The bentonite seal will be allowed to set undisturbed for a minimum of 15 to 30 minutes before installation activities continue.

High solids bentonite grout will then be placed in the annular space above the bentonite seal to within approximately 3 feet of the ground surface. The grout will be mixed and placed via tremmie pipe, in accordance with Wyoming Water Quality Rules and Regulations, Chapter 11 Part G "Well Construction Standards". Once the grout has set up, a 4- or 6-inch diameter protective steel casing will be placed over the PVC riser such that the bottom extends into the annular space to the top of the grout and the top rises above the PVC casing by several inches. The protective casing will be equipped with a locking cover to prevent unauthorized entry and allow access for water level measurement. A concrete pad, approximately 3-foot square, sloping away from the monitoring well, will be constructed around the protective casing. A removable well slip cap will be placed on top of the PVC well riser inside the protective casing. Finally, three steel bollards, 3-inch diameter by 5 feet in length, will be installed and spaced at equal distances around each monitoring well. Monitoring well construction details will be documented on a monitoring well construction log.

Based on the description above and estimated depths, Golder assumes the completion of 5 monitoring wells totaling about 600 linear feet. A summary of proposed monitoring well installation information is provided in Table 2, and a typical monitoring well construction detail is provided in Attachment A.

4.2.5 Monitoring Well Development

The completed monitoring wells will be bailed, pumped, or air-lifted to extract fines in the screen and sand pack after the grout has set for a minimum of 24 hours in each. Water quality parameters (temperature, pH, and conductivity) will be monitored on samples of the development water. Development will continue until these parameters stabilize or at least five casing volumes of water are removed, whichever comes first. Golder assumes that purge water can be poured directly on the ground surface at the site. Following water level stabilization, levels will be measured using an electronic water level indicator. Development and water level information will be recorded on either the monitoring well construction log, a monitoring well development form, or in a field book.

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4.2.6 Monitoring Well Hydraulic Testing

Golder proposes that, several days after monitoring well development activities, single borehole variable head "slug" hydraulic testing be performed at all of the new and existing monitoring wells. This testing will be used to evaluate the in-situ horizontal hydraulic conductivity of geologic materials isolated by the monitoring well-screened intervals.

4.2.6.1 Hydraulic Testing Procedure

Golder will measure the static water level at each monitoring well by use of an electronic water level meter. An instantaneous rise or fall in the monitoring well water level will be created by rapidly inserting or extracting a stainless steel or PVC rod (slug) into the water column. The type of slug test (rising or falling) will depend on the location of the water level with respect to the screened interval as detailed below.

- In monitoring wells where the water level is above the screened interval, a "slug in" falling head test will be performed.
- In monitoring wells where the screened interval intersects the water column, a "slug out" rising head test will be performed by removing water with a bailer or pump.

Changes in the water level will be monitored with a pressure transducer/data logger set to record water levels at 2- to 5-second intervals until the monitoring well has recovered to at least 70 percent (%) of its initial static level. If the monitoring well recovers at least 90% of its static head within 30 minutes during a falling head test, the slug will be removed and a rising head test will be monitored until 70% recovery is achieved.

Hydraulic test activities will be recorded on a Variable Head (Slug) Test Field Record or in a field book.

4.2.6.2 Hydraulic Test Analysis

Formational hydraulic conductivities will be estimated by using the Hvorslev (1951) and/or Bouwer and Rice (1976) analytical methods. Generally, both methods of analysis involve fitting a straight line, or lines, to the linear portions or portions, of water level recovery test data plotted on a semi-log scale. Hydraulic conductivity is then estimated from the slope of this line(s). Both methods can be applied to rising and falling head tests.

4.2.7 Monitoring Well Sampling and Analysis

One round of groundwater samples from the newly installed wells and well GW-5B for analysis of WDEQ Chapter 2, Appendix A - Detection Monitoring and Appendix B - Assessment Monitoring groundwater

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quality constituents will be conducted. WDEQ will be consulted to assess which of the wells should be included into the current groundwater monitoring program.

4.2.8 Gas Monitoring Probe Installation and Sampling

Following monitoring well installation, gas monitoring probes will be installed in 6 additional boreholes at locations around the perimeter of the Landfill area (Figure 4), as described in preceding sections of this Work Plan. Gas probe installation will be performed immediately following drilling and soil sampling of the probe borings. In general, the gas probes will be installed such that the perforated or screened interval extends from about 7 feet below ground surface (bgs) to 5 feet lower than the base of waste placement adjacent to the probe (which equates to probe completion depths currently anticipated to be on the order of not more than 40 feet bgs). The probe completions will be consistent with those previously installed and will conform to industry standards. Installation specifics are provided below.

Probes will be completed through sonic casing or hollow stem augers using 1-inch, threaded, Schedule 40 polyvinyl chloride (PVC) screen and riser pipe. The screen in each probe will be perforated with 0.020-inch slots. A slip-on or threaded PVC end cap will be placed at the bottom of each screen before it is placed in the borehole. Lengths of PVC screen and casing will be added to the string as it is lowered in the borehole until the bottom of the screen is set to the desired depth and the top of the casing extends at least two to three feet above the ground surface.

Next, the annular space around the probe screen and end cap will be backfilled with clean, washed, pea gravel. The gravel pack will be gravity-fed into the annular space between the PVC and borehole wall until it extends approximately 2 feet above the top perforation of the screen. A minimum of 2 feet of medium bentonite chips will be gravity-fed or tremmied into the annular space above the screen and gravel pack to provide a seal. Distilled water or water from a known potable source will be added to hydrate the bentonite.

Once the bentonite has hydrated, a 4- or 6-inch diameter protective steel casing will be placed over the PVC riser such that the bottom extends into the annular space to the top of the bentonite and the top rises above the PVC casing by several inches. The protective casing will be equipped with a locking cover to prevent unauthorized entry and allow access for gas measurement. A concrete pad, approximately 3-foot square, sloping away from the probe, will be constructed similar to the pads around the monitoring wells. A removable well cap (slip or J-plug) will be placed on top of the PVC casing. Finally, three steel bollards, 3-inch diameter by 5 feet in length, will be installed and spaced at equal distances around each probe. Probe construction details will be documented on a probe construction log.

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Based on the description above and estimated depths, Golder assumes the completion of 6 gas probes totaling approximately 270 linear feet. A summary of proposed gas probe installation information is provided in Table 2, and a typical gas monitoring probe construction detail is provided in Attachment A.

Subsequent to installation, one round of methane monitoring will be conducted in the methane probes. It is anticipated that these new probes would be allowed to stabilize before sampling for at least one week, to allow for gas to enter the well.

