Rosebud Power Plant
CCR Landfill Closure Plan

Prepared for Colstrip Energy Limited Partnership
by Allied Engineering Services, Inc.

October 17, 2016

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INTRODUCTION

This report outlines the plan for closure of the CCR landfill at the Rosebud Power Plant *in Rosebud County, Montana* owned by Colstrip Energy Limited Partnership (CELP) in order to fulfill the requirements of the CCR rule as published in the Federal Register on April 17, 2015 and July 2, 2015 and its effective date of October 17, 2015. The applicable rule section is 40 CFR Parts 257 and 261. This report fulfills the requirements of 40 CFR § 257.102(b). The landfill addressed in this report holds hydrated coal ash, which is solid and practically impermeable to water, similar to concrete.

The project site is located approximately seven miles north of the town of Colstrip, Montana in the southwest quarter of Section 29 and the northwest quarter of Section 32, Township 3 North, Range 41 East (Latitude 45.978859°, Longitude -106.663772° (WGS 84)). A vicinity map is included on Sheet C0-1 of the plan set included in Appendix A. The landfill serves an on-site Power Plant owned by Colstrip Energy Limited Partnership. The Power Plant and the landfill are operated by Rosebud Operating Services, Inc. The power plant's landfill has been permitted under Montana law at all times since commercial operations commenced in 1990.

The landfill area covered by this report is an active landfill located on the subject property. There is also a closed landfill, last used in October, 2005, that has since been reclaimed in general accordance with applicable permits and regulations in effect at closure in accordance with 40CFR § 257.50(d). This closed landfill is not subject to regulation by the above referenced rules and is not the subject of this report. The active landfill includes Phase I and Phase II of a contiguous landfill permitted in 1997 and placed in service in October, 2005. This active landfill is subject to regulation by the above referenced CCR rules.

The information contained herein is based on an investigation and analysis of the property's topographical and subsurface conditions, a review of existing permits, regulatory requirements, maps and literature for the project area as related to the landfilling operations of combusted coal residuals (CCR), more familiarly referred to as bottom ash and fly ash. The purpose of this report is to provide a design plan that will fulfill the closure requirements of the CCR rule, and provide recommendations and design and permitting assistance for closure of the active CCR landfill.

The CCR unit is a landfill that will remain in place once the power plant ceases operations and the remaining CCR is landfilled and hydrated per plant operating procedures. Currently the plant is planned to operate until July 1, 2024 and the CCR landfill area is more than adequate for those operations. The landfill design and operation includes the run-on and run-off provisions as part of the CCR rule (CFR § 257.81). Operating procedures also include construction and reclamation of the final cover system as the CCR is placed and advances upwards in elevation. Reclamation of side-slopes as landfilling progresses provides erosion control measures that will minimize sediment transport as well as ensure that reclamation/closure techniques are tested and perfected prior to final closure.

Final closure will essentially include the construction of the final cap cover and upper side-slopes that have not been reclaimed, construction of perimeter drainage-ways in accordance with the run-on/run-off provisions of the rule, and plugging and abandonment of the piping that runs underneath the landfill.

REGULATORY SETTING

As of April 17, 2015, new rules for coal combustion residuals (CCR) were published in the Federal Register Volume 80, Number 74, dated Friday April 17, 2015. The applicable sections include 40 CFR Parts 257 and 261. These rules spell out the conditions for existing operating CCR landfills such as the active landfill at the Rosebud Power Plant. The rules provide over all closure planning, location restrictions, structural stability assessment requirements, groundwater monitoring requirements, surface water protection, design and operating criteria, along with inspection requirements. Part of the requirements includes the preparation of an Annual Engineers Inspection Report. The first report was completed and posted to the CELP website in accordance with the CCR rule.

The power plant is currently operating under several permits that include protection criteria for air, surface water and groundwater quality. Permits include:

- Montana Ground Water Pollution Control System (MGWPCS) Permit No. MTX000052
- Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activity. Permit No. MTR000058
- Air Quality Permit Nos. #2035-06 and OP2035-3

The applicable requirements of the current CCR rule cover active CCR landfills and exclude closed landfills.

BACKGROUND

Rosebud Power Plant is a waste coal burning facility using a fluidized bed boiler and limestone to control sulfur emissions. During the burning process of the coal and limestone, bottom and fly ash or combusted coal residuals (CCR) are produced. The CCR which contain high levels of pozzalonic compounds (calcium oxide and anhydrous calcium sulfate) are either sold for commercial/industrial purposes or landfilled on-site near the power plant. The active landfill, consisting of two phases, is located northwest of the power plant.

In 1996, Chandler Geotechnical, Inc. (a predecessor to Allied Engineering Services, Inc.) was hired as a sub-consultant to JSM, Inc. to provide engineering analysis and design of the current active landfill. Over the course of operations at the plant, fly ash was sold during some years; thus the amount of fly ash placed in the Phase 1 area was less than anticipated with the original design and has not yet reached its maximum storage capacity. These changes resulted in the need for minor modifications of the original design of the landfill area. Phase 2 modifications began in September of 2015 with simultaneous re-design and construction. Construction has been ongoing for Phase 2 of the active landfill in general conformance with the original 1996 design with modifications undertaken during construction under the direction of Allied Engineering Services, Inc.

ESTIMATED VOLUMES AND AREAS

The active landfill must store at least the expected produced volume of 636,000 CY of CCR for the rest of the anticipated operating life of the power plant. This volume assumes that no fly ash will be sold and is therefore a conservative value. The design provides an additional 214,000 CY of CCR capacity available if needed. This design volume is less than the originally designed and permitted ash quantity. The original design had a final storage volume of approximately 2,200,000 CY and the revised design will have a total storage volume of approximately 1,300,000 CY, which includes approximately 440,000 CY in Phase 1 plus 850,000 CY in Phase 2. The estimated closure year is 2024.

Closure will include providing final cover and reclaiming the landfill with stockpiled sub-soil, excavated subsoil from cut areas of the proposed perimeter drainage ways, and stockpiled topsoil. The total area requiring final cover for Phases 1 and 2 CCR areas is anticipated to be 15.7 acres. In order to meet the 18-inch minimum of sub-soil required per CCR rules, containment berms will be constructed out of sub-soil and the final cap will be constructed on the top of the final CCR surface. Combined these sub-soil coverings will need approximately 165,990 CY. Stockpiled volumes of sub-soil have been surveyed and calculated at approximately 107,150 cubic yards with an anticipated excess cut from the Drainage Ways 1 and 2 of 116,529 CY. Use of the minimum allowed CCR Rule reclamation section therefore would provide excess subsoil. In summary, the final soil cover section will vary but will always be at least 18" of subsoil plus 6" of topsoil. Some places will have considerably more soil cover to achieve the required finished slopes and the desired earthwork balance.

The total estimated volume of available topsoil stockpiled on site is approximately 11,090 cubic yards. Based on the final cover area and the topsoil requirement of 6-inches minimum, an estimated 10,060 CY is needed to cover the whole area. This close balance of topsoil will require careful attention to the separating, stockpiling and use of topsoil, which can be supplemented by additional depth of stripping over newly disturbed areas and maximum salvage amount of quality available topsoil from all earthwork activities.

SCHEDULE

The planned closure of the CCR unit is in accordance with the CCR rule. The active operating procedures take into account the post closure configuration. As the elevation of the landfilled CCR increases, the cover/final reclamation cover is established on the side-slopes. The final cap cover and perimeter drainage ways will be completed during final closure following the cessation of operations of the power plant. The existing piping system under the landfill will be plugged and abandoned upon final closure.

The major milestones associated with the final closure of the CCR landfill include:

1. Regulatory timeframes associated with the CCR rule as well as several other permits that include protection criteria for air, surface water and groundwater quality. Permits include:
    - The CCR rule includes statutory implementation timeframes as follows:
        - Recordkeeping, Notification, and Internet Requirements – Begin 10/19/15 (40 CFR Parts §257.105-107). Required recordkeeping, required notifications, and establishment of a public website has been initiated and maintained.
        - Air Criteria – Due 10/19/15 (40 CFR Part §257.80). Preparation of the fugitive dust control plan has been completed.
        - Weekly Inspections – Begin By 10/19/15 (40 CFR Part §257.84). Weekly inspections will continue until final closure.
        - Annual Engineer's Inspection Reports – Initial Report Due 1/19/16 (40 CFR Part §257.84). First Annual Engineers Inspection Report of the CCR Unit has been completed. Annual inspections and report will continue until final closure.
        - Run-on Run-off Controls – Due 10/17/16. Prepare initial run-on and run-off control system plans. Plans must be revised every 5 years (10/17/21).
        - Closure and Post-Closure – Due 10/17/16 (40 CFR Part §257.102) - Prepare written closure and post-closure plans (10/17/16). Amendments can be made at any time with notification requirements.

  - Groundwater Monitoring and Corrective Action – Due 10/17/17 (40 CFR Part §257.102) - Install the groundwater monitoring system, develop the groundwater sampling and analysis program, initiate the detection monitoring program, and begin evaluating the groundwater monitoring data for statistically significant increase over background levels. The requirements under this section apply from the effective date through the post closure care period (7/1/54).
  - Location Restrictions – Due 10/17/18 (40 CFR Part §257.64) – Completed. Location restrictions were addressed in the 1st Annual Engineers Inspection Report (January, 2016).

- Montana Ground Water Pollution Control System (MGWPCS) Permit No. MTX000052. This operational permit is in the renewal process (expires 9/30/16) and anticipated to be renewed in 2017 (due to DEQ backlog). Subsequent renewals are anticipated every 5 years until facility closure or corrective action (if applicable).
- Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activity. Permit No. MTR000058. This permit is valid until 12/31/20 and will be renewed every four years until the final stabilization of reclamation is attained (11/1/27). The Stormwater Pollution Prevention Plan (SWPPP) is scheduled to be evaluated at least every three years. Post closure care requirements of the CCR Rule will continue following termination of this authorization.
- Air Quality Permit Nos. #2035-06 and OP2035-3. These operational permits for plant emissions includes the treatment of all unpaved portions of the haul roads, access roads, parking lots, or general plant area with water and/or chemical dust suppressant as necessary to maintain compliance with the reasonable precautions limitation (ARM 17.8.749). Termination of these permits are anticipated within one-year of plant closure. The Fugitive Dust requirements (available on the CELP website) in the CCR Rule will be followed.

2. Concurrent operational CCR placement, final cover establishment and reclamation – This ongoing task includes the reclamation of the landfill slopes as CCR is placed in areas that will produce side-slopes, predominately in the south and west sides of the landfill in earlier stages of landfill operations and all side slopes later in the operational life.
3. Plant closure and final landfill grading/construction/reclamation of final cover system.
4. Construction of perimeter drainage ways
5. Abandonment of piping under the landfill.
6. Post closure care.

Power generation is anticipated to cease in July of 2024. Final closure operations will continue as weather allows with final reclamation and seeding by the fall of 2024.

FINAL COVER SYSTEM

The final cover system is comprised of an 18-inch minimum compacted infiltration layer that meets the hydraulic conductivity requirements of the CCR Rule, and a minimum 6-inch thick topsoil layer that is capable of supporting vegetation. The landfill side-slope cover will be constructed as the placement of fly ash progresses. The side-slope cover will also provide operational containment of storm water (run-off control) and will be constructed as berms around the perimeter of the active landfill unit. Reclamation of the side-slopes including topsoil placement and seeding will be completed as the side-

slope cover progresses with the landfilling of fly ash. Reclamation will typically be completed in late fall or early spring of each year. The progressive reclamation activities will provide the opportunity to evaluate reclamation success during the operational phase of the landfill that will allow modification of techniques and design (if necessary). This process will ensure a reclamation approach that will result in a stable well vegetated cover system on the side-slopes of the landfill by the date of final closure.

Immediately following cessation of placement of fly ash (anticipated date of 7/1/2024), Construction of the landfill cap will be initiated that will include final grading resulting in a concave surface with the infiltration layer, topsoil layer and reclamation seeding as described above. The cap is designed in order to facilitate a well vegetated surface with minimum grades (approximately 1%) that will encourage evapotranspiration and limit storm water run-off. In order to accommodate high intensity storm or melt events, the cap design will slope gently to the north and will be graded to a rock armored storm water channel that will convey flow to a rock armored plunge pool and ultimately the constructed drainage ways.

FINAL CLOSURE

As outlined in the first Annual Engineers Inspection Report, there is currently a piping system that conveys storm water under the landfill. To avoid reliance on the buried pipelines and any risks that they might otherwise present during the post closure period, perimeter drainage ways will be constructed in order to convey run-on and run-off water around the landfill. The final configuration will be a trapezoidal channel with a 12 foot bottom width and 3V:1H side slopes. These channels are designed to be vegetated swales but will include subsurface rock grade-control structures that will reduce the potential for head-cutting of the drainage ways in steeper reaches. The drainage ways will be reclaimed with a 6 inch topsoil cover as described previously. Following construction of the perimeter surface drainage system, the piping system will be plugged and abandoned. Abandonment will consist of filling the pipe with low permeability fill on the upstream end and free draining sand or gravel fill on the downstream end. The use different materials are to limit water from entering the piping system and if any does it will be able to exit the piping system without building any pressure. The length of the pipe to be filled is based on the potential of subsidence of the material above the piping system, which is estimated to occur up to 10’ above the top of pipe. Assuming 3H:1V side slopes for the existing pipe, ends of the pipe would need to be filled at least 30 feet from the end to limit the possibility of future subsidence.

Final closure of the active landfill may happen at any time before or after the estimated closure date (July 1, 2024). Generally, the closure plan will remain the same and will include construction of the final cover, construction of perimeter drainage ways, and abandonment of the existing piping system. An amendment of the closure plan and run-on and run-off control plans may be necessary in order to update specific design parameters of the landfill system. These updates may include, but are not necessarily limited to:

- The re-design of the perimeter drainage system that would essentially lower the elevation of the northern portion of the drainage way.
- The update of final volumes of stored CCR and distribution of the final cover system.
- The update of drainage basin configurations and calculations associated with the run-on and run-off control plan.

REGULATORY ACKNOWLEDGEMENT AND CLARIFICATION

The following include the relevant CCR Rule citations (*italics*) followed by the response (**bold**):

257.102 (b) Written closure plan—(1) Content of the plan.
The owner or operator of a CCR unit must prepare a written closure plan that describes the steps necessary to close the CCR unit at any point during the active life of the CCR unit consistent with recognized and generally accepted good engineering practices. The written closure plan must include, at a minimum, the information specified in paragraphs (b)(1)(i) through (vi) of this section.

(i) A narrative description of how the CCR unit will be closed in accordance with this section.
The CCR unit is a landfill that will remain in place once the power plant ceases operations and the remaining CCR is landfilled and hydrated per plant operating procedures. Currently the plant is planned to operate until July 1, 2024. The landfill design and operation includes the run-on and run-off provisions as part of the CCR rule. Operating procedures also include construction and reclamation of the final cover system as the CCR is placed and advances upwards in elevation. Reclamation of side-slopes as landfilling progresses provides erosion control measures that will minimize sediment transport as well as ensure that reclamation/closure techniques are tested and perfected prior to final closure. Final closure will essentially include the construction of the final cap cover (and upper side-slopes that have not been reclaimed), construction of perimeter drainage-ways (in accordance with the run-on/run-off provisions of the rule), and abandonment of the piping system that runs underneath the landfill.

(ii) If closure of the CCR unit will be accomplished through removal of CCR from the CCR unit, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with paragraph (c) of this section.
N/A

(iii) If closure of the CCR unit will be accomplished by leaving CCR in place, a description of the final cover system, designed in accordance with paragraph (d) of this section, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in paragraph (d) of this section.
As discussed earlier in this report, the side slopes are constructed as berms to contain the hydrated ash; thereby installing the cover on the side-slopes during operation. The top cover will consist of an 18-inch minimum compacted infiltration layer that meets the hydraulic conductivity requirements of the CCR Rule, and a topsoil layer that is capable of supporting vegetation.

(iv) An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.

Landfill Volumes Table

Description	Volume
Phase 1 Landfill Ash Storage	440,000 CY
Phase 2 Landfill Ash Storage	850,000 CY
Closed Landfill Ash Storage	836,000 CY
Stockpile 1 – Top Soil	6,000 CY
Stockpile 2 – Sub Soil	82,460 CY
Stockpile 3 – Top Soil	5,090 CY
Stockpile 4 – Sub Soil	29,300CY
***Soil volumes are approximate and estimated from topographic data taken on 9/14/15, 9/29/15, 10/13/15, and 1/27/16. Sub soil stockpiles will be stripped of top 6 inches in order to salvage additional top soil.**	

(v) An estimate of the largest area of the CCR unit ever requiring a final cover as required by paragraph (d) of this section at any time during the CCR unit's active life.

The largest footprint the CCR could reach is 14.6 acres with a surface area (due to slope) of 15.7 acres.

(vi) A schedule for completing all activities necessary to satisfy the closure criteria in this section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of CCR unit closure. When preparing the written closure plan, if the owner or operator of a CCR unit estimates that the time required to complete closure will exceed the timeframes specified in paragraph (f)(1) of this section, the written closure plan must include the site-specific information, factors and considerations that would support any time extension sought under paragraph (f)(2) of this section.

See schedule section of this report.

(2) Timeframes for preparing the initial written closure plan—
(i) Existing CCR landfills and existing CCR surface impoundments. No later than October 17, 2016, the owner or operator of the CCR unit must prepare an initial written closure plan consistent with the requirements specified in paragraph (b)(1) of this section.
(ii) New CCR landfills and new CCR surface impoundments, and any lateral expansion of a CCR unit. No later than the date of the initial receipt of CCR in the CCR unit, the owner or operator must prepare an initial written closure plan consistent with the requirements specified in paragraph (b)(1) of this section.

(ii) The owner or operator has completed the written closure plan when the plan, including the certification required by paragraph (b)(4) of this section, has been placed in the facility's operating record as required by § 257.105(i)(4).

Acknowledged.

(3) Amendment of a written closure plan.
(i) The owner or operator may amend the initial or any subsequent written closure plan developed pursuant to paragraph (b)(1) of this section at any time.