4.2.9 Surveying

Golder will coordinate with the County to have the monitoring well and gas probe locations surveyed as soon as possible following installation so that groundwater elevations and flow direction can be determined promptly. The final elevations and locations of the monitoring well (ground surface and top of casing), and gas probe locations will be established by survey once field activities are complete. The surveying will be performed using the established state plane coordinate system. Monitoring well elevations will be surveyed to the nearest hundredth of a foot in elevation to allow the measured depths to water to be transformed into accurate elevations for purposes of identifying flow directions and computing hydraulic gradients.

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5.0 DATA EVALUATION AND NATURE AND EXTENT REPORTING

A Hydrogeologic Characterization report will be prepared upon completion of field activities and data analysis. The report will include the following components at a minimum:

- A discussion of the field investigative activities performed, methodologies, subsurface conditions encountered or inferred, testing location and results, and a qualitative discussion of the results;
- Tables summarizing the field data;
- Figures showing the surveyed monitoring well and gas probe locations and providing one or more cross sections of the Landfill; and
- Appendices containing the borehole geologic logs, monitoring well and probe construction logs, and State of Wyoming well registration forms. Geologic logs will include depths, elevation, and descriptions (based on USCS classification) of all subsurface materials encountered, and depths where groundwater was first encountered.

The Hydrogeologic Characterization Report will include text describing the Landfill geologic/hydrogeologic setting, as well as limited discussion regarding the regional geology and hydrogeology. The text of the Hydrogeologic Characterization Report will include discussions of the site hydrogeologic model. Supporting information will consist of figures showing the potentiometric surface, groundwater flow direction, and cross-sections.

A Nature and Extent report will be prepared that will include the following components at a minimum:

- Update the Conceptual Site Model (CSM);
- Describe any additional data gaps identified through the subsurface investigation and develop plans to address. This would potentially include installing additional groundwater monitoring wells, conducting a soil gas survey, and/or evaluating VOC partitioning between landfill gas and groundwater.
- Evaluate potentially impacted media;
- Identify the Contaminants of Concern (COCs), such as VOCs, metals and general chemistry;
- Evaluate nature and extent of COCs; and
- Identify human and/or ecological receptors.

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6.0 CLOSING

We appreciate the opportunity to be of assistance. Should you have any questions regarding this report, please contact the undersigned.

GOLDER ASSOCIATES INC.

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Lesley Sebol, PhD
Senior Project Hydrogeologist

DRAFT

Mark McClain, PE
Principal

DRAFT

7.0 REFERENCES

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TABLES

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TABLE 2. APPROXIMATE PROPOSED WELL COMPLETION DEPTHS AND SCREENED INTERVALS

Well ID	Approximate Ground Surface Elevation (ft. amsl)	Anticipated Maximum Total Depth		Anticipated Top of Screen		Anticipated Bottom of Screen	
		ft. bgs	Elevation (ft. amsl)	Depth (ft. bgs)	Elevation (ft. amsl)	Depth (ft. bgs)	Elevation (ft. amsl)
GW-3B	6104	100	6004	80	6024	100	6004
GW-4B	6113	100	6013	80	6033	100	6013
GW-6A	6262	200	6062	180	6082	200	6062
GW-6B	6262	100	6162	80	6182	100	6162
GW-7*	6510	200	6310	180	6330	200	6310
M-3	6215	40	6175	5	6210	40	6175
M-4	6225	40	6185	5	6220	40	6185
M-5	6310	40	6270	5	6305	40	6270
M-6	6377	40	6337	5	6372	40	6337
M-7	6495	40	6455	5	6490	40	6455
M-8	6505	40	6465	5	6500	40	6465

Notes:
ft. bgs: feet below ground surface.
ft. amsl: feet above mean sea level.
Depths listed are approximate; final depths will be determined based on conditions observed in the field.
*GW-7 targeted as a water table well (estimated maximum depth provided).

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FIGURES

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APPROXIMATE SITE LIMITS

REFERENCES

COORDINATE SYSTEM: NAD 1983 STATEPLANE WYOMING WEST FIPS 4904 FEET.
AERIAL IMAGERY: 2009 NAIP NATURAL COLOR IMAGERY FOR WYOMING ACQUIRED BETWEEN JULY 5, 2009 AND AUGUST 28, 2009.
INSET MAP BACKGROUND: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS.

N

0 1,000 2,000
FEET
1 INCH = 1,000 FEET
IF PRINTED AT 11 X 17 IN

PROJECT
TETON COUNTY LANDFILL
NATURE AND EXTENT WORK PLAN
TETON COUNTY, WYOMING

TITLE
LOCATION PLAN

Golder Associates

PROJECT No. 123-81604			FILE No.	Location_Plan.mxd
DESIGN	JP	6/4/2012	SCALE AS SHOWN	REV 0
GIS	KJC	6/18/2012		
CHECK	XXX	xx/xx/xxxx	**FIGURE 1**	
REVIEW	XXX	xx/xx/xxxx		

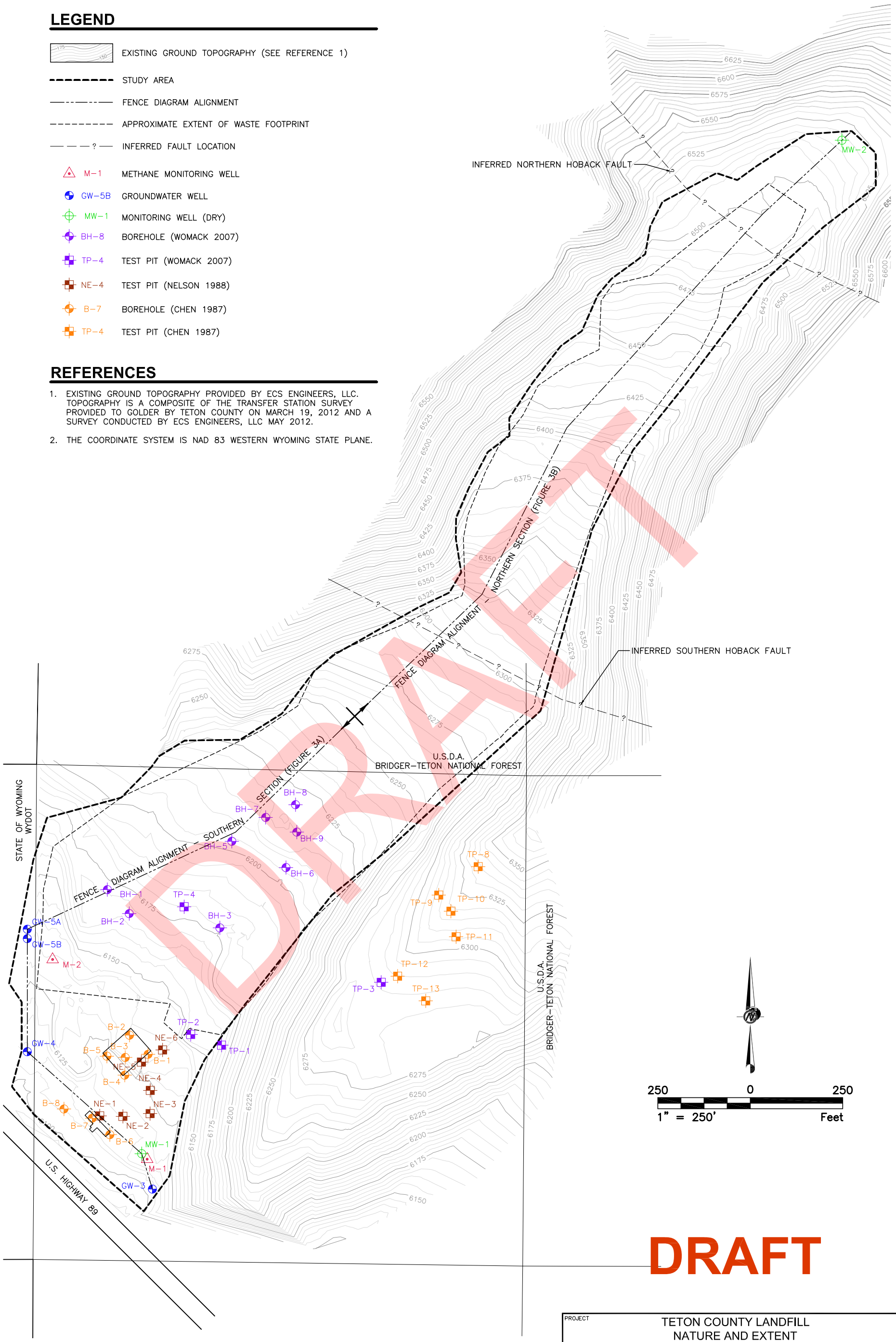
M:\Teton_County_LandFill\Mapping\Location_Plan.mxd | Modified: KJCarpenter 6/18/2012 5:21:45 PM | Denver, CO

LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- STUDY AREA
- FENCE DIAGRAM ALIGNMENT
- APPROXIMATE EXTENT OF WASTE FOOTPRINT
- INFERRED FAULT LOCATION
- M–1 METHANE MONITORING WELL
- GW–5B GROUNDWATER WELL
- MW–1 MONITORING WELL (DRY)
- BH–8 BOREHOLE (WOMACK 2007)
- TP–4 TEST PIT (WOMACK 2007)
- NE–4 TEST PIT (NELSON 1988)
- B–7 BOREHOLE (CHEN 1987)
- TP–4 TEST PIT (CHEN 1987)

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY ECS ENGINEERS, LLC. TOPOGRAPHY IS A COMPOSITE OF THE TRANSFER STATION SURVEY PROVIDED TO GOLDER BY TETON COUNTY ON MARCH 19, 2012 AND A SURVEY CONDUCTED BY ECS ENGINEERS, LLC MAY 2012.
2. THE COORDINATE SYSTEM IS NAD 83 WESTERN WYOMING STATE PLANE.



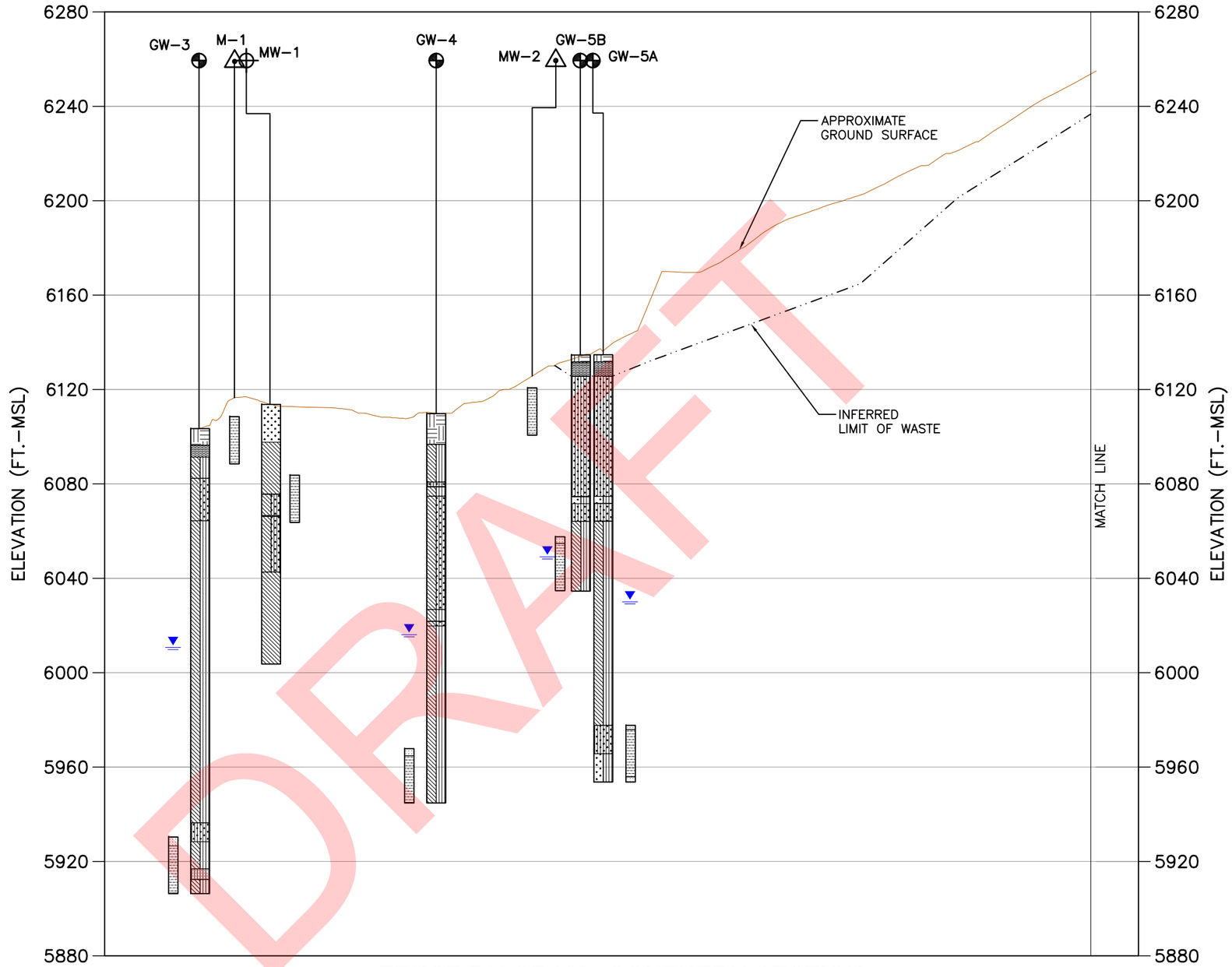
PROJECT
TETON COUNTY LANDFILL
NATURE AND EXTENT
TETON COUNTY, WYOMING

TITLE
SITE PLAN

Golder Associates

PROJECT No.	123–81604		FILE No.	12381604C002
DESIGN	JP	06/04/12	SCALE AS SHOWN	REV. A
CADD	JP	06/04/12	**FIGURE 2**	
CHECK				
REVIEW				