(ii) The owner or operator must amend the written closure plan whenever:
(A) There is a change in the operation of the CCR unit that would substantially affect the written closure plan in effect; or
(B) Before or after closure activities have commenced, unanticipated events necessitate a revision of the written closure plan.
(iii) The owner or operator must amend the closure plan at least 60 days prior to a planned change in the operation of the facility or CCR unit, or no later than 60 days after an unanticipated event requires the need to revise an existing written closure plan. If a written closure plan is revised after closure activities have commenced for a CCR unit, the owner or operator must amend the current closure plan no later than 30 days following the triggering event.
(4) The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of requirements of this section.
Acknowledged.

(c) Closure by removal of CCR. An owner or operator may elect to close a CCR unit by removing and decontaminating all areas affected by releases from the CCR unit. CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to § 257.95(h) for constituents listed in appendix IV to this part.
N/A

(d) Closure performance standard when leaving CCR in place—(1) The owner or operator of a CCR unit must ensure that, at a minimum, the CCR unit is closed in a manner that will:
(i) Control, minimize or eliminate, to the maximum extent feasible, postclosure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;
Based on the operational logistics that include the pozzolanic properties of fly ash, the hydration of ash renders the material at this facility relatively inert. The final vegetated cap, side slopes and perimeter drainage ways are designed to minimize the possibility of release to the subsurface and vegetation establishment on the cap and side-slopes will provide storage and evapotranspiration of most precipitation events. The perimeter channels provide run-on run-off control for the 25-year, 24-hour design event and has been modeled for adequacy up to the 500-year, 24-hour event.

(ii) Preclude the probability of future impoundment of water, sediment, or slurry;
The current operation, design and post closure design does not include future impoundments. The post closure design includes abandoning piping that currently conveys flow under the landfill. Permanent perimeter drainage-ways will convey surface water flow around the landfill upon closure in order to prohibit any ponding associated with pipe failure under the landfill.

(iii) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;
Landfill slopes are designed at 3H:1V and interrupted with a bench in order to minimize slope steepness and length. The landfill top will be subtly graded to direct flow toward the north where the perimeter drainage is higher in elevation. All areas will be seeded and protected with various erosion control methods as outlined on the design plans. Abandonment of piping under the landfill and the construction of perimeter drainage ways will mitigate the potential of ponding and subsequent slope failure possibility associated with oversaturated soils.

(iv) Minimize the need for further maintenance of the CCR unit; and

(v) Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.

Reclamation activities are part of the current landfill operations. There has been successful vegetation establishment on the reclaimed slopes that has limited erosional occurrences. Reclamation including vegetation establishment and hydrologic controls have been successful and will continue through operational and closure phases of the CCR unit. Vegetation establishment and hydrologic controls that take into account typical climatic conditions along with soils and geology are the primary reclamation techniques that will limit the need for post closure maintenance. Effective vegetation establishment is anticipated within one to three growing seasons.

(3) Final cover system. If a CCR unit is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (d)(3)(i) of this section, or the requirements of the alternative final cover system specified in paragraph (d)(3)(ii) of this section.

The cover system has been analyzed in order to meet the criteria set forth in this section. Native soils have been tested and have the hydraulic conductivity requirements as outlined in the CCR rule. Samples were collected from a stripped area adjacent the landfill. These samples were composited as Sample B-1. Samples were also collected from the sub-soil stockpiles and composited into one sample – Sample SP-1. These samples were delivered to Pioneer Technical Services where permeability testing was conducted following ASTM Standard ASTM D5804. Results indicate that the landfill base (sample B-1) has a permeability of $2.1X10^{-07}$ cm/sec. The subsoil sample (sample SP-1) has a permeability of $4.2X10^{-08}$. Hydraulic conductivity results indicate that the final cover system and landfill base exceeds the criteria set forth by the CCR Rule.

(i) The final cover system must be designed and constructed to meet the criteria in paragraphs (d)(3)(i)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.

(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less.

See above

(*B) The infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.*

As mentioned previously the 18-inch infiltration layer to be constructed from the on-site sub soil exceeds the permeability requirements of the CCR Rule. Due to the excess quantity of soil generated by the cutting of drainage ways around the landfill, there is sufficient quantity of these soils on site to use a minimum of 2 feet of the native sub soil on the side slopes as well as additional material on the the landfill cap. As shown above the site has sufficient material to construct a compliant infiltration layer.

(C) The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

As shown above calculations of stockpiled top soil and drainage way construction verify that there is sufficient quantity of material to cover the entire landfill area .

(D) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

The subsidence is limited within the CCR unit by operational activities that include the hydration following placement of CCR using a water truck and using harrows to mix water and CCR. This results in a relatively solid medium that will resist any settling or subsidence (a more complete analysis of the CCR stability is available in the 1st Annual Engineers Inspection Report that is included in the operating record and available on the website http://www.celpccr.com). The grading and reclamation design of the landfill incorporates slopes that will support vegetation and are interrupted by a bench designed to reduce slope distance thereby reducing the erosion potential. The final configuration also includes perimeter channels that will limit the possibility of ponding that could result in oversaturation and subsequent subsidence or sloughing of the cover side slopes.

(ii) The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (f)(3)(ii)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.

N/A an alternative cover system is not anticipated. Final grading includes the construction of perimeter channels that will generate excess material that can be used in the event of a shortage of cover material that is currently stockpiled on site.

(A) The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (d)(3)(i)(A) and (B) of this section.

(B) The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph (d)(3)(i)(C) of this section.

(C) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

(iii) The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the design of the final cover system meets the requirements of this section.

(e) Initiation of closure activities.

Except as provided for in paragraph (e)(4) of this section and § 257.103, the owner or operator of a CCR unit must commence closure of the CCR unit no later than the applicable timeframes specified in either paragraph (e)(1) or (2) of this section.

Acknowledged

(1) The owner or operator must commence closure of the CCR unit no later than 30 days after the date on which the CCR unit either:

(i) Receives the known final receipt of waste, either CCR or any non-CCR waste stream; or

(ii) Removes the known final volume of CCR from the CCR unit for the purpose of beneficial use of CCR.

(2)(i) Except as provided by paragraph (e)(2)(ii) of this section, the owner or operator must commence closure of a CCR unit that has not received CCR or any non-CCR waste stream or is no longer removing CCR for the purpose of beneficial use within two years of the last receipt of waste or within two years of the last removal of CCR material for the purpose of beneficial use.

Acknowledged

(ii) Notwithstanding paragraph (e)(2)(i) of this section, the owner or operator of the CCR unit may secure an additional two years to initiate closure of the idle unit provided the owner or operator provides written documentation that the CCR unit will continue to accept wastes or will start removing CCR for the purpose of beneficial use. The documentation must be supported by, at a minimum, the information specified in paragraphs (e)(2)(ii)(A) and (B) of this section. The owner or operator may obtain two-year extensions provided the owner or operator continues to be able to demonstrate that there is reasonable likelihood that the CCR unit will accept wastes in the foreseeable future or will remove CCR from the unit for the purpose of beneficial use. The owner or operator must place each completed demonstration, if more than one time extension is sought, in the facility's operating record as required by§ 257.105(i)(5) prior to the end of any two-year period.

Acknowledged.

(A) Information documenting that the CCR unit has remaining storage or disposal capacity or that the CCR unit can have CCR removed for the purpose of beneficial use; and

(B) Information demonstrating that that there is a reasonable likelihood that the CCR unit will resume receiving CCR or non-CCR waste streams in the foreseeable future or that CCR can be removed for the purpose of beneficial use. The narrative must include a best estimate as to when the CCR unit will resume receiving CCR or non-CCR waste streams. The situations listed in paragraphs (e)(2)(ii)(B)(1) through (4) of this section are examples of situations that would support a determination that the CCR unit will resume receiving CCR or non-CCR waste streams in the foreseeable future.

(1) Normal plant operations include periods during which the CCR unit does not receive CCR or non-CCR waste two or more CCR units whereby at any point in time one CCR unit is receiving CCR while CCR is being removed from a second CCR unit after its dewatering.

(2) The CCR unit is dedicated to a coal-fired boiler unit that is temporarily idled (e.g., CCR is not being generated) and there is a reasonable likelihood that the coal-fired boiler will resume operations in the future.

(3) The CCR unit is dedicated to an operating coal-fired boiler (i.e., CCR is being generated); however, no CCR are being placed in the CCR unit because the CCR are being entirely diverted to beneficial uses, but there is a reasonable likelihood that the CCR unit will again be used in the foreseeable future.

(4) The CCR unit currently receives only non-CCR waste streams and those non-CCR waste streams are not generated for an extended period of time, but there is a reasonable likelihood that the CCR unit will again receive non-CCR waste streams in the future.

(iii) In order to obtain additional time extension(s) to initiate closure of a CCR unit beyond the two years provided by paragraph (e)(2)(i) of this section, the owner or operator of the CCR unit must include with the demonstration required by paragraph (e)(2)(ii) of this section the following statement signed by the owner or operator or an authorized representative:

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this demonstration and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

(3) For purposes of this subpart, closure of the CCR unit has commenced if the owner or operator has ceased placing waste and completes any of the following actions or activities:

(i) Taken any steps necessary to implement the written closure plan required by paragraph (b) of this section;

(ii) Submitted a completed application for any required state or agency permit or permit modification; or

(iii) Taken any steps necessary to comply with any state or other agency standards that are a prerequisite, or are otherwise applicable, to initiating or completing the closure of a CCR unit.

(4) The timeframes specified in paragraphs (e)(1) and (2) of this section do not apply to any of the following owners or operators:
(i) An owner or operator of an inactive CCR surface impoundment closing the CCR unit as required by § 257.100(b);
(ii) An owner or operator of an existing unlined CCR surface impoundment closing the CCR unit as required by § 257.101(a);
(iii) An owner or operator of an existing CCR surface impoundment closing the CCR unit as required by§ 257.101(b);
(iv) An owner or operator of a new CCR surface impoundment closing the CCR unit as required by § 257.101(c); or
(v) An owner or operator of an existing CCR landfill closing the CCR unit as required by § 257.101(d).
(f) Completion of closure activities.
(1) Except as provided for in paragraph (f)(2) of this section, the owner or operator must complete closure of the CCR unit:
(i) For existing and new CCR landfills and any lateral expansion of a CCR landfill, within six months of commencing closure activities.
Acknowledged.

(ii) For existing and new CCR surface impoundments and any lateral expansion of a CCR surface impoundment, within five years of commencing closure activities.
Not applicable – No surface impoundments are planned on site

§ 257.103 Alternative closure requirements.
Not applicable - Since the final cover system meets the criteria of the CCR Rule, an alternative cover system is not necessary or required.

CERTIFICATION

This report was prepared by Allied Engineering Services, Inc., under the direction of Douglas S. Chandler, PhD, PE, with assistance from Andrew Graham, PE, and Ronald Orton, Environmental Scientist, and QC review by Brock Athman, PE.

ALLIED ENGINEERING SERVICES, INC

Douglas S. Chandler, PhD, PE

cn=Douglas S. Chandler, PhD, PE, o=Allied Engineering Services, Inc., ou, email=doug@alliedengineering.com, c=US
2016.10.11 13:27:34 -06'00'

MONTANA
DOUGLAS S. CHANDLER
7403 PE
PROFESSIONAL ENGINEER

Andrew S. Graham, PE

MONTANA
ANDREW SCOTT GRAHAM
No. 40761PE
10-10-16
LICENSED
PROFESSIONAL ENGINEER

Ron Orton

QC Approval: Brock D. Athman, PE

MONTANA
BROCK D. ATHMAN
No. 19765PE
10/10/16
LICENSED
PROFESSIONAL ENGINEER

REFERENCES

1. Environmental Protection Agency, 2015. "*Federal Register*", Vol. 80, No. 74, Part 257.
2. Hydrologic Analysis and Design, Third Edition. McCuen, Richard. 2005
3. Montana Bureau of Mines and Geology, 2007. Geologic Map of the Lame Deer 30' x 60' quadrangle, eastern Montana. Vuke, S.M., Heffern, E.L., Bergantino, R.N., and Colton, R.B. Accessed via the USGS National Geologic Map Database Map View. Accessed 12/23/15 http://ngmdb.usgs.gov/maps/mapview/
4. Montana Bureau of Mines and Geology, Groundwater Information Center, Well log data website, http://mbmggwic.mtech.edu/sqlserver/v11/menus/menuData.asp. Accessed 1/6/15
5. Natural Resource Conservation Service, Web Soil Survey. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm Accessed 12/23/15.
6. Rosebud Power Plant Ash Disposal Site Engineering Design and Construction Specifications by Chandler Geotechnical. Chandler, D.S. dated July 16, 1996.

Appendix A: **Plan Set - Rosebud Power Plant, Fly Ash Landfill Post Closure Design – Dated September 15, 2016** (31 sheets)

ROSEBUD POWER PLANT

FLY ASH LANDFILL POST-CLOSURE DESIGN

PROJECT LOCATION: 6.5 MILES NORTH OF COLSTRIP, MT ON HIGHWAY 39

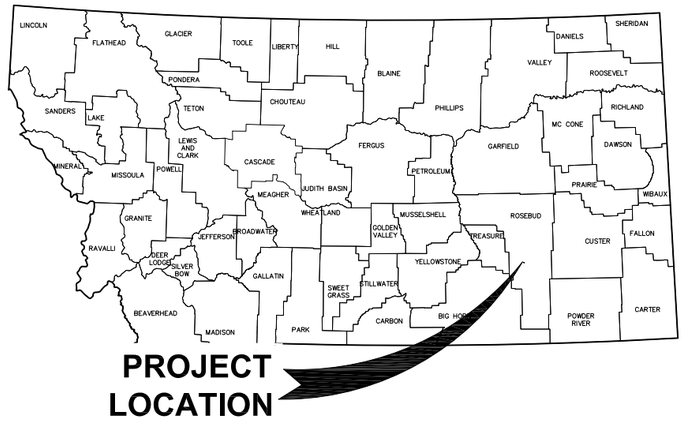
LEGAL DESCRIPTION: NW $\frac{1}{4}$, SECTION 32, TOWNSHIP 3N, RANGE 41E, P.M.M., ROSEBUD COUNTY, MT

OWNER: COLSTRIP ENERGY LIMITED PARTNERSHIP (CELP)
1087 W. RIVER STREET, SUITE 200
BOISE, ID 83702

CLIENT: ROSEBUD OPERATING SERVICES, INC.
1087 W. RIVER STREET, SUITE 200
BOISE, ID 83702

SEPTEMBER 15, 2016

SET NO. _____



PRINCIPAL-IN-CHARGE: DOUG CHANDLER, PE, Ph.D

PROJECT ENGINEER: ANDREW S. GRAHAM, PE

QC REVIEW: BROCK D. ATHMAN, PE

PROJECT SURVEYOR: KYLE THOMPSON, PLS
GREG FINCK, PLS

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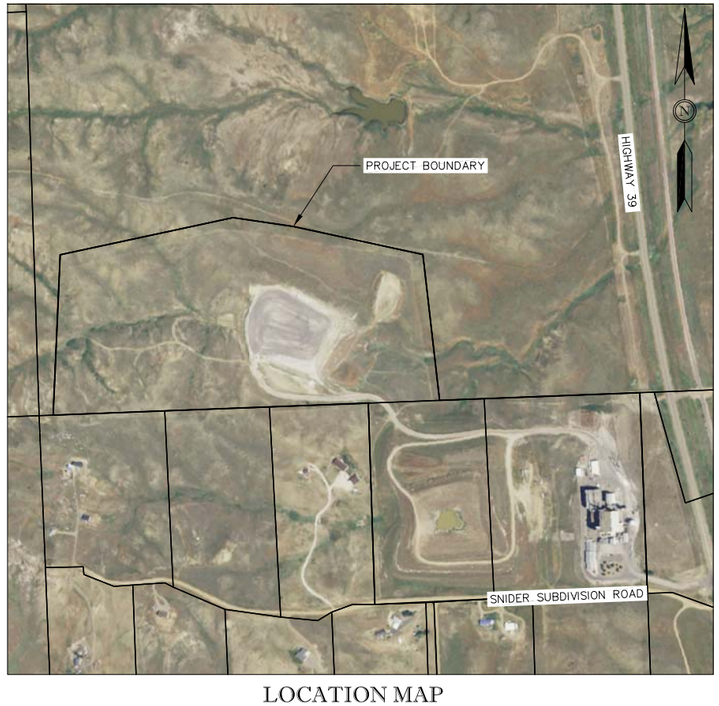

LOCATION MAP

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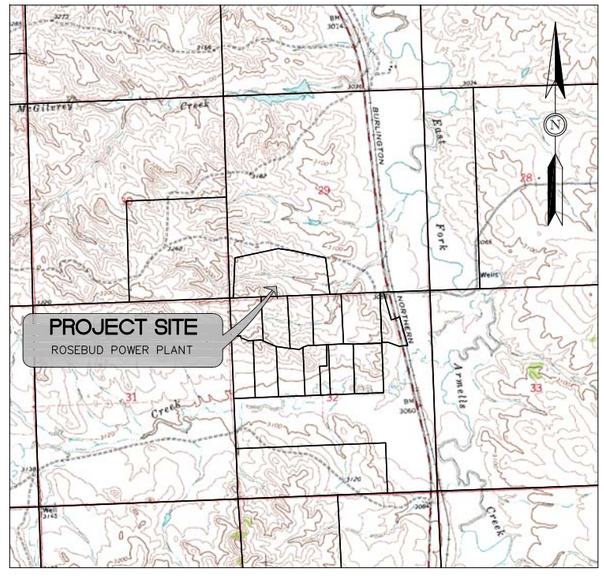
SCALE (FEET)



VICINITY MAP

0 2000 4000 6000

SCALE (FEET)

ROSEBUD POWER PLANT
ROSEBUD COUNTY, MONTANA

NO.	REVISIONS	DATE

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\POST-CLOSURE COVER & NOTES.dwg

ROSEBUD POWER PLANT
CO-1 COVER SHEET

SHEET INDEX

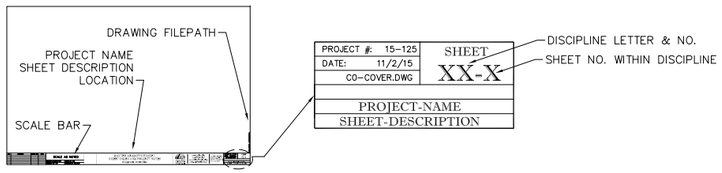
GENERAL NOTES:

1. THESE PLANS PRESENT FIELD AND DESIGN CHANGES TO THE ORIGINAL PLAN SET, ROSEBUD FLYASH DISPOSAL - DATED MAY, 1996. THESE ORIGINAL PLANS WERE CREATED BY CHANDLER GEOTECHNICAL, INC. FOR THE DESIGN OF PHASE 1 AND PHASE 2 OF THE FLYASH LANDFILL. ASH PLACEMENT IN PHASE 1 BEGAN IN 2005 AND CONSTRUCTION OF PHASE 2 BEGAN IN AUGUST, 2015. THESE PLANS ARE A CONTINUATION TO THE ROSEBUD POWER PLANT, FLY ASH LANDFILL DESIGN MODIFICATIONS - DATED JANUARY 7, 2016.
2. THIS PROJECT SHALL BE CONSTRUCTED IN ACCORDANCE WITH ALLIED ENGINEERING'S PLAN SET; ALONG WITH THE MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS (MPWSS), SIXTH EDITION.
3. ALL DuroMaxx PIPE IS TO BE INSTALLED PER ALLIED ENGINEERING'S PLANS AND SPECIFICATIONS; ALONG WITH CONTECH'S DuroMaxx STEEL REINFORCED PE TECHNOLOGY INSTALLATION GUIDE.