Drawing File: N:\12\123-81604_C Nature & Extent\ 12381604C002.dwg | Layout: 11x17 Portrait | Modified: Jun 13, 2012 14:22 JParks | Plotted: 06/13/12 2:22pm JParks



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FENCE DIAGRAM - SOUTHERN SECTION

LEGEND

SIMPLIFIED STRATIGRAPHY

- SOIL/FILL
- CLAY
- SILT
- GRAVEL
- WASTE
- BLACK ROCK
- SHALE

FILTER PACK — SCREENED INTERVAL

- MW-1 MONITORING WELL (DRY)
- GW-3 GROUNDWATER WELL
- M-1 METHANE MONITORING WELL
- STATIC WATER LEVEL IN WELL (OCT 12, 2012)

250 0 250 HORIZONTAL SCALE Feet

50 0 50 VERTICAL SCALE Feet

NOTES:

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE, AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY AT EACH BOREHOLE LOCATION, REFER TO THE BOREHOLE LOGS.
2. DEPTHS ARE EXPRESSED IN FEET.

PROJECT
TETON COUNTY LANDFILL
NATURE AND EXTENT WORKPLAN
TETON COUNTY, WYOMING

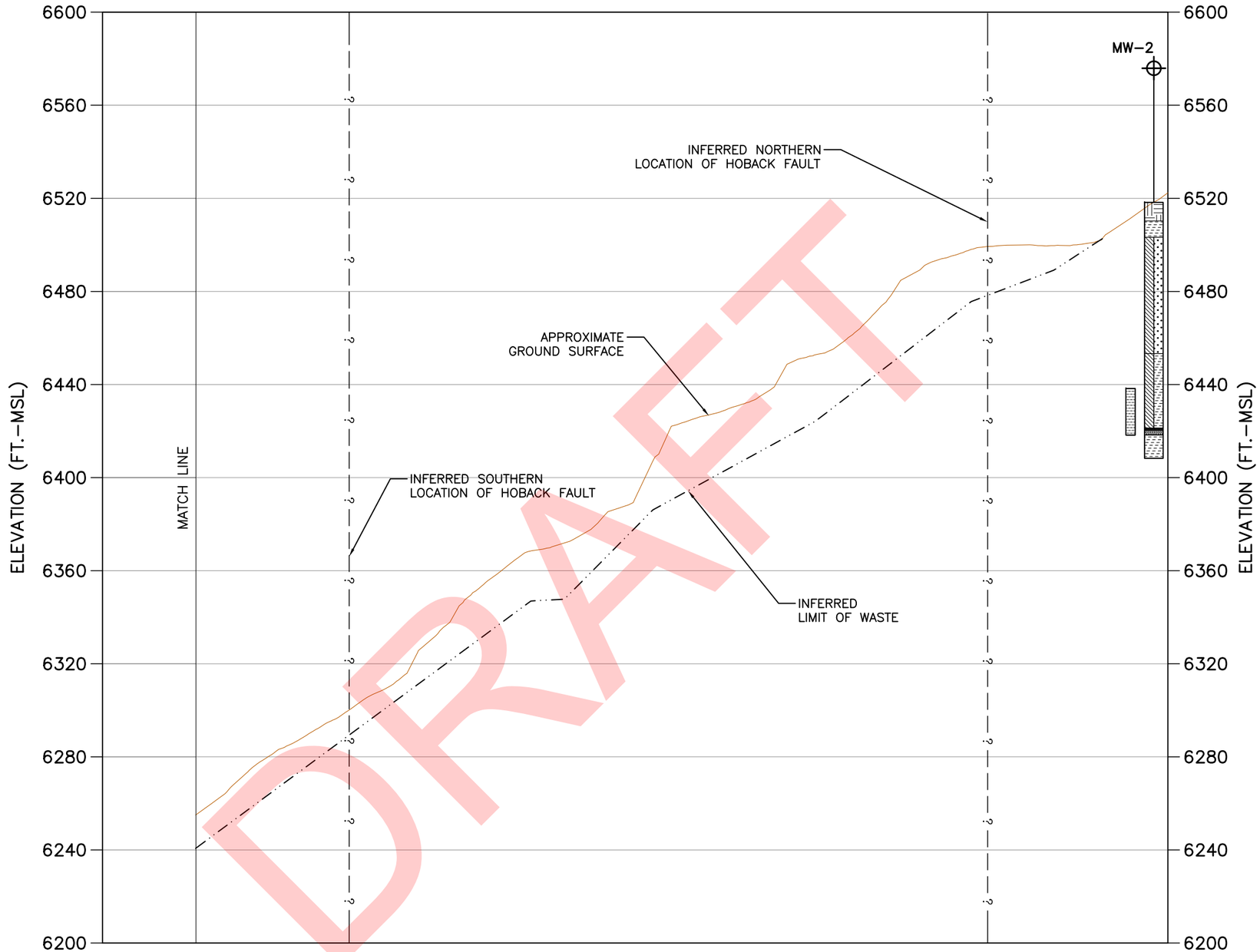
TITLE
FENCE DIAGRAM - SOUTHERN SECTION

Golder Associates

PROJECT No. 123-81604	FILE No. 12381604C003
	SCALE AS SHOWN REV. A

FIGURE 3A

Drawing File: N:\12\123-81604_C Nature & Extent\ 12381604C003.dwg | Layout: 3A | Modified: Jun 18, 2012 14:52 JParks | Plotted: 06/28/12 1:34pm JParks



FENCE DIAGRAM - NORTHERN SECTION

DRAFT

LEGEND

SIMPLIFIED STRATIGRAPHY

- SOIL/FILL
- CLAY
- SILT
- GRAVEL
- WASTE
- BLACK ROCK
- SHALE

FILTER PACK — SCREENED INTERVAL

MW–1 MONITORING WELL (DRY)

STATIC WATER LEVEL IN WELL (OCT 12, 2012)

250 0 250 HORIZONTAL SCALE Feet

50 0 50 VERTICAL SCALE Feet

NOTES:

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE, AND SO MAY VARY FROM THAT SHOWN. FOR DETAILED STRATIGRAPHY AT EACH BOREHOLE LOCATION, REFER TO THE BOREHOLE LOGS.
2. DEPTHS ARE EXPRESSED IN FEET.