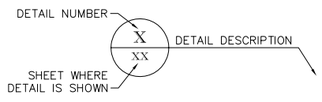
CIVIL ABBREVIATIONS:

AESI	ALLIED ENGINEERING SERVICES, INC.
AC	ACRE
AVE	AVENUE
BLDG	BUILDING
BM	BENCHMARK
BOG	BACK OF GRATE (GUTTER)
CI	CAST IRON
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
COB	CITY OF BOZEMAN
CONC	CONCRETE
CY	CUBIC YARD
DI	DUCTILE IRON
DIA	DIAMETER
DWG	DRAWING
E	EAST
EA	EACH
EG	EXISTING GRADE
ELEV	ELEVATION
EOG	EDGE OF GRAVEL
EOP	EDGE OF PAVEMENT
EX	EXISTING
FETS	FLARED END TERMINAL SECTION
FG	FINISHED GRADE
FHYD	FIRE HYDRANT
FL	FLANGE
FL	FLOWLINE
FM	SEWER FORCE MAIN
FT	FEET
GPM	GALLONS PER MINUTE
GV	GATE VALVE
HDPE	HIGH DENSITY POLYETHYLENE
HORZ	HORIZONTAL
HP	HIGH POINT
HWY	HIGHWAY
IE	INVERT ELEVATION
IN	INCH
INV	INVERT
LF	LINEAR FEET
LP	LOW POINT
LT	LEFT
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
MP	MID POINT
MPWSS	MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS
MSU	MONTANA STATE UNIVERSITY
N	NORTH
PC	POINT OF CURVATURE
PE	PLAIN END
PE	POLYETHYLENE
PI	POINT OF INTERSECTION
PL	PROPERTY LINE
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
R	RADIUS
RP	RADIUS POINT
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT-OF-WAY
RT	RIGHT
S	SOUTH
SCH	SCHEDULE
SD	STORM DRAIN
SECT	SECTION
SG	SUBGRADE
S	SANITARY SEWER MAIN
SS	SANITARY SEWER SERVICE
ST	STREET
STA	STATION
STD	STANDARD
SY	SQUARE YARD
TBM	TEMPORARY BENCH MARK
TBC	TOP BACK OF CURB
TDH	TOTAL DYNAMIC HEAD
TYP	TYPICAL
UG	UNDERGROUND
VC	VITRIFIED CLAY
VERT	VERTICAL
W	WATER MAIN
W	WEST
W/	WITH
W/O	WITHOUT
WS	WATER SERVICE

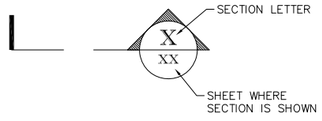
AESI STANDARD BORDER FORMAT



PLAN SHEET DETAIL CALLOUTS



PLAN SHEET SECTION CALLOUTS



LEGEND

- 4770 — MAJOR CONTOUR - FG
- 4771 — MINOR CONTOUR - FG
- 4770 — MAJOR CONTOUR - EG
- 4771 — MINOR CONTOUR - EG
- FOUND MONUMENT AS NOTED
- SET MONUMENT
- CONTROL POINT
- X — X — FENCE - EXISTING
- OHP — OVERHEAD POWER - EXISTING
- G — G — UTILITY GAS - EXISTING
- TEL — UTILITY PHONE - EXISTING
- E — E — UTILITY ELECTRIC - EXISTING
- UTILITY POWER POLE - EXISTING
- LIGHT POLE - EXISTING
- E — ELECTRICAL PEDESTAL - EXISTING
- EM — ELECTRICAL METER - EXISTING
- TEL — TELEPHONE PEDESTAL - EXISTING
- GM — GAS METER - EXISTING
- GAS VALVE - EXISTING
- GUY ANCHOR - EXISTING
- EASEMENT LINE
- BOUNDARY/ LOT LINE
- ROAD CENTERLINE
- ROAD - CURB
- CONCRETE SIDEWALK
- STREET SIGN
- S — SEWER MAIN
- S — SEWER MAIN - EXISTING
- SEWER SERVICE
- (S) — SANITARY SEWER MANHOLE
- (CO) — SEWER CLEANOUT
- W — WATER MAIN
- W — WATER MAIN - EXISTING
- WATER SERVICE
- FIRE HYDRANT
- (BO) — BLOW-OFF HYDRANT
- WV — WATER VALVE
- (W) — WELL
- (MW) — MONITORING WELL
- SD — STORM MAIN
- CULVERT - EXISTING
- DITCH-CENTERLINE - EXISTING
- (D) — STORM MAIN JOINT,BEND, OR STRUCTURE

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\POST-CLOSURE COVER & NOTES.dwg

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG, BDA	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
SHEET INDEX, LEGEND, & GENERAL NOTES
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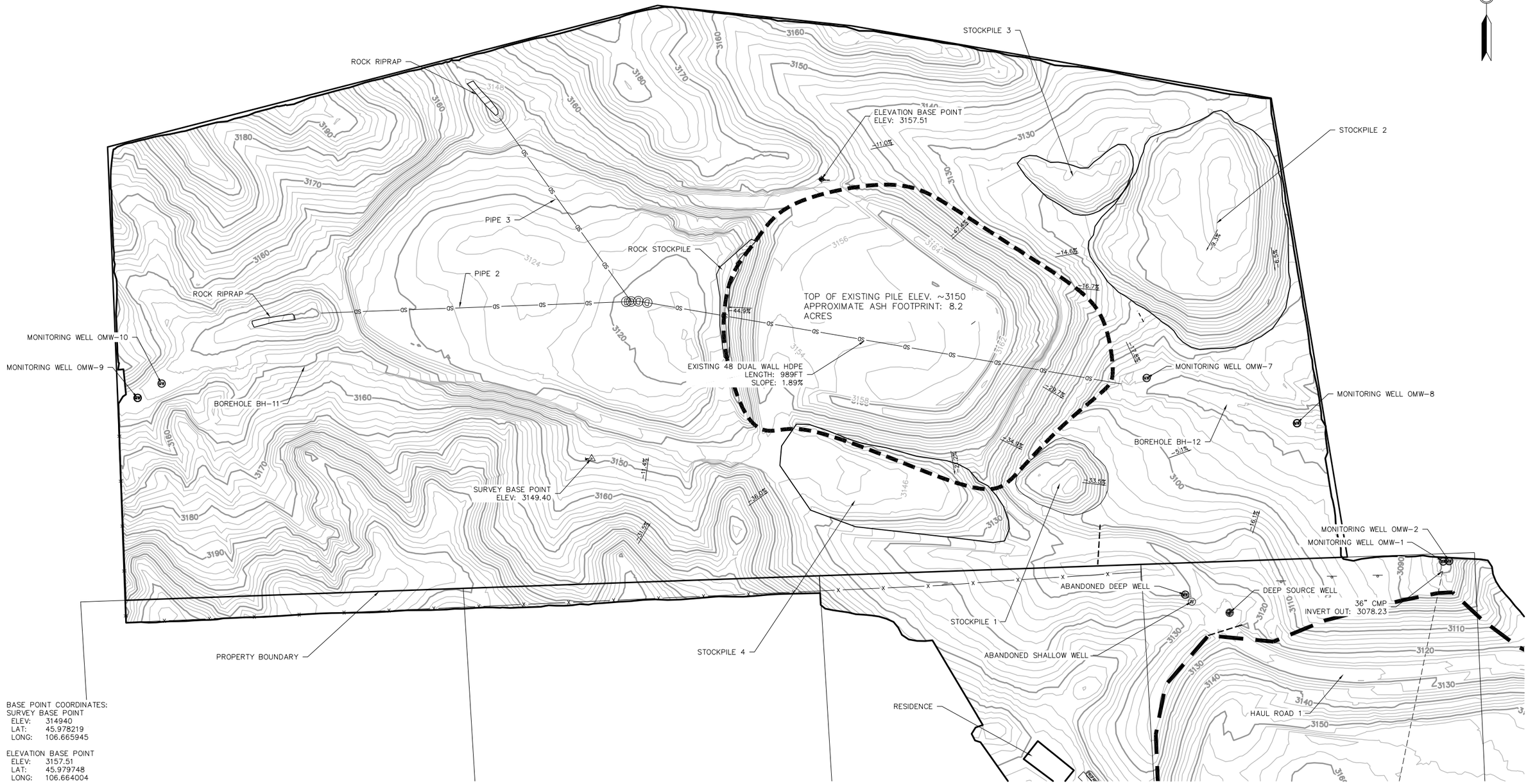
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C0-2
	INDEX, LEGEND, & NOTES

SURVEY OF PHASE 1 LANDFILL AND SURROUNDING AREA
BASED ON TOPOGRAPHIC SURVEYS COMPLETED ON:
9/14/15 BY GREG FINCK OF AESI
1/27/16 BY GREG FINCK AND KYLE THOMPSON OF AESI



BASE POINT COORDINATES:
SURVEY BASE POINT
ELEV: 314940
LAT: 45.978219
LONG: 106.665945

ELEVATION BASE POINT
ELEV: 3157.51
LAT: 45.979748
LONG: 106.664004

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EXISTING CONDITIONS (AS-BUILT)
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PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C0-3
	EXISTING CONDITIONS

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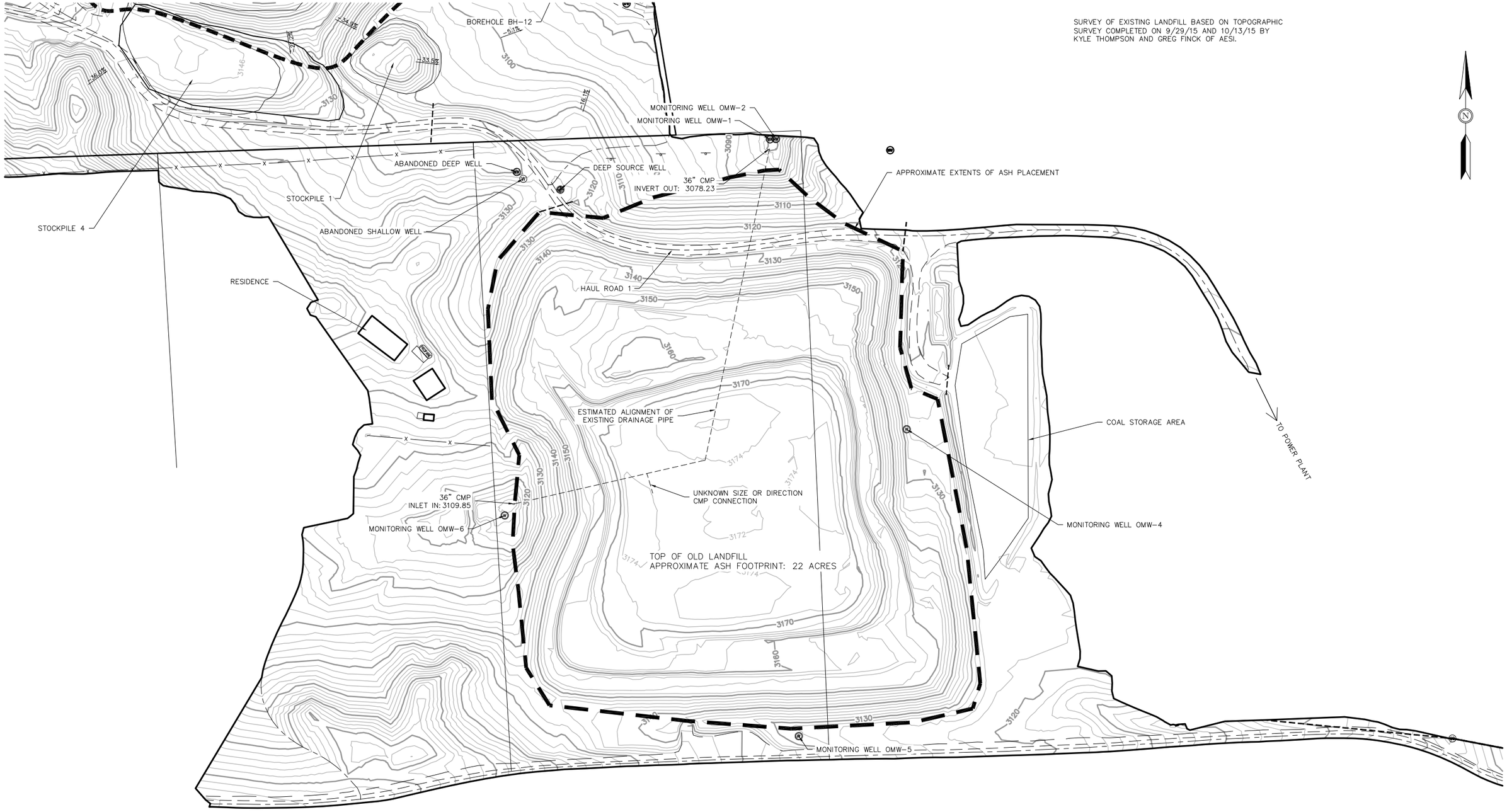
SURVEY OF EXISTING LANDFILL BASED ON TOPOGRAPHIC SURVEY COMPLETED ON 9/29/15 AND 10/13/15 BY KYLE THOMPSON AND GREG FINCK OF AESI.



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SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

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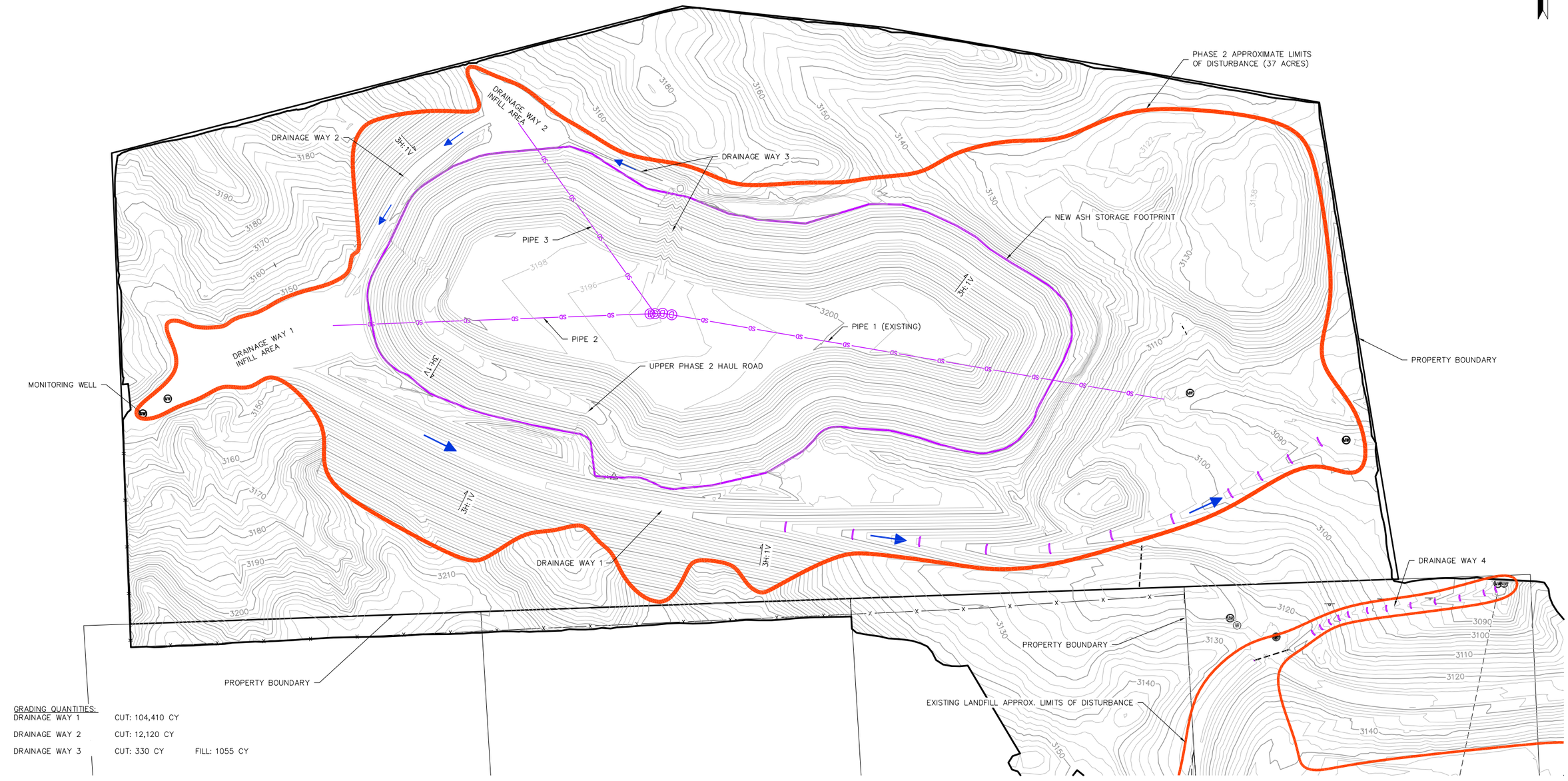
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C0-4