PROJECT
TETON COUNTY LANDFILL
NATURE AND EXTENT WORKPLAN
TETON COUNTY, WYOMING

TITLE
FENCE DIAGRAM - NORTHERN SECTION

Golder Associates

PROJECT No. 123–81604	FILE No. 123816040003
	SCALE AS SHOWN REV. A

FIGURE 3B

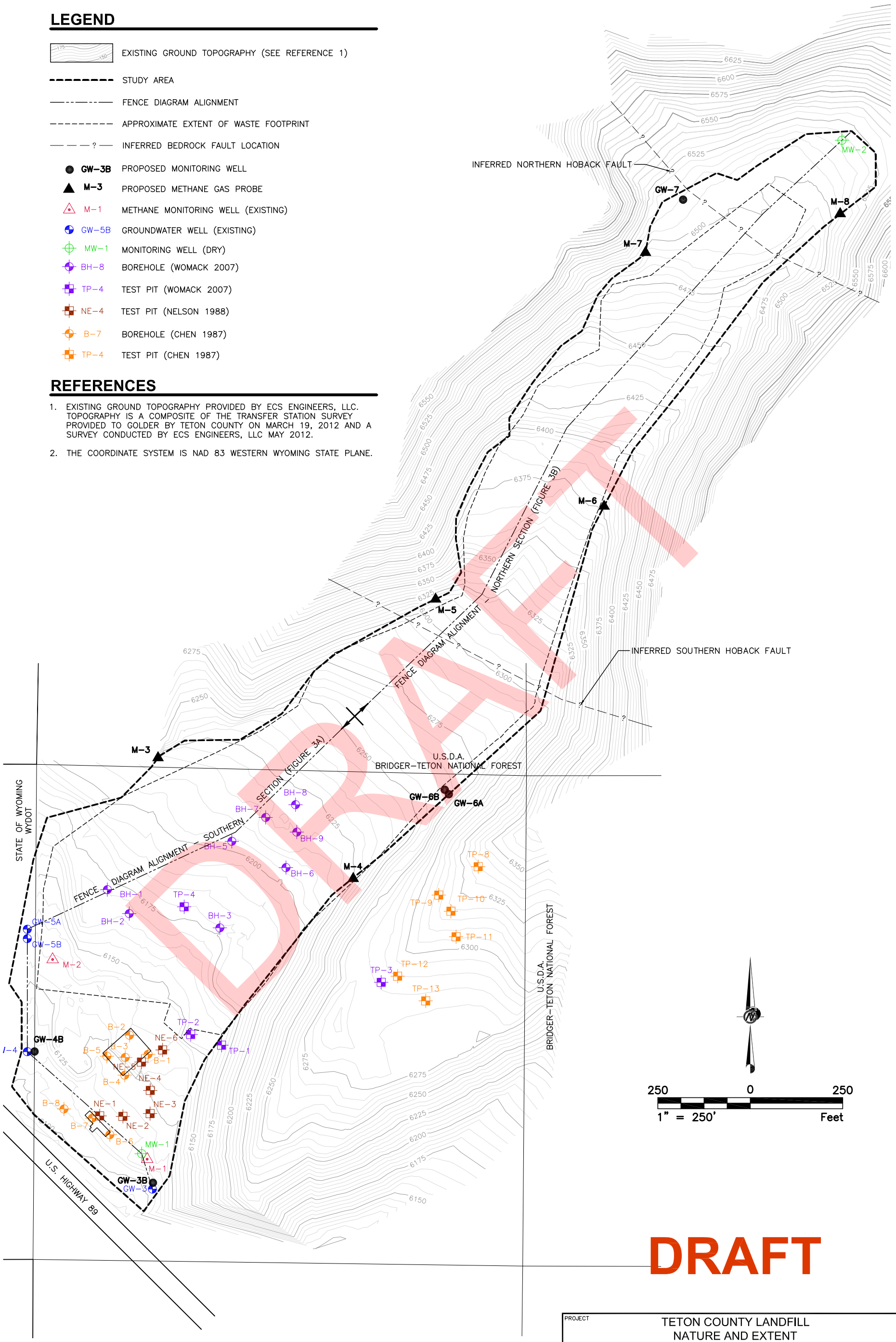
Drawing File: N:\12\123-81604_C Nature & Extent\ 123816040003.dwg | Layout: 3B | Modified: Jun 28, 2012 13:35 JParks | Plotted: 06/28/12 1:35pm JParks

LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- STUDY AREA
- FENCE DIAGRAM ALIGNMENT
- APPROXIMATE EXTENT OF WASTE FOOTPRINT
- INFERRED BEDROCK FAULT LOCATION
- GW-3B PROPOSED MONITORING WELL
- M-3 PROPOSED METHANE GAS PROBE
- M-1 METHANE MONITORING WELL (EXISTING)
- GW-5B GROUNDWATER WELL (EXISTING)
- MW-1 MONITORING WELL (DRY)
- BH-8 BOREHOLE (WOMACK 2007)
- TP-4 TEST PIT (WOMACK 2007)
- NE-4 TEST PIT (NELSON 1988)
- B-7 BOREHOLE (CHEN 1987)
- TP-4 TEST PIT (CHEN 1987)

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY ECS ENGINEERS, LLC. TOPOGRAPHY IS A COMPOSITE OF THE TRANSFER STATION SURVEY PROVIDED TO GOLDER BY TETON COUNTY ON MARCH 19, 2012 AND A SURVEY CONDUCTED BY ECS ENGINEERS, LLC MAY 2012.
2. THE COORDINATE SYSTEM IS NAD 83 WESTERN WYOMING STATE PLANE.



PROJECT
TETON COUNTY LANDFILL
NATURE AND EXTENT
TETON COUNTY, WYOMING

TITLE
PROPOSED DRILLING LOCATIONS

Golder Associates

PROJECT No.	123-81604		FILE No.	12381604C004
DESIGN	JP	06/04/12	SCALE AS SHOWN	REV. A
CADD	JP	06/04/12		
CHECK				
REVIEW				

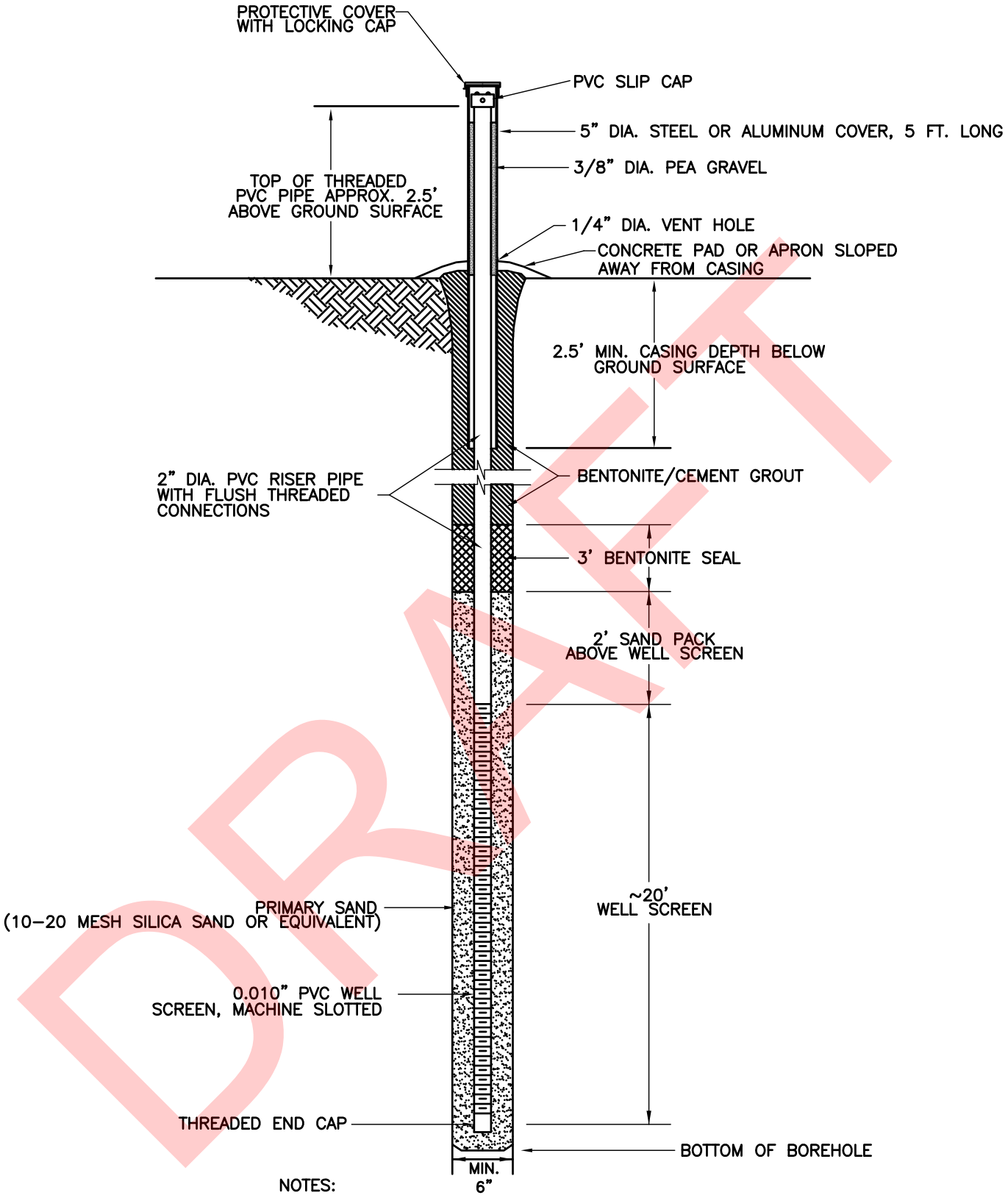
FIGURE 4

Drawing File: N:\12\123-81604_C Nature & Extent\ 12381604C004.dwg | Layout: 11x17 Portrait | Modified: Jun 15, 2012 12:09 JParks | Plotted: 06/15/12 12:09pm JParks

ATTACHMENT A

TYPICAL MONITORING WELL AND METHANE PROBE CONSTRUCTION DETAILS

DRAFT



NOTES:

1) DETAIL IS NOT TO SCALE.

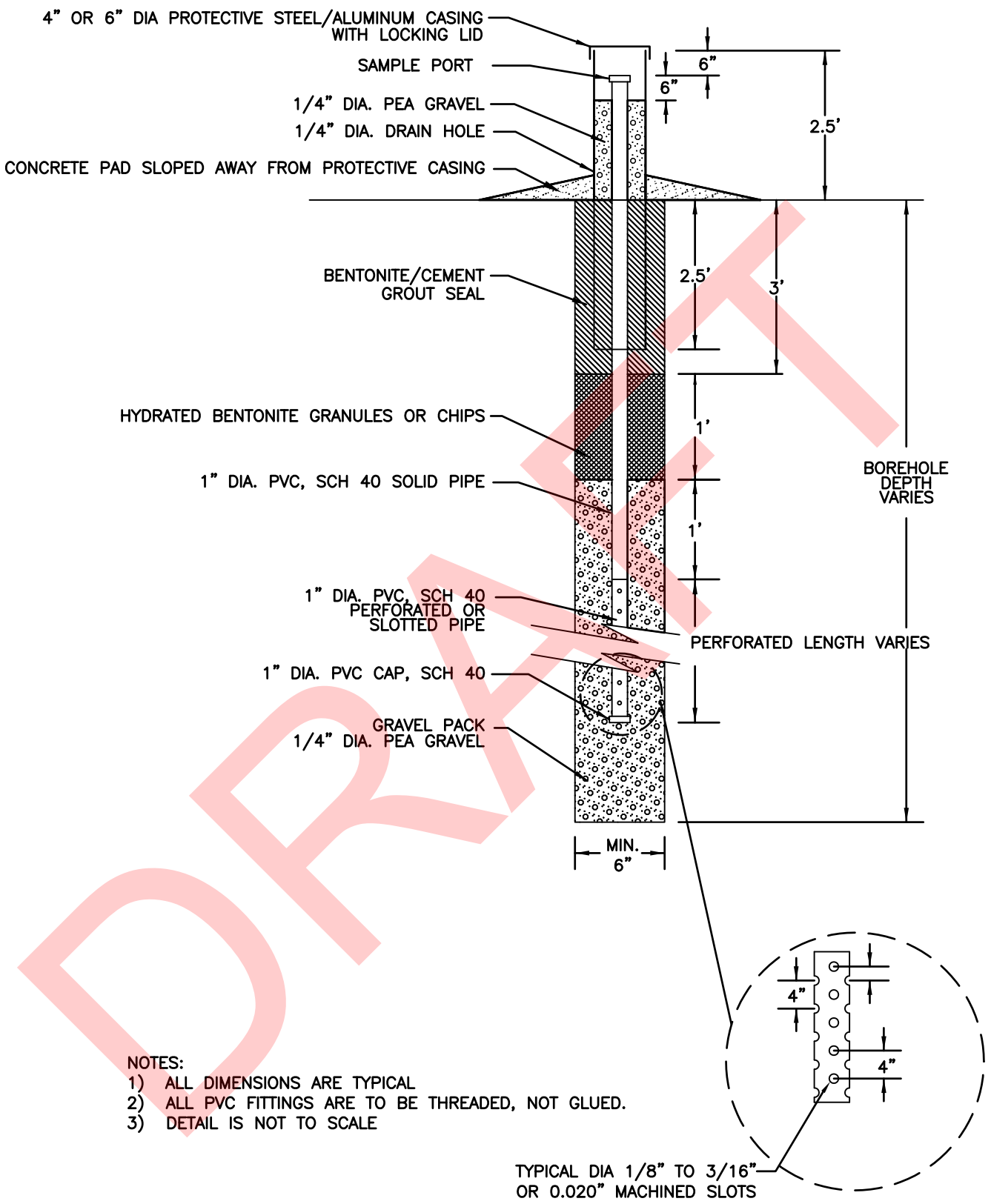
DRAFT

TYPICAL GROUNDWATER MONITORING WELL

Golder Associates

FIGURE A-1

Drawing File: N:\12\123-81604_C Nature & Extent_12381604C005.dwg | Layout: GW MONITORING WELL | Modified: Jun 15, 2012 12:02 JPorks | Plotted: 06/15/12 12:02pm JPorks