EXISTING CONDITIONS

LEGEND

- EG MAJOR CONTOUR
- EG MINOR CONTOUR
- FG MAJOR CONTOUR
- FG MINOR CONTOUR
- EDGE OF ROAD
- ROAD CENTERLINE
- STORM DRAINAGE PIPE
- LIMITS OF DISTURBANCE
- EXTENTS OF NEW LANDFILL EXPANSION ELEV: 3150
- FLOW ARROW
- ROCK GRADE CONTROL



GRADING QUANTITIES:

DRAINAGE WAY 1	CUT: 104,410 CY	
DRAINAGE WAY 2	CUT: 12,120 CY	
DRAINAGE WAY 3	CUT: 330 CY	FILL: 1055 CY

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DESIGN PLAN - DRAINAGE WAY 1 & 2
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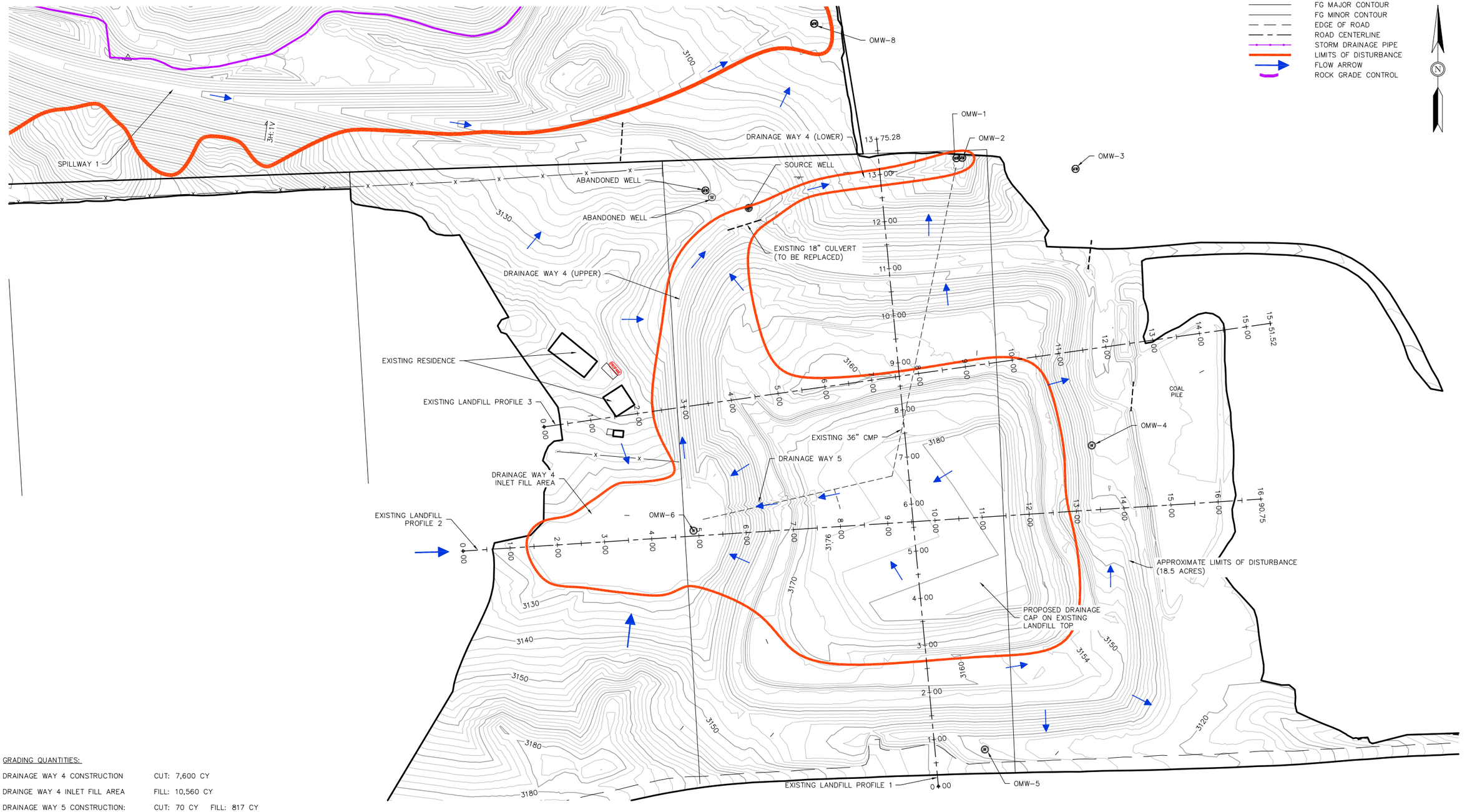
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-1
	DESIGN PLAN -DRAINAGE

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\08 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN - ACTIVE LANDFILL.dwg

LEGEND

- EG MAJOR CONTOUR
- EG MINOR CONTOUR
- FG MAJOR CONTOUR
- FG MINOR CONTOUR
- EDGE OF ROAD
- ROAD CENTERLINE
- STORM DRAINAGE PIPE
- LIMITS OF DISTURBANCE
- FLOW ARROW
- ROCK GRADE CONTROL



GRADING QUANTITIES:

DRAINAGE WAY 4 CONSTRUCTION	CUT: 7,600 CY
DRAINGE WAY 4 INLET FILL AREA	FILL: 10,560 CY
DRAINAGE WAY 5 CONSTRUCTION:	CUT: 70 CY FILL: 817 CY
EXISTING LANDFILL TOP FILL	FILL: 25,480 CY

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DESIGN PLAN - EXISTING LANDFILL
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DATE: 9/15/2016	

DESIGN PLAN - EXISTING

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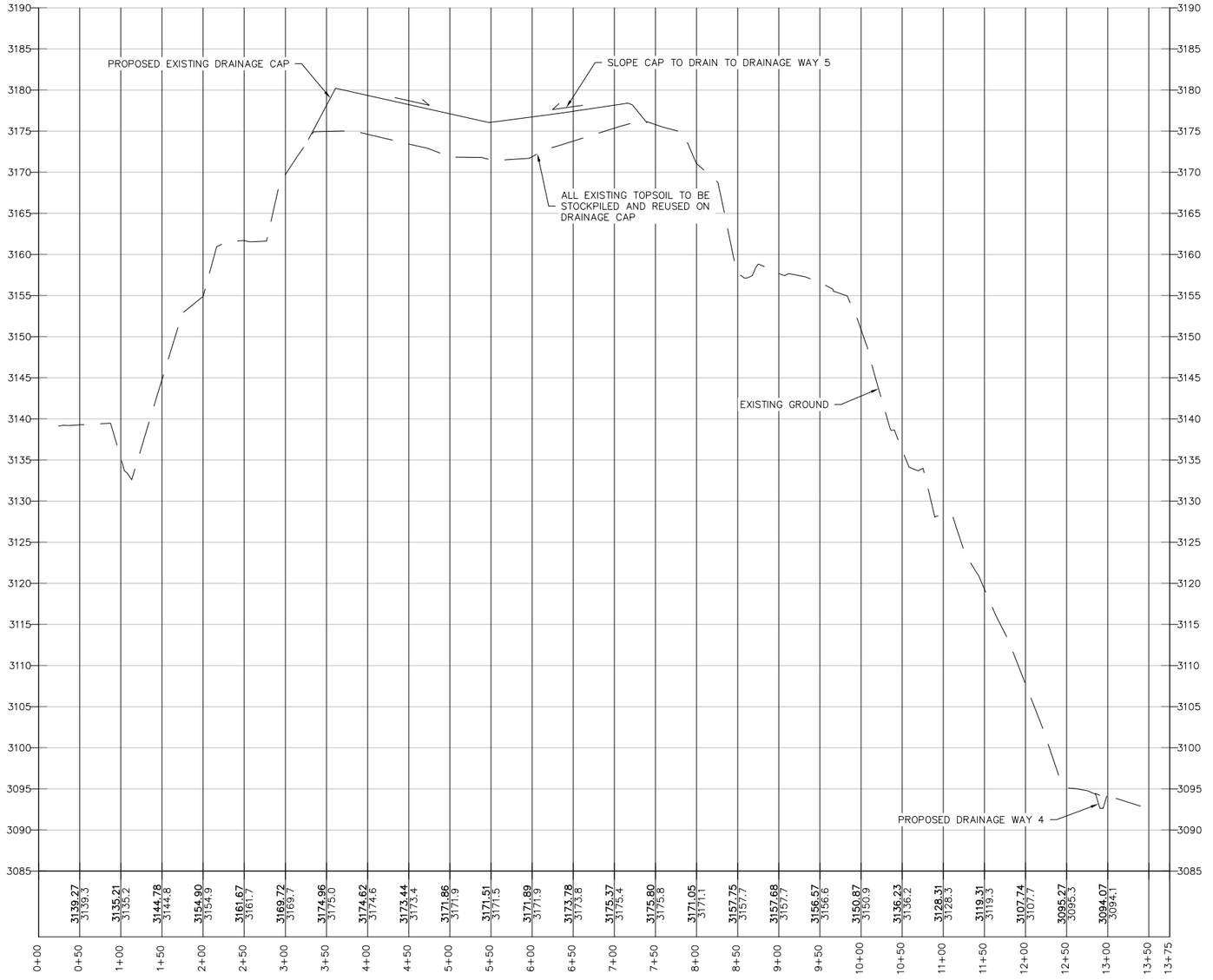

PROFILE VIEW - EXISTING LANDFILL PROFILE 1

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NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 80 160
VERTICAL SCALE FEET 0 8 16

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PROFILE VIEW - EXISTING LANDFILL PROFILE 1
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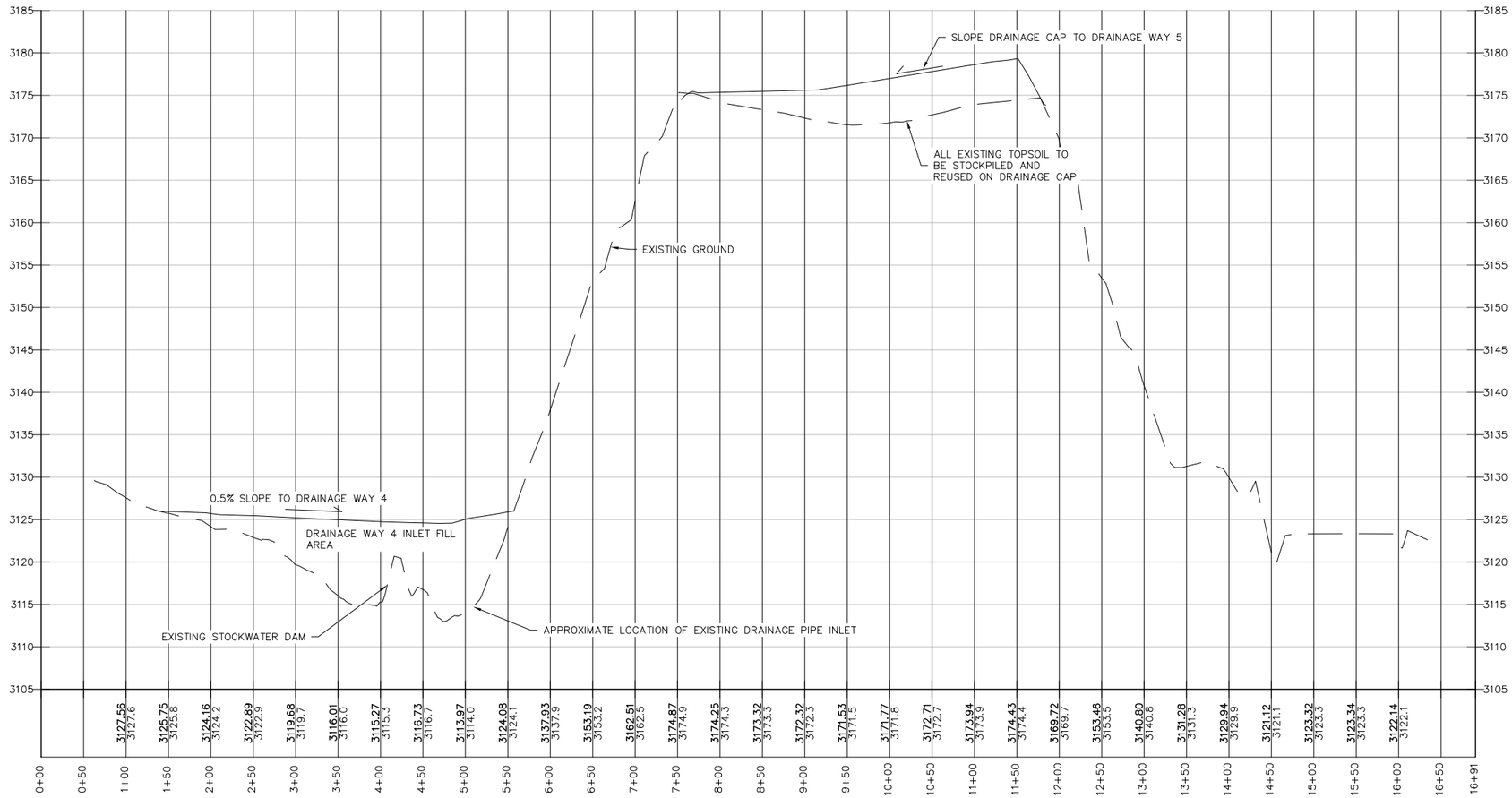
DATE: 9/15/2016
SHEET C1-3

DESIGN PLAN - EXISTING



PROFILE VIEW - PROFILE 2

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN- EXISTING LANDFILL.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 80 160
VERTICAL SCALE FEET 0 8 16

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PROFILE VIEW - EXISTING LANDFILL PROFILE 2
ROSEBUD COUNTY, MT

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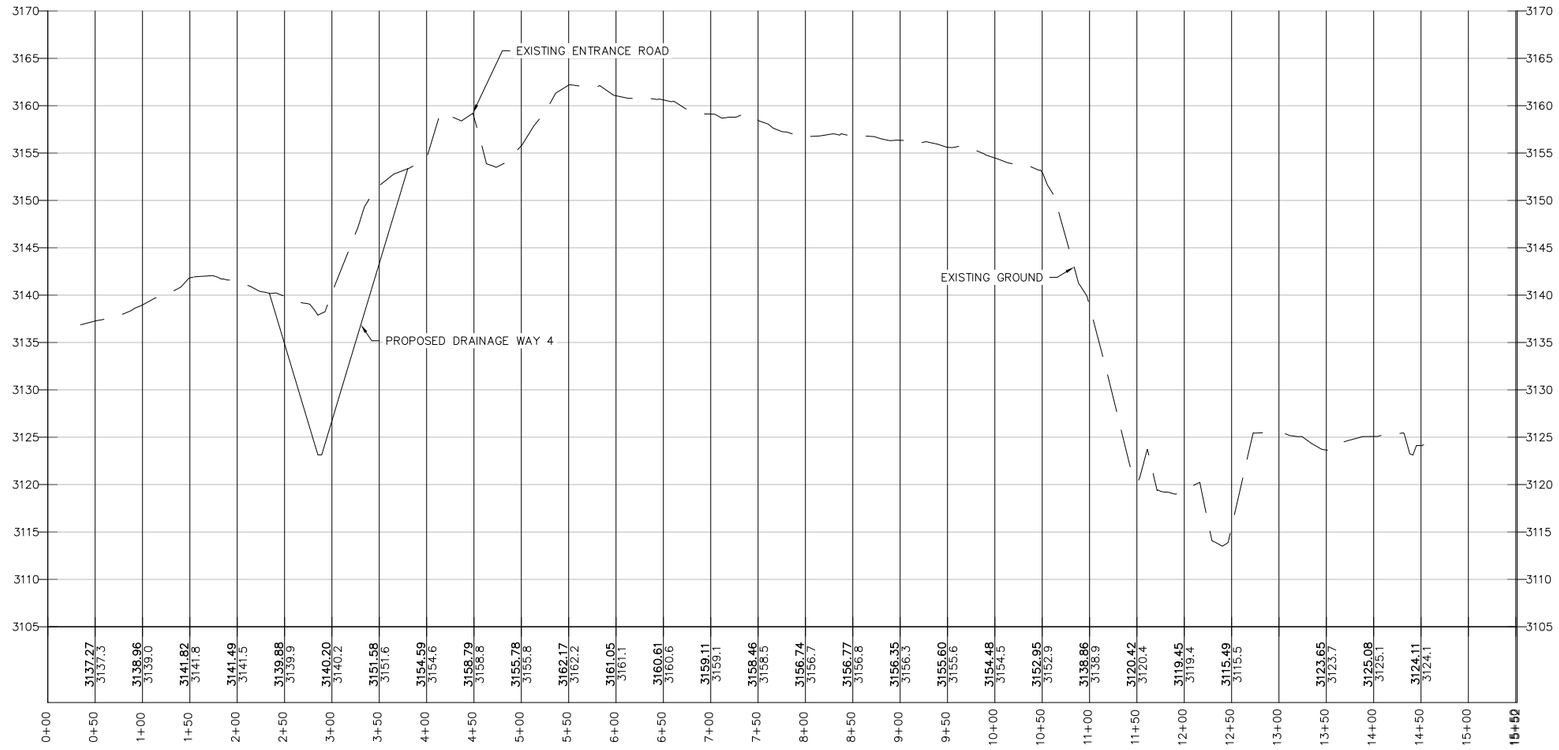
PROJECT #: 15-125
DATE: 9/15/2016
SHEET C1-4

DESIGN PLAN - EXISTING



PROFILE VIEW - PROFILE 3

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 80 160
VERTICAL SCALE FEET 0 8 16

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PROFILE VIEW - EXISTING LANDFILL PROFILE 3
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PROJECT #: 15-125
DATE: 9/15/2016
SHEET C1-5

DESIGN PLAN - EXISTING

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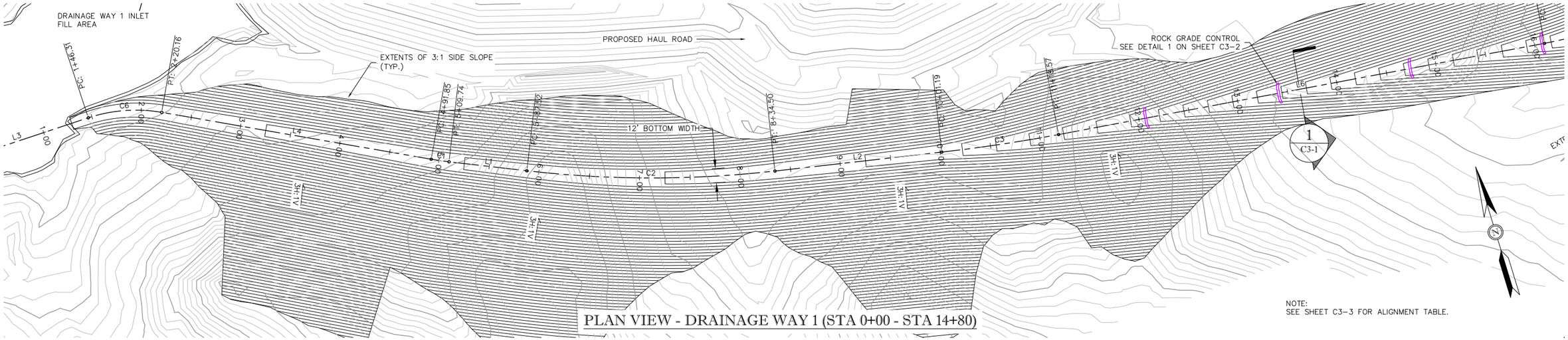
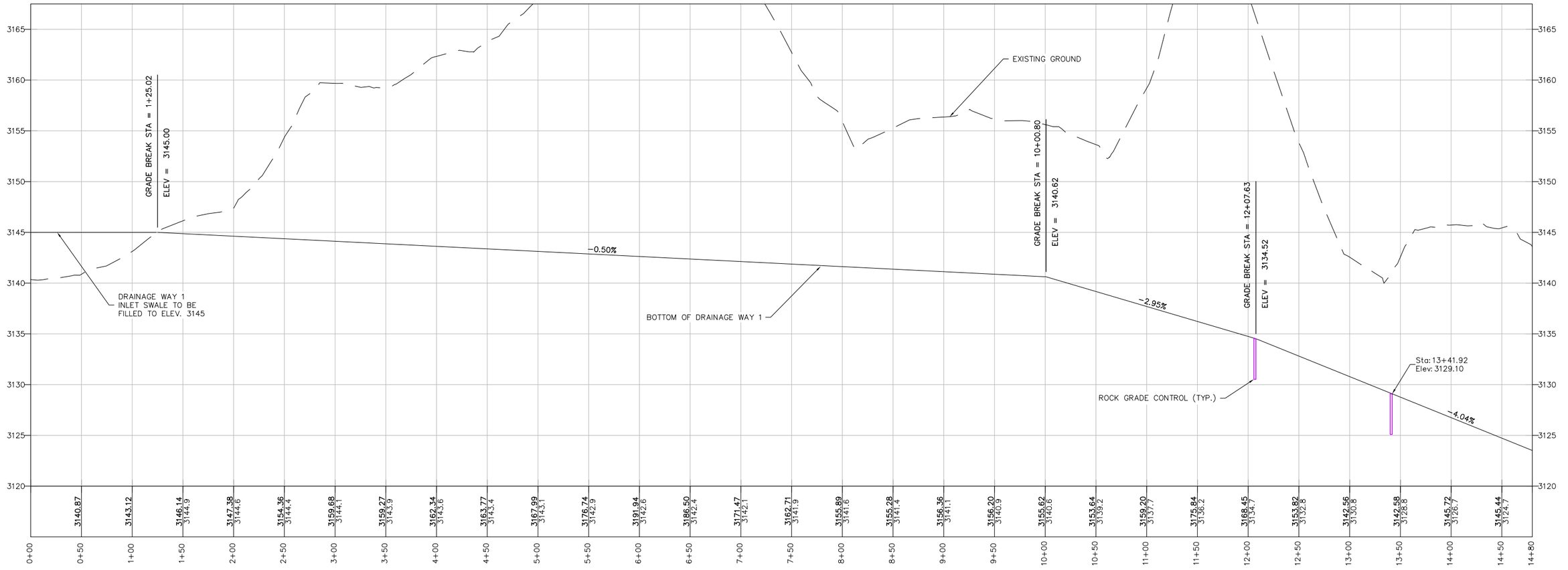


PLAN VIEW - DRAINAGE WAY 1 (STA 0+00 - STA 14+80)



PROFILE VIEW - DRAINAGE WAY 1 (STA 0+00 - STA 14+80)

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NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 50 100
VERTICAL SCALE FEET 0 5 10

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 1
ROSEBUD COUNTY, MT

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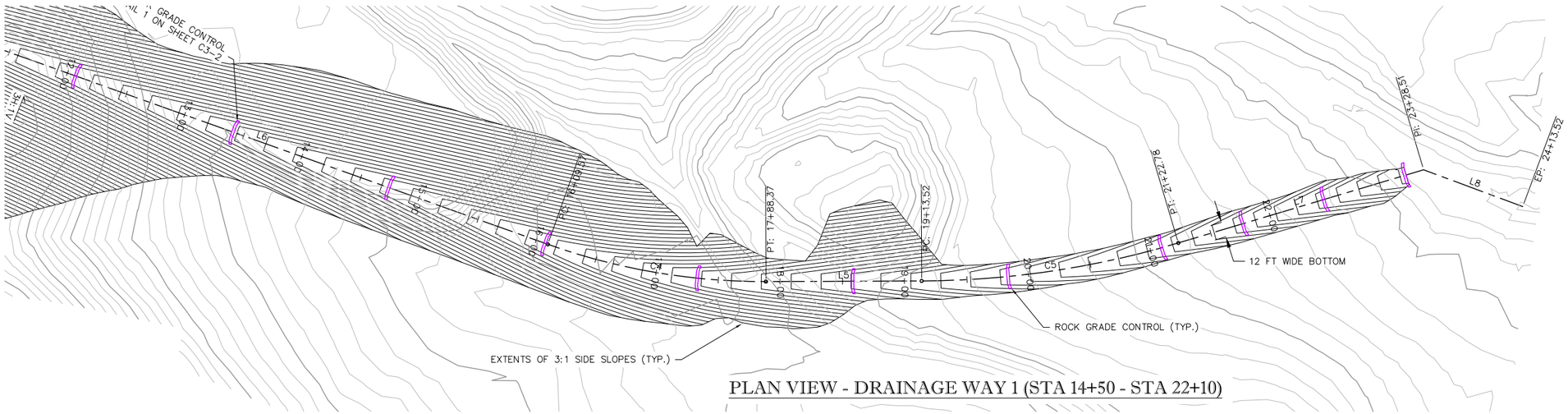
PROJECT #: 15-125
DATE: 9/15/2016

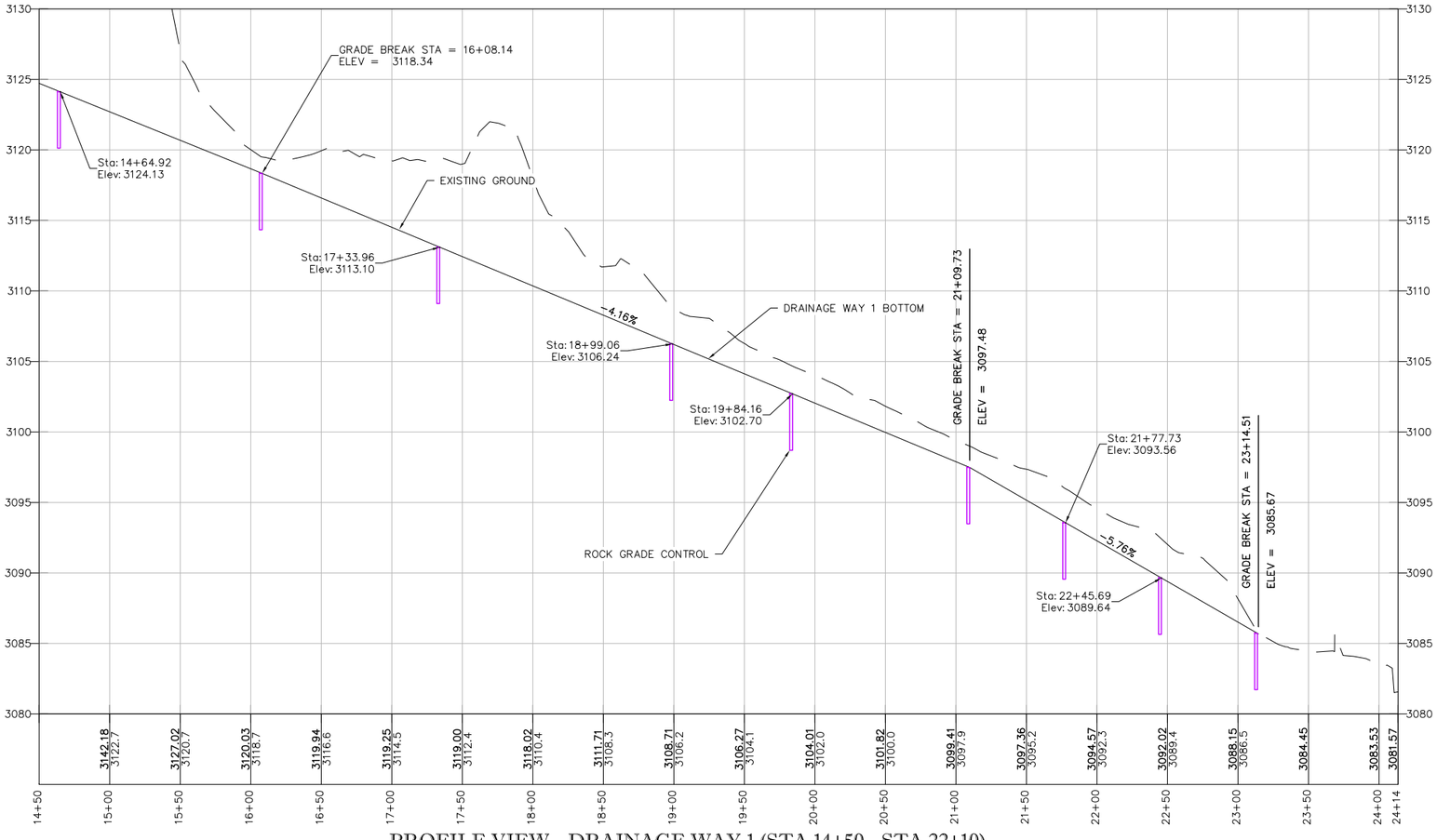
SHEET
C1-6

P & P - DRAINAGE WAY 1



PLAN VIEW - DRAINAGE WAY 1 (STA 14+50 - STA 22+10)

NOTE:
SEE SHEET C3-3 FOR ALIGNMENT TABLE.



PROFILE VIEW - DRAINAGE WAY 1 (STA 14+50 - STA 22+10)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0 50 100
VERTICAL SCALE FEET: 0 5 10

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 1
ROSEBUD COUNTY, MT

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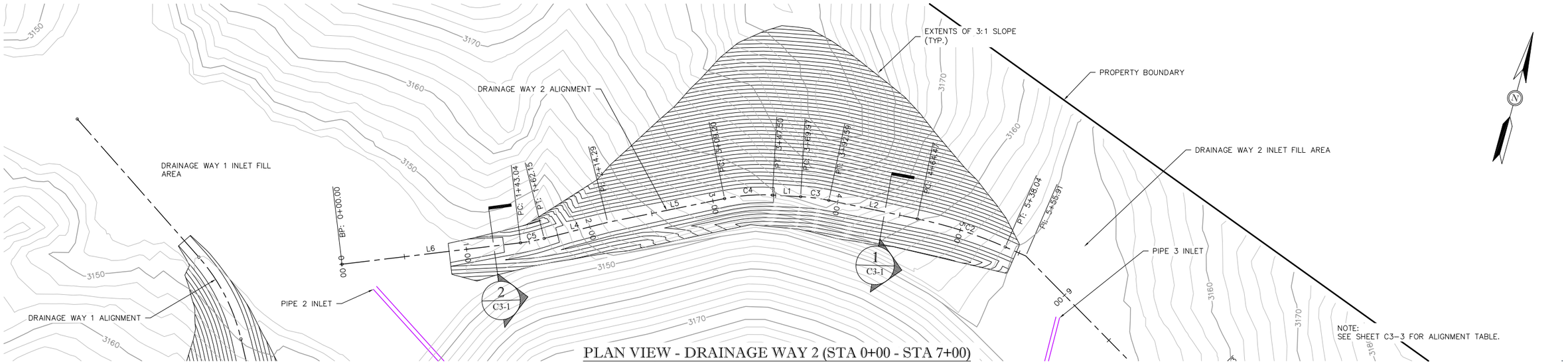
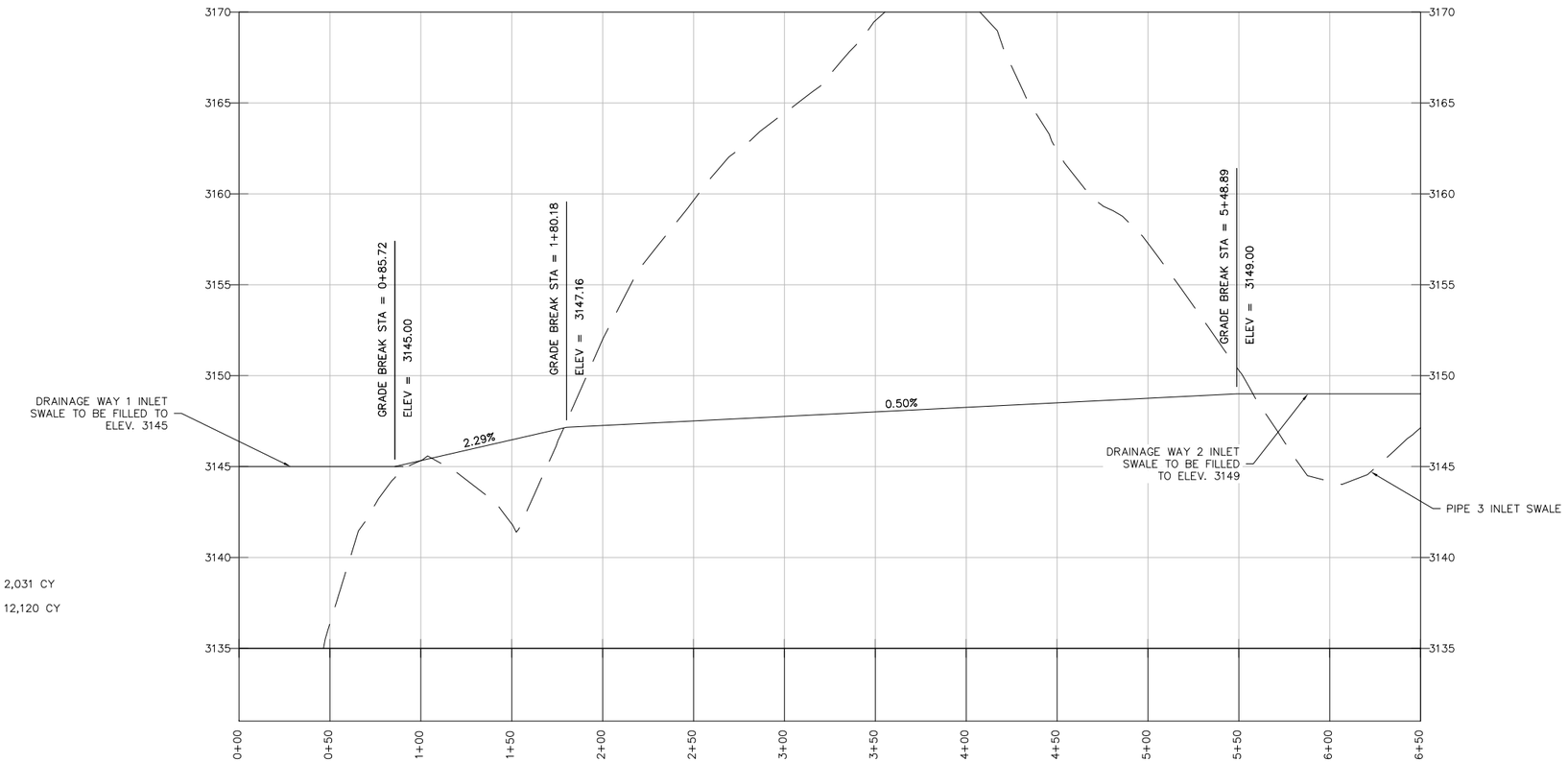
DATE: 9/15/2016	C1-7

P & P - SPILLLWAY 1

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 1.dwg



PLAN VIEW - DRAINAGE WAY 2 (STA 0+00 - STA 7+00)



PROFILE VIEW - DRAINAGE WAY 2 (STA 0+00 - STA 7+00)

GRADING QUANTITIES:

DRAINAGE WAY 2 INLET FILL VOLUME: 2,031 CY

DRAINAGE WAY 2 CUT VOLUME: 12,120 CY

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 2.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 40 80

VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 2
ROSEBUD COUNTY, MT

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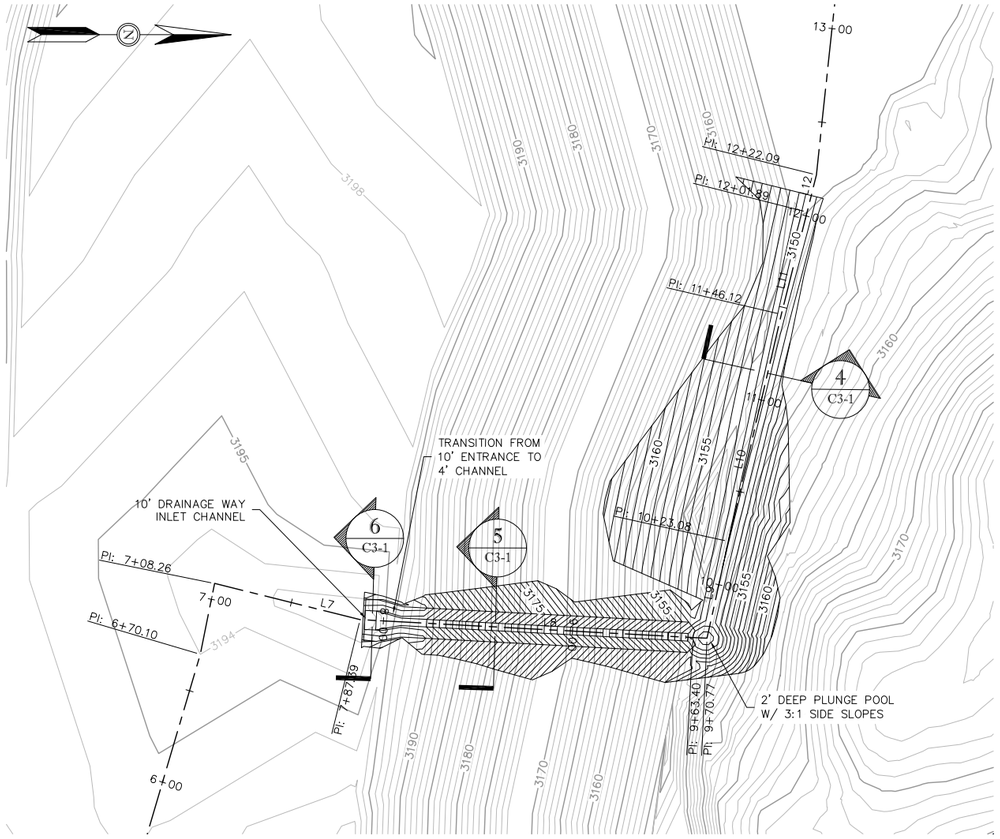
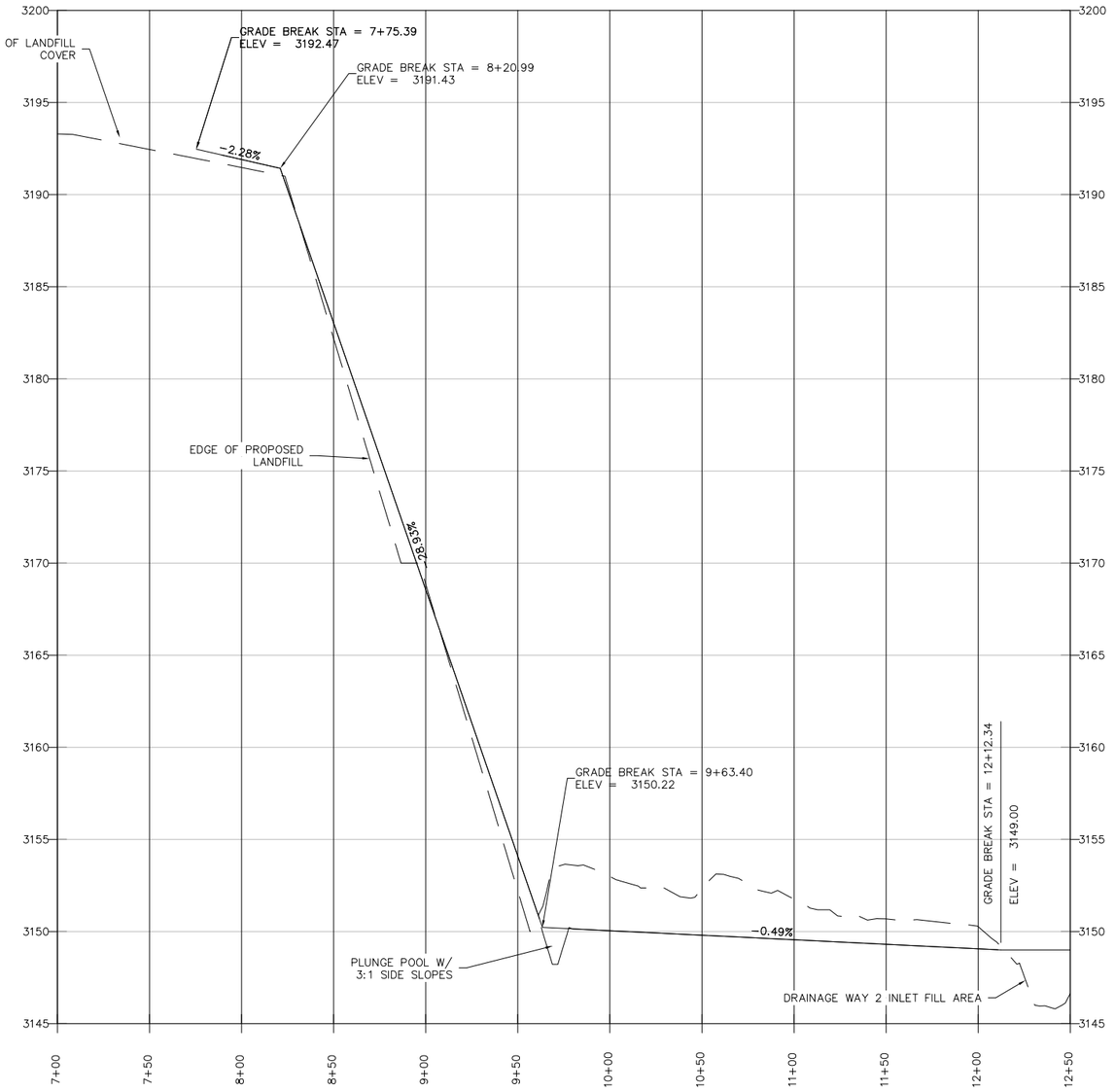
DATE: 9/15/2016

SHEET
C1-8

P & P - DRAINAGE WAY 2



PLAN VIEW - DRAINAGE WAY 3 (STA 7+00 - STA 10+00)



PROFILE VIEW - DRAINAGE WAY 3 (STA 7+00 - STA 10+00)

CONSTRUCTION NOTES:
ALIGNMENT TABLE: SEE SHEET C3-3

EROSION CONTROL: SEE SHEET C4-1

FOR CHANNEL TYPICAL CROSS-SECTIONS OF DRAINAGE WAY 3 ON SHEET C3-1.

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 3.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 40 80
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 3
ROSEBUD COUNTY, MT

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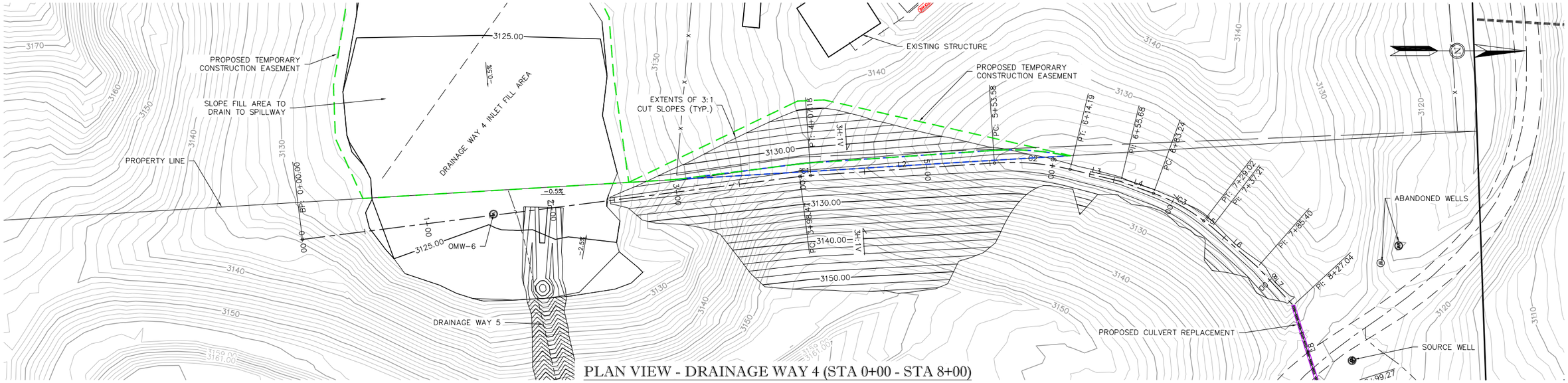
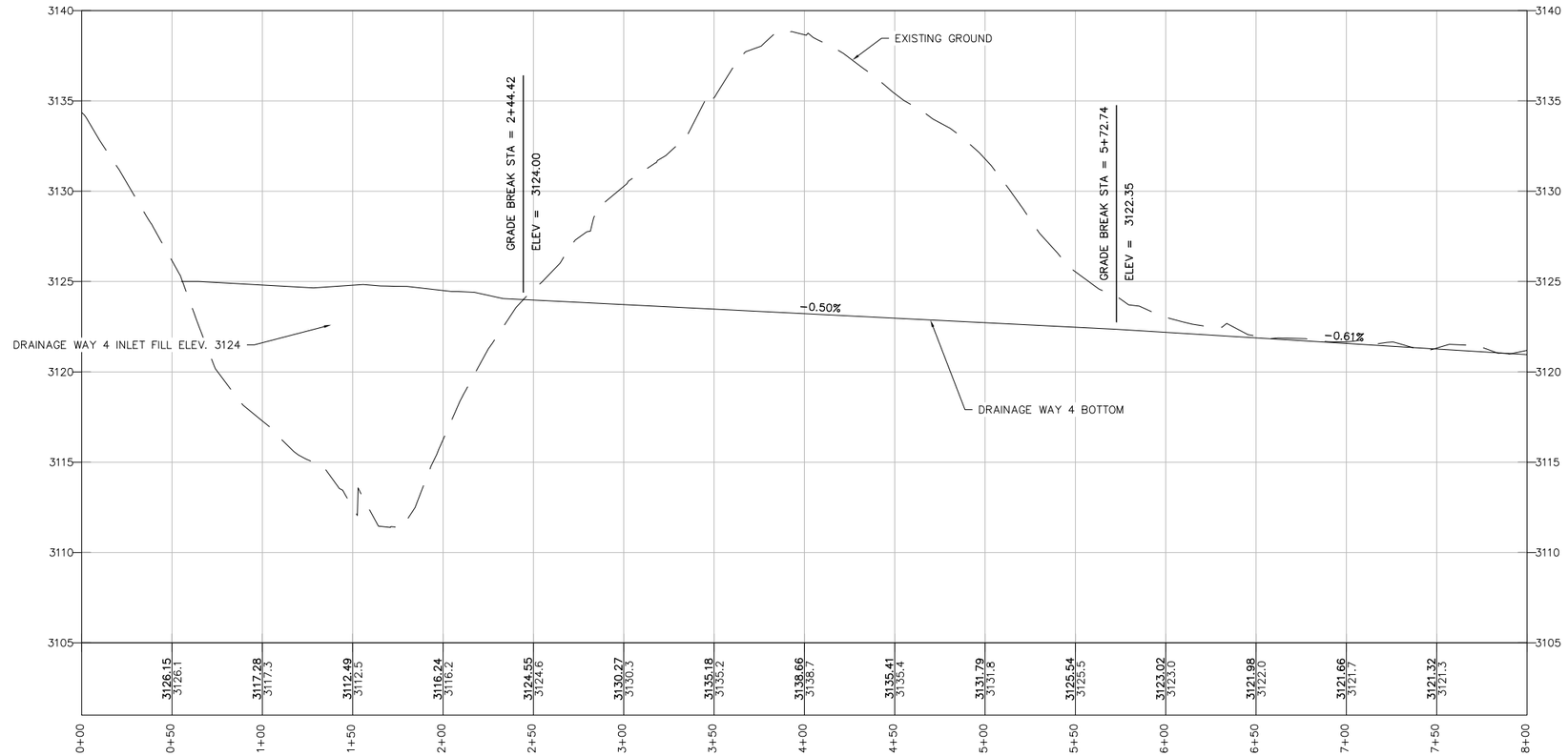
DATE: 9/15/2016

SHEET
C1-9

P & P - DRAINAGE WAY 3



PLAN VIEW - DRAINAGE WAY 4 (STA 0+00 - STA 8+00)



PROFILE VIEW - DRAINAGE WAY 4 (STA 0+00 - STA 8+00)

NOTE:
SEE SHEET C4-9 FOR ALIGNMENT TABLE.
SEE SHEET C1-8 FOR EASEMENT TABLE.

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 4.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 40 80
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 4
ROSEBUD COUNTY, MT

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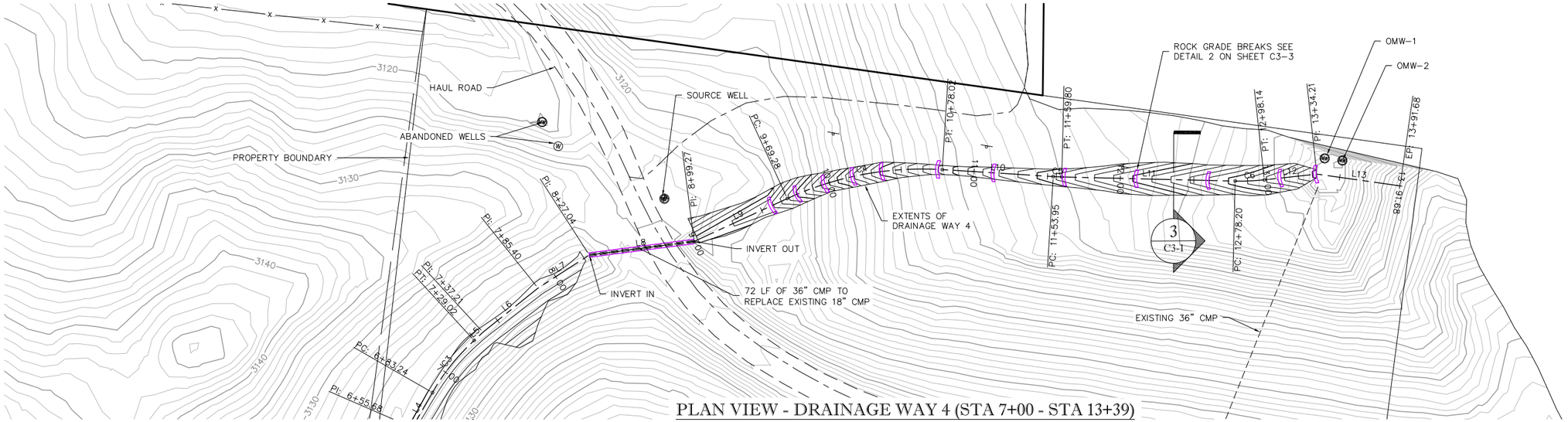
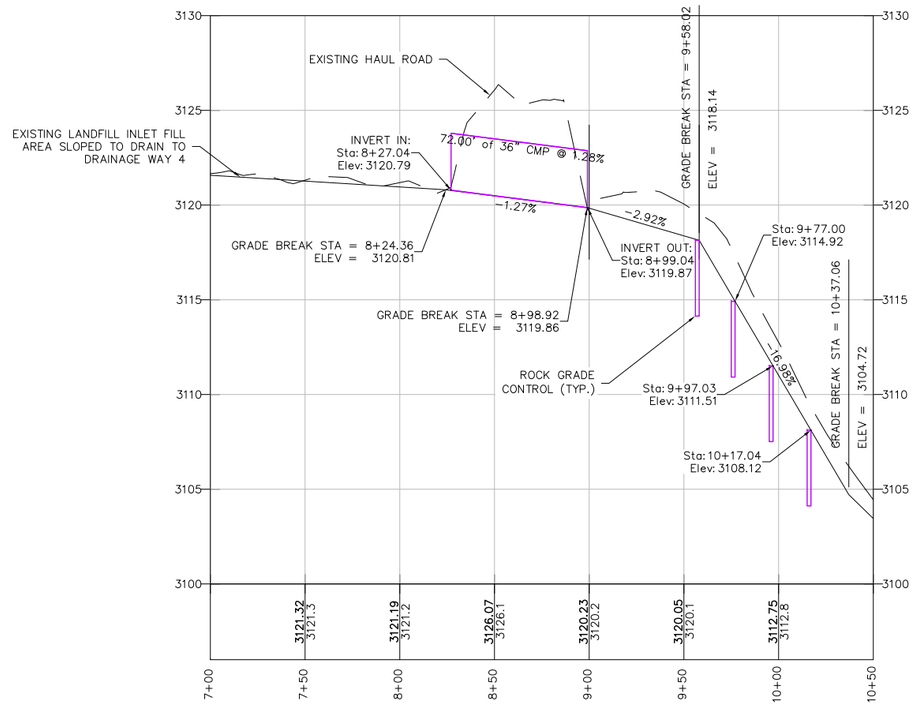
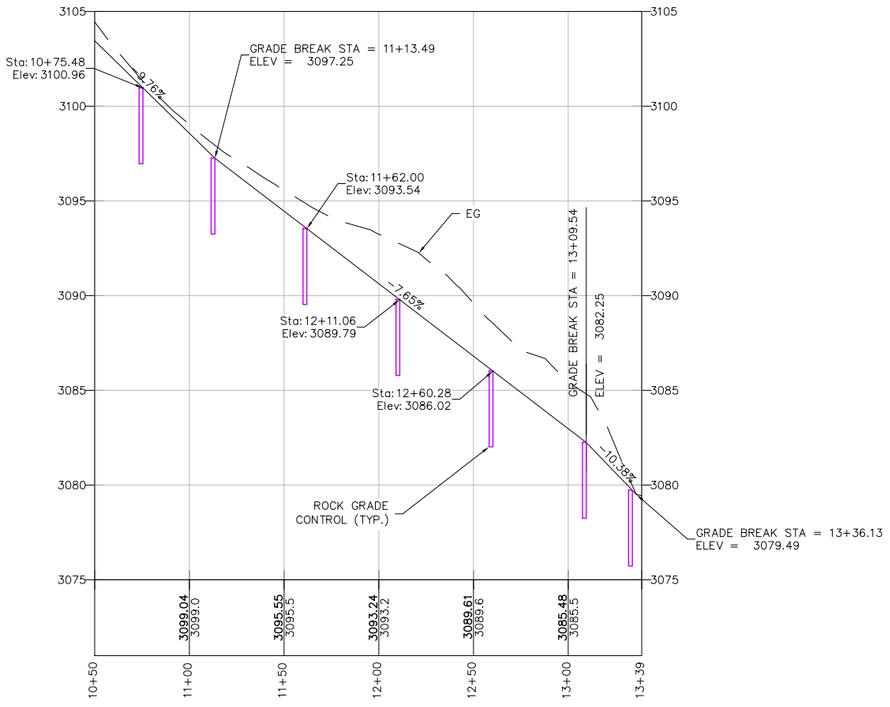
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-10