NOTES:
1) ALL DIMENSIONS ARE TYPICAL
2) ALL PVC FITTINGS ARE TO BE THREADED, NOT GLUED.
3) DETAIL IS NOT TO SCALE

DRAFT

TYPICAL LANDFILL GAS MONITORING WELL

Golder Associates

FIGURE A-2

PROJECT No. 123-81604 CADD JP DATE 06/15/12 FILE No. 12381604C005.dwg

Drawing File: N:\12\123-81604_C Nature & Extent\ 12381604C005.dwg | Layout: GAS PROBE | Modified: Jun 15, 2012 11:59 JParks | Plotted: 06/15/12 12:00pm JParks

APPENDIX C
LANDFILL GAS EMISSION MODEL REPORT SUMMARY

Teton County Landfill Project No. 123-81604

Landfill Gas Emission Model Report Summary

(US EPA LandGEM Model Version 3.02)

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	1960
Landfill Closure Year (with 80-year limit)	1989
Actual Closure Year (without limit)	1989
Have Model Calculate Closure Year?	No
Waste Design Capacity	558000 short tons

MODEL PARAMETERS

Methane Generation Rate, k	0.04	year-1
Potential Methane Generation Capacity, Lo	100	m3/Mg
Methane Content	50	% by volume

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	Total landfill gas
Gas / Pollutant #2:	Methane

Results

Year	Waste Accepted	Waste-in-place	Total Landfill Gas				Methane				Methane vented on FS property*	
	(ton)	(ton)	(Mg/year)	(m3/year)	(ave. cfm)	(ton/yr)	(Mg/year)	(m3/year)	(ave. cfm)	(ton/yr)	(ave. cfm)	(ton/yr)
1960	18600	0	0	0	0	0	0	0	0	0	0	0
1961	18600	18600	166	132868	9	183	44	66434	4	49	3	32
1962	18600	37200	325	260527	18	359	87	130263	9	96	6	63
1963	18600	55800	479	383180	26	527	128	191590	13	141	8	92
1964	18600	74400	626	501024	34	690	167	250512	17	184	11	121
1965	18600	93000	767	614246	41	846	205	307123	21	226	14	148
1966	18600	111600	903	723030	49	995	241	361515	24	266	16	174
1967	18600	130200	1033	827548	56	1139	276	413774	28	304	18	199
1968	18600	148800	1159	927968	62	1277	310	463984	31	341	20	223
1969	18600	167400	1279	1024450	69	1410	342	512225	34	377	23	247
1970	18600	186000	1395	1117149	75	1538	373	558574	38	411	25	269
1971	18600	204600	1506	1206213	81	1660	402	603107	41	444	27	291
1972	18600	223200	1613	1291785	87	1778	431	645893	43	475	28	311
1973	18600	241800	1716	1374002	92	1891	458	687001	46	505	30	331
1974	18600	260400	1815	1452995	98	2000	485	726498	49	534	32	350
1975	18600	279000	1909	1528891	103	2105	510	764445	51	562	34	368
1976	18600	297600	2000	1601810	108	2205	534	800905	54	589	35	386
1977	18600	316200	2088	1671871	112	2301	558	835935	56	615	37	403
1978	18600	334800	2172	1739184	117	2394	580	869592	58	639	38	419
1979	18600	353400	2253	1803858	121	2483	602	901929	61	663	40	434
1980	18600	372000	2330	1865996	125	2569	622	932998	63	686	41	449
1981	18600	390600	2405	1925698	129	2651	642	962849	65	708	42	464
1982	18600	409200	2476	1983059	133	2730	661	991529	67	729	44	478
1983	18600	427800	2545	2038170	137	2806	680	1019085	68	749	45	491
1984	18600	446400	2611	2091121	141	2879	698	1045560	70	769	46	504
1985	18600	465000	2675	2141995	144	2949	715	1070998	72	788	47	516
1986	18600	483600	2736	2190875	147	3016	731	1095437	74	806	48	528
1987	18600	502200	2795	2237838	150	3081	746	1118919	75	823	49	539
1988	18600	520800	2851	2282959	153	3143	762	1141480	77	839	50	550
1989	18600	539400	2905	2326311	156	3202	776	1163156	78	855	51	560
1990	0	558000	2957	2367964	159	3260	790	1183982	80	871	52	570
1991	0	558000	2841	2275115	153	3132	759	1137557	76	837	50	548
1992	0	558000	2730	2185906	147	3009	729	1092953	73	804	48	526
1993	0	558000	2623	2100195	141	2891	701	1050098	71	772	46	506
1994	0	558000	2520	2017846	136	2778	673	1008923	68	742	44	486
1995	0	558000	2421	1938725	130	2669	647	969362	65	713	43	467
1996	0	558000	2326	1862706	125	2564	621	931353	63	685	41	449
1997	0	558000	2235	1789668	120	2464	597	894834	60	658	39	431
1998	0	558000	2147	1719495	116	2367	574	859747	58	632	38	414
1999	0	558000	2063	1652072	111	2274	551	826036	56	607	36	398
2000	0	558000	1982	1587294	107	2185	529	793647	53	584	35	382
2001	0	558000	1905	1525055	102	2099	509	762527	51	561	34	367
2002	0	558000	1830	1465257	98	2017	489	732628	49	539	32	353
2003	0	558000	1758	1407803	95	1938	470	703902	47	518	31	339
2004	0	558000	1689	1352602	91	1862	451	676301	45	497	30	326
2005	0	558000	1623	1299566	87	1789	434	649783	44	478	29	313
2006	0	558000	1559	1248609	84	1719	417	624305	42	459	27	301
2007	0	558000	1498	1199651	81	1651	400	599825	40	441	26	289
2008	0	558000	1439	1152612	77	1587	384	576306	39	424	25	278
2009	0	558000	1383	1107417	74	1524	369	553709	37	407	24	267
2010	0	558000	1329	1063995	71	1465	355	531997	36	391	23	256
2011	0	558000	1277	1022275	69	1407	341	511137	34	376	22	246
2012	0	558000	1227	982191	66	1352	328	491095	33	361	22	237
2013	0	558000	1178	943679	63	1299	315	471839	32	347	21	227
2014	0	558000	1132	906676	61	1248	302	453338	30	333	20	218
2015	0	558000	1088	871125	59	1199	291	435563	29	320	19	210
2016	0	558000	1045	836968	56	1152	279	418484	28	308	18	202

2017	0	558000	1004	804150	54	1107	268	402075	27	296	18	194
2018	0	558000	965	772619	52	1064	258	386309	26	284	17	186
2019	0	558000	927	742324	50	1022	248	371162	25	273	16	179
2020	0	558000	891	713217	48	982	238	356608	24	262	16	172
2021	0	558000	856	685251	46	943	229	342626	23	252	15	165
2022	0	558000	822	658382	44	906	220	329191	22	242	14	159
2023	0	558000	790	632567	43	871	211	316283	21	233	14	152
2024	0	558000	759	607763	41	837	203	303882	20	223	13	146
2025	0	558000	729	583933	39	804	195	291966	20	215	13	141
2026	0	558000	701	561036	38	772	187	280518	19	206	12	135
2027	0	558000	673	539038	36	742	180	269519	18	198	12	130
2028	0	558000	647	517902	35	713	173	258951	17	190	11	125
2029	0	558000	621	497595	33	685	166	248797	17	183	11	120
2030	0	558000	597	478084	32	658	159	239042	16	176	11	115
2031	0	558000	574	459338	31	632	153	229669	15	169	10	111
2032	0	558000	551	441327	30	608	147	220663	15	162	10	106
2033	0	558000	530	424022	28	584	141	212011	14	156	9	102
2034	0	558000	509	407396	27	561	136	203698	14	150	9	98
2035	0	558000	489	391422	26	539	131	195711	13	144	9	94
2036	0	558000	470	376074	25	518	125	188037	13	138	8	91
2037	0	558000	451	361328	24	497	121	180664	12	133	8	87
2038	0	558000	434	347160	23	478	116	173580	12	128	8	84
2039	0	558000	417	333548	22	459	111	166774	11	123	7	80
2040	0	558000	400	320469	22	441	107	160235	11	118	7	77
2041	0	558000	385	307903	21	424	103	153952	10	113	7	74
2042	0	558000	369	295830	20	407	99	147915	10	109	7	71
2043	0	558000	355	284231	19	391	95	142115	10	105	6	68
2044	0	558000	341	273086	18	376	91	136543	9	100	6	66
2045	0	558000	328	262378	18	361	88	131189	9	96	6	63
2046	0	558000	315	252090	17	347	84	126045	8	93	6	61
2047	0	558000	302	242205	16	333	81	121103	8	89	5	58
2048	0	558000	291	232708	16	320	78	116354	8	86	5	56
2049	0	558000	279	223584	15	308	75	111792	8	82	5	54
2050	0	558000	268	214817	14	296	72	107408	7	79	5	52
2051	0	558000	258	206394	14	284	69	103197	7	76	5	50
2052	0	558000	248	198301	13	273	66	99150	7	73	4	48
2053	0	558000	238	190525	13	262	64	95263	6	70	4	46
2054	0	558000	229	183055	12	252	61	91527	6	67	4	44
2055	0	558000	220	175877	12	242	59	87939	6	65	4	42
2056	0	558000	211	168981	11	233	56	84490	6	62	4	41
2057	0	558000	203	162355	11	223	54	81178	5	60	4	39
2058	0	558000	195	155989	10	215	52	77995	5	57	3	38
2059	0	558000	187	149873	10	206	50	74936	5	55	3	36
2060	0	558000	180	143996	10	198	48	71998	5	53	3	35
2061	0	558000	173	138350	9	190	46	69175	5	51	3	33
2062	0	558000	166	132925	9	183	44	66463	4	49	3	32
2063	0	558000	159	127713	9	176	43	63857	4	47	3	31
2064	0	558000	153	122705	8	169	41	61353	4	45	3	30
2065	0	558000	147	117894	8	162	39	58947	4	43	3	28
2066	0	558000	141	113271	8	156	38	56636	4	42	2	27
2067	0	558000	136	108830	7	150	36	54415	4	40	2	26
2068	0	558000	131	104563	7	144	35	52281	4	38	2	25
2069	0	558000	125	100463	7	138	34	50231	3	37	2	24
2070	0	558000	121	96523	6	133	32	48262	3	35	2	23
2071	0	558000	116	92739	6	128	31	46369	3	34	2	22
2072	0	558000	111	89102	6	123	30	44551	3	33	2	21
2073	0	558000	107	85609	6	118	29	42804	3	31	2	21
2074	0	558000	103	82252	6	113	27	41126	3	30	2	20
2075	0	558000	99	79027	5	109	26	39513	3	29	2	19
2076	0	558000	95	75928	5	105	25	37964	3	28	2	18
2077	0	558000	91	72951	5	100	24	36475	2	27	2	18
2078	0	558000	88	70090	5	96	23	35045	2	26	2	17
2079	0	558000	84	67342	5	93	22	33671	2	25	1	16
2080	0	558000	81	64702	4	89	22	32351	2	24	1	16
2081	0	558000	78	62165	4	86	21	31082	2	23	1	15
2082	0	558000	75	59727	4	82	20	29864	2	22	1	14
2083	0	558000	72	57385	4	79	19	28693	2	21	1	14
2084	0	558000	69	55135	4	76	18	27568	2	20	1	13
2085	0	558000	66	52973	4	73	18	26487	2	19	1	13
2086	0	558000	64	50896	3	70	17	25448	2	19	1	12
2087	0	558000	61	48900	3	67	16	24450	2	18	1	12
2088	0	558000	59	46983	3	65	16	23491	2	17	1	11
2089	0	558000	56	45141	3	62	15	22570	2	17	1	11
2090	0	558000	54	43371	3	60	14	21685	1	16	1	10
2091	0	558000	52	41670	3	57	14	20835	1	15	1	10
2092	0	558000	50	40036	3	55	13	20018	1	15	1	10
2093	0	558000	48	38466	3	53	13	19233	1	14	1	9
2094	0	558000	46	36958	2	51	12	18479	1	14	1	9
2095	0	558000	44	35509	2	49	12	17754	1	13	1	9
2096	0	558000	43	34117	2	47	11	17058	1	13	1	8
2097	0	558000	41	32779	2	45	11	16389	1	12	1	8
2098	0	558000	39	31494	2	43	11	15747	1	12	1	8
2099	0	558000	38	30259	2	42	10	15129	1	11	1	7
2100	0	558000	36	29072	2	40	10	14536	1	11	1	7

*Assumes 19 of of the proposed 29 vents are located on Forest Service property