P & P - DRAINAGE WAY 4



PLAN VIEW - DRAINAGE WAY 4 (STA 7+00 - STA 13+39)





PROFILE VIEW - DRAINAGE WAY 4 (STA 7+00 - STA 13+39)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0 40 80
VERTICAL SCALE FEET: 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 4
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P & P - DRAINAGE WAY 4

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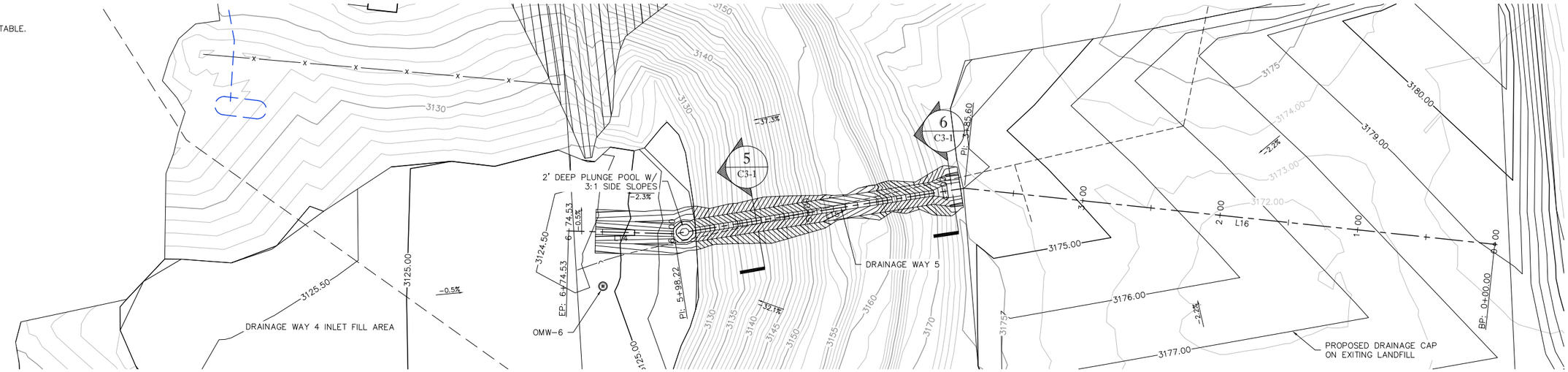
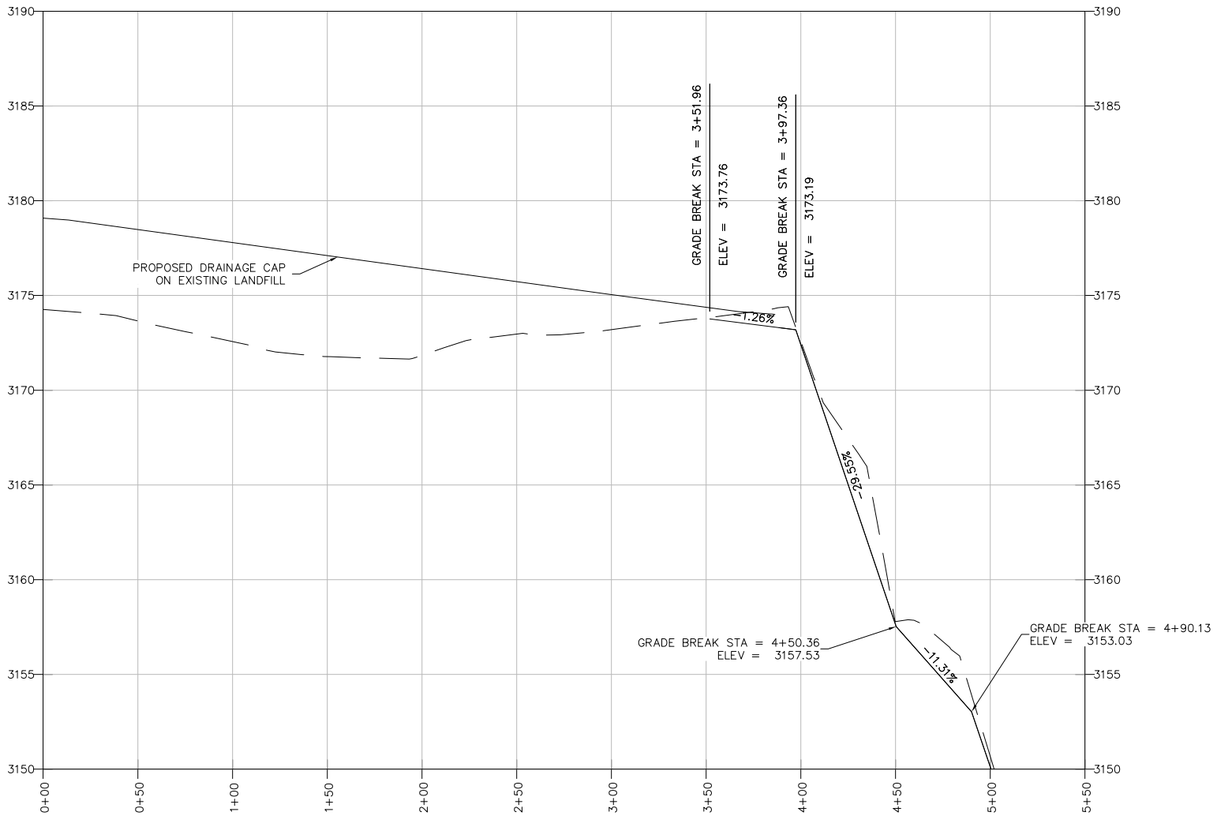
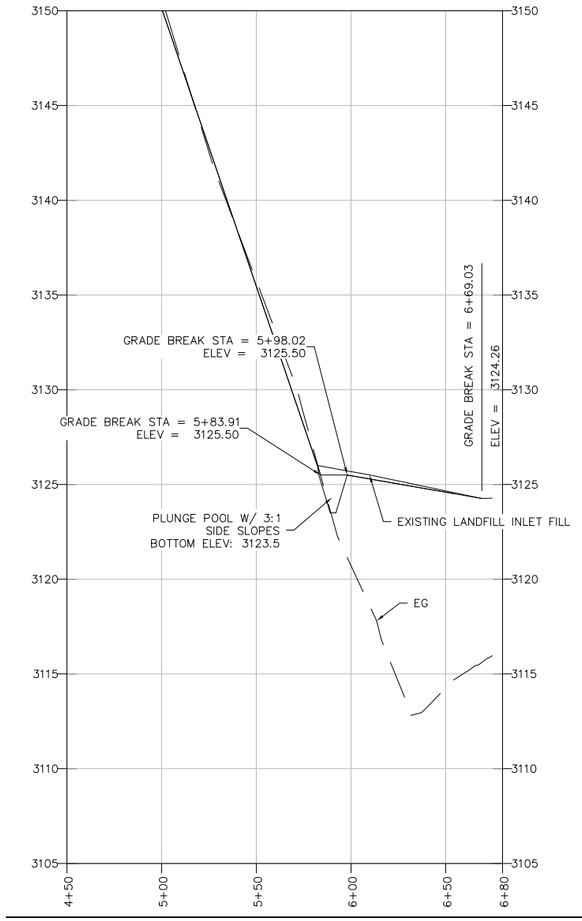
NOTE:
SEE SHEET C3-3 FOR ALIGNMENT TABLE.



PLAN VIEW - DRAINAGE WAY 5 (STA 0+00 - STA 6+75)





PROFILE VIEW - DRAINAGE WAY 5 (STA 0+00 - STA 6+75)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 40 80
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 5
ROSEBUD COUNTY, MT

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DATE: 9/15/2016

SHEET
C1-12

P & P - DRAINAGE WAY 4

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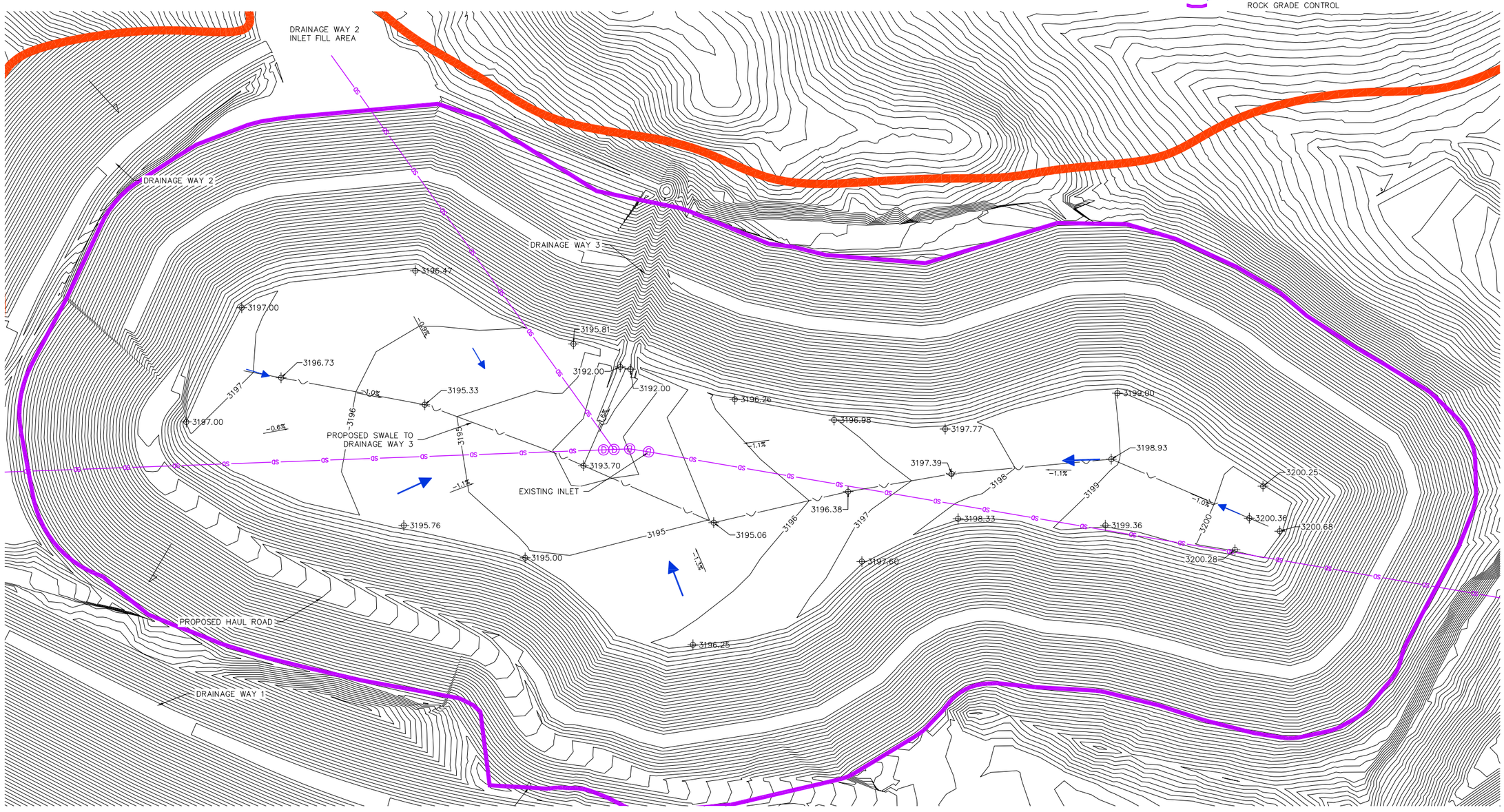
LEGEND

- FG MAJOR CONTOUR
- FG MINOR CONTOUR
- EDGE OF ROAD
- ROAD CENTERLINE
- STORM DRAINAGE PIPE
- LIMITS OF DISTURBANCE
- EXTENTS OF NEW LANDFILL EXPANSION ELEV: 3150
- FLOW ARROW
- ROCK GRADE CONTROL



CONSTRUCTION NOTES:
ALL ELEVATIONS SHOWN ARE FOR SUB-SOIL. ON TOP OF THIS SUB-SOIL WILL BE PLACED A MINIMUM OF 6 INCHES OF TOP SOIL.

THE FIRST 18 INCHES OF SUB-SOIL IS TO BE COMPACTED TO 95% OF PROCTOR DENSITY. REMAINING SUB-SOIL AND TOP SOIL IS ONLY TO BE COMPACTED TO 80% PROCTOR DENSITY TO PROMOTE PLANT GROWTH.

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DESIGN PLAN - PHASE 1 & 2 DRAINAGE CAP
ROSEBUD COUNTY, MT

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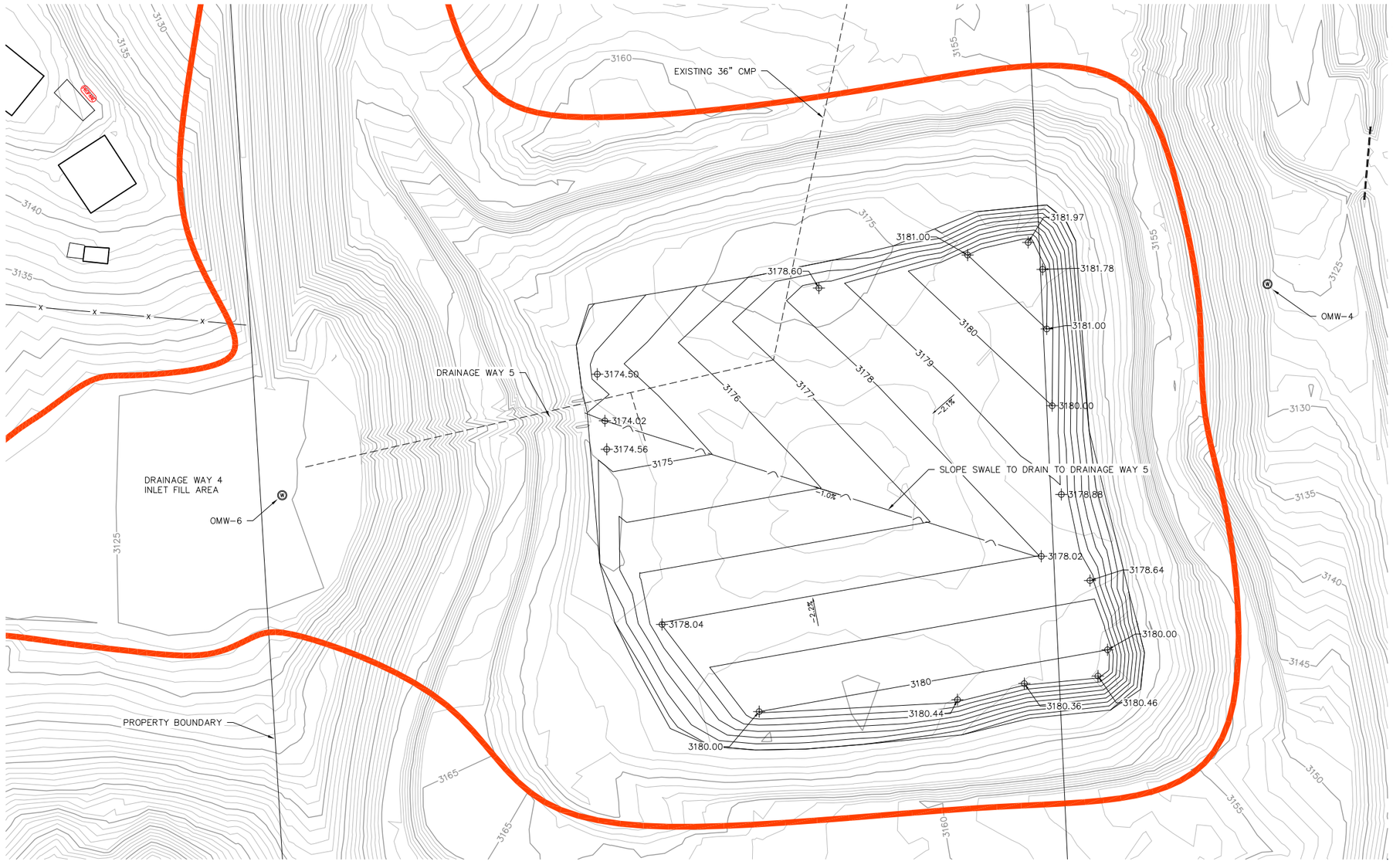
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-13

DESIGN PLAN -DRAINAGE

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\06 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN - ACTIVE LANDFILL.dwg



CONSTRUCTION NOTES:
ALL AREAS TO BE FILLED ARE TO BE STRIPPED OF ALL TOP SOIL.

ALL ELEVATIONS SHOWN ARE FOR SUB-SOIL. ON TOP OF THIS SUB-SOIL WILL BE PLACED A MINIMUM OF 6 INCHES OF TOP SOIL.

THE FIRST 18 INCHES OF SUB-SOIL IS TO BE COMPACTED TO 95% OF PROCTOR DENSITY. REMAINING SUB-SOIL AND TOP SOIL IS ONLY TO BE COMPACTED TO 80% PROCTOR DENSITY TO PROMOTE PLANT GROWTH.

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DESIGN PLAN - EXISTING LANDFILL DRAINAGE CAP
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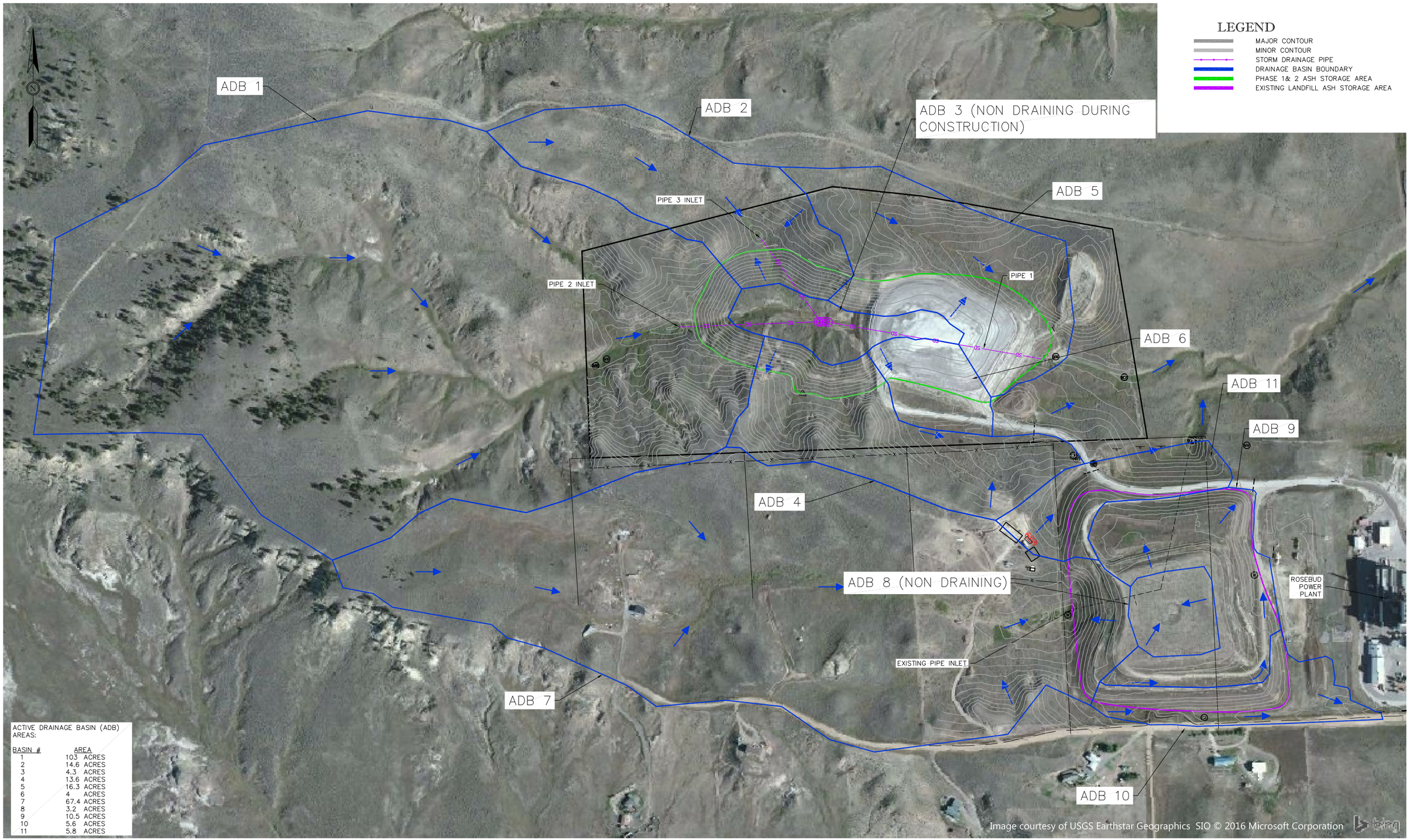
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-14

DESIGN PLAN - EXISTING

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN- EXISTING DRAINAGE CAP.dwg



ACTIVE DRAINAGE BASIN (ADB) AREAS:

BASIN #	AREA
1	103 ACRES
2	14.6 ACRES
3	4.3 ACRES
4	13.6 ACRES
5	16.3 ACRES
6	4 ACRES
7	67.4 ACRES
8	3.2 ACRES
9	10.5 ACRES
10	5.6 ACRES
11	5.8 ACRES

NO.	REVISIONS	DRAWN BY	DATE

0 200 400 600
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
ACTIVE LANDFILL DRAINAGE BASINS
ROSEBUD COUNTY, MT

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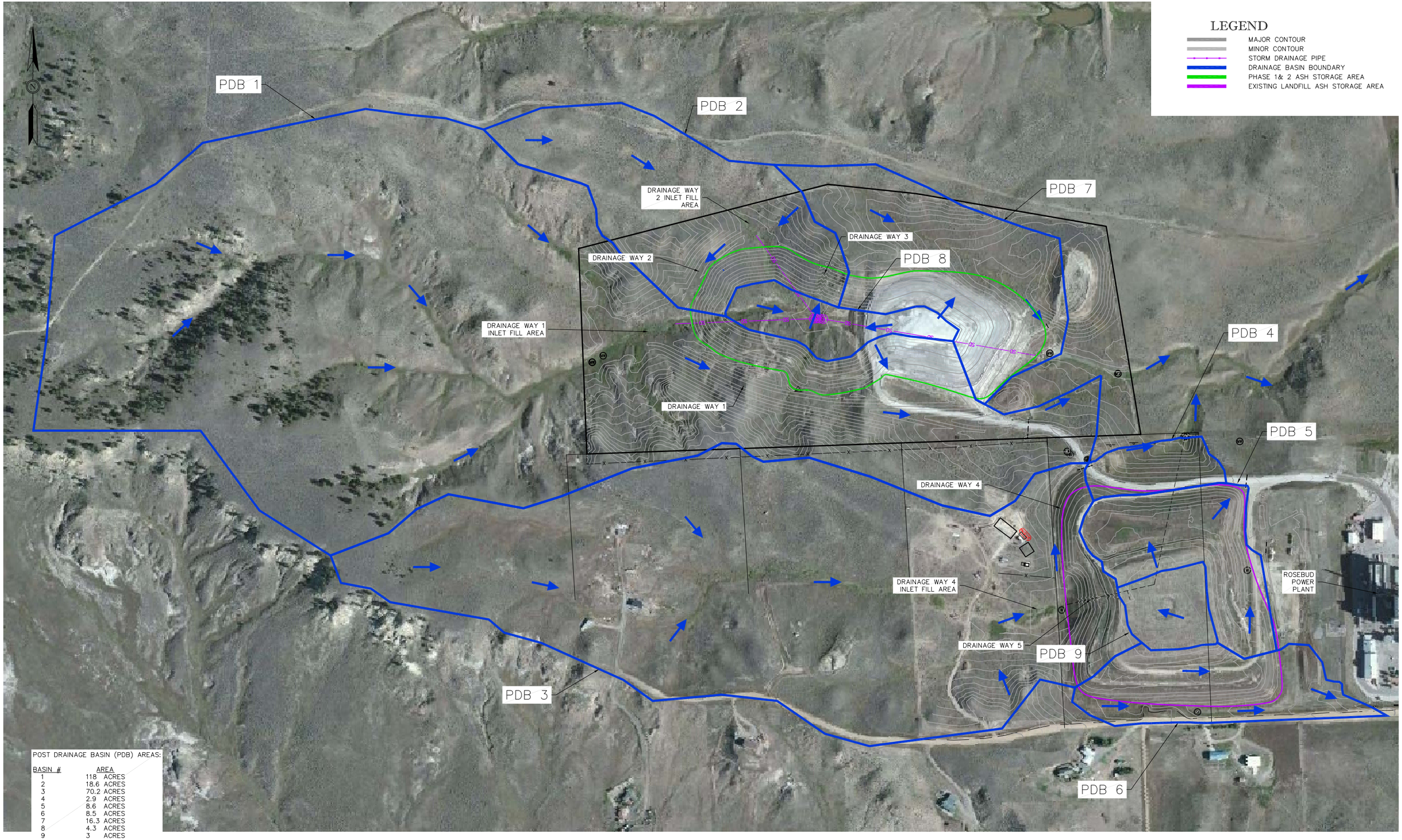
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C2-1
	ACTIVE DRAINAGE BASINS

C:\Users\...w\Desktop\2015\15-125 Rosebud Power Plant Ash Disposal Site\29 CAD-Production\Storm\PIPES H&H FIGURES.dwg



POST DRAINAGE BASIN (PDB) AREAS:

BASIN #	AREA
1	118 ACRES
2	18.6 ACRES
3	70.2 ACRES
4	2.9 ACRES
5	8.6 ACRES
6	8.5 ACRES
7	16.3 ACRES
8	4.3 ACRES
9	3 ACRES

NO.	REVISIONS	DRAWN BY	DATE

0 200 400 600
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
POST-CLOSURE DRAINAGE BASINS
ROSEBUD COUNTY, MT

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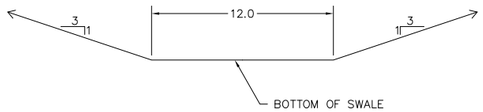
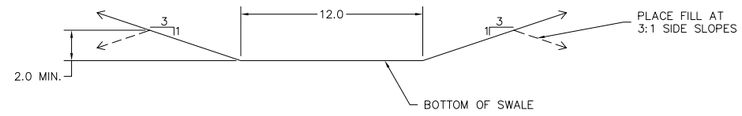
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C2-2

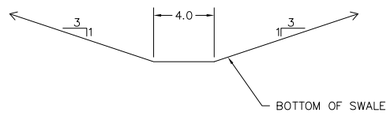
POST DRAINAGE BASINS



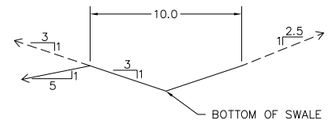
1 C1-3 SECTION
12' DRAINAGE SWALE
1" = 5'



2 C1-5 SECTION
12' DRAINAGE SWALE W/ RIGHT BERM
1" = 5'



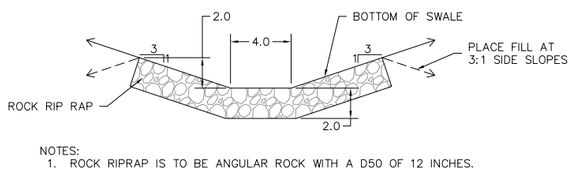
3 C1-7 SECTION
4' DRAINAGE SWALE
1" = 5'



NOTES:
1. PLACE LEFT SIDE DAYLIGHT FILL AT 5:1 SLOPES FILLING ANY DEPRESSIONS, AND DIRECTING DRAINAGE INTO SWALE.

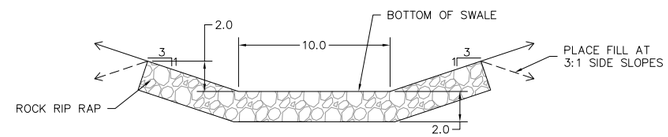
2. CUT RIGHT SIDE DAYLIGHT TO A 2.5:1 OR GREATER DEPENDING ON SOIL CONDITIONS ENCOUNTERED.

4 C1-9 SECTION
SPILLWAY 4
1" = 5'



NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 12 INCHES.

5 C1-6 SECTION
4' DRAINAGE SWALE
1" = 5'



NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 12 INCHES.

6 C1-6 SECTION
10' DRAINAGE SWALE
1" = 5'

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DETAILS - SWALE SECTIONS
ROSEBUD COUNTY, MT

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PROJECT #: 15-125
DATE: 9/15/2016
SHEET C3-1

DETAILS - SWALE SECTIONS

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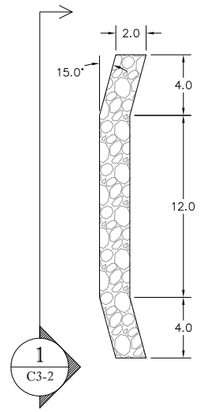
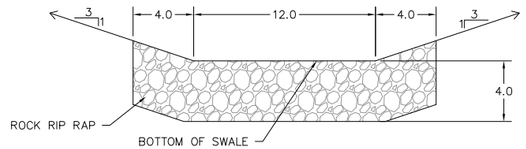
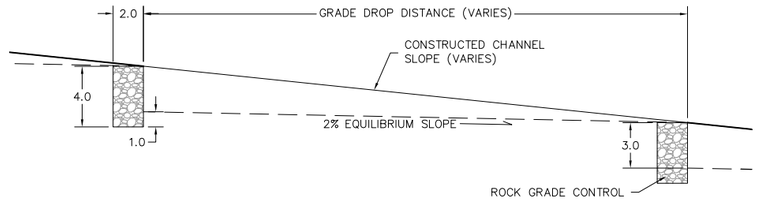


1 C3-2 DETAIL
SPILLWAY 1 GRADE CONTROL - PLAN VIEW
1 " = 5'



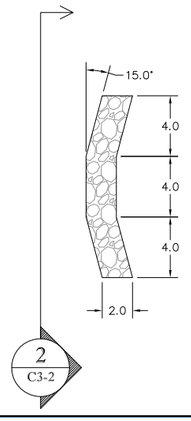
NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 8 INCHES.

1 C3-2 SECTION
SPILLWAY 1 GRADE CONTROL
1" = 5'

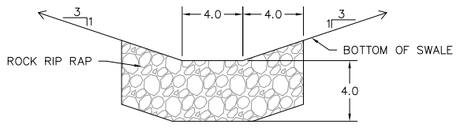


NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 8 INCHES.
2. DISTANCE BETWEEN GRADE DROPS IS SHOWN ON PLANS. IT VARIES WITH CHANNEL SLOPE.
3. EQUILIBRIUM SLOPE WAS DETERMINED BY COMPARISON OF EXISTING SLOPES.

3 C3-2 DETAIL
TYPICAL GRADE CONTROL PROFILE
1 " = 5'



2 S3-3 DETAIL
SPILLWAY 3 GRADE CONTROL - PLAN VIEW
1 " = 5'



NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 8 INCHES.

2 C3-2 SECTION
SPILLWAY 3 GRADE CONTROL
1" = 5'

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DETAILS - ROCK GRADE CONTROLS
ROSEBUD COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
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PROJECT #: 15-125
DATE: 9/15/2016
SHEET C3-2
DETAILS - ROCK CONTROL

DRAINAGE WAY 1 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L3		146.31	N88° 36' 59.04"E	0+00.00	1+46.31	643344.5741, 2687756.5228
C6	150.00	73.86	S77° 16' 41.83"E	1+46.31	2+20.16	643348.1068, 2687902.7880
L4		271.68	S63° 10' 22.69"E	2+20.16	4+91.85	643332.0065, 2687974.1047
C1	312.15	17.89	S64° 48' 54.31"E	4+91.85	5+09.74	643209.3966, 2688216.5469
L1		77.78	S66° 27' 25.94"E	5+09.74	5+87.52	643201.7835, 2688232.7365
C2	1084.22	246.98	S72° 58' 58.71"E	5+87.52	8+34.50	643170.7161, 2688304.0411
L2		166.70	S79° 30' 31.48"E	8+34.50	10+01.19	643098.5926, 2688539.6957
C3	1614.37	117.37	S81° 35' 29.84"E	10+01.19	11+18.57	643068.2396, 2688703.6054
L6		491.00	S83° 40' 28.20"E	11+18.57	16+09.57	643051.0800, 2688819.6928
C4	516.43	178.80	N86° 24' 25.40"E	16+09.57	17+88.37	642996.9829, 2689307.7071
L5		125.15	N76° 29' 19.00"E	17+88.37	19+13.52	643008.1319, 2689485.2646
C5	732.50	209.26	N68° 18' 16.74"E	19+13.52	21+22.78	643037.3726, 2689606.9542
L7		205.73	N60° 07' 14.48"E	21+22.78	23+28.51	643114.4664, 2689800.7281
L8		85.01	S82° 55' 28.98"E	23+28.51	24+13.52	643216.9581, 2689979.1158

DRAINAGE WAY 2 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L6		143.04	N33° 10' 00.74"E	0+00.00	1+43.04	643431.7828, 2687980.2610
C5	150.00	19.11	N29° 31' 01.66"E	1+43.04	1+62.15	643551.5167, 2688058.5138
L4		52.14	N25° 52' 02.59"E	1+62.15	2+14.29	643568.1351, 2688067.9226
L5		94.91	N28° 30' 48.36"E	2+14.29	3+09.20	643615.0533, 2688090.6719
C4	150.00	38.30	N35° 49' 38.90"E	3+09.20	3+47.50	643698.4554, 2688135.9809
L1		22.47	N43° 08' 29.44"E	3+47.50	3+69.97	643729.4211, 2688158.3366
C3	150.00	22.62	N47° 27' 42.66"E	3+69.97	3+92.59	643745.8146, 2688173.6997
L2		71.88	N51° 46' 55.89"E	3+92.59	4+64.47	643761.0939, 2688190.3518
C2	355.54	73.57	N57° 42' 36.31"E	4+64.47	5+38.04	643805.5653, 2688246.8288

DRAINAGE WAY 3 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L7		79.14	N23° 58' 15.77"E	7+08.26	7+87.39	643460.8902, 2688626.0039
L8		176.01	N13° 05' 01.79"E	7+87.39	9+63.40	643533.2022, 2688658.1555
L9		52.31	N67° 32' 36.83"W	9+70.77	10+23.08	643711.8326, 2688699.6038
L10		123.04	N66° 51' 54.52"W	10+23.08	11+46.12	643731.8139, 2688651.2609
L11		55.76	N65° 51' 12.83"W	11+46.12	12+01.89	643780.1573, 2688538.1121
L12		20.20	N66° 02' 56.78"W	12+01.89	12+22.09	643802.9681, 2688487.2288

DRAINAGE WAY 4 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L1		398.47	N7° 12' 41.64"W	0+00.00	3+98.47	641989.0819, 2689783.7761
C1	150.00	8.71	N5° 32' 52.52"W	3+98.47	4+07.18	642384.3984, 2689733.7549
L2		146.40	N3° 53' 03.40"W	4+07.18	5+53.58	642393.0672, 2689732.9129
C2	200.00	60.61	N4° 47' 51.97"E	5+53.58	6+14.19	642539.1338, 2689722.9953
L3		41.48	N13° 28' 47.34"E	6+14.19	6+55.68	642599.3026, 2689728.0455
L4		27.57	N19° 55' 02.83"E	6+55.68	6+83.24	642639.6409, 2689737.7148
C3	150.00	45.78	N28° 39' 40.33"E	6+83.24	7+29.02	642665.5578, 2689747.1055
L5		8.19	N37° 24' 17.83"E	7+29.02	7+37.21	642705.5746, 2689768.9789
L6		48.18	N41° 16' 43.16"E	7+37.21	7+85.40	642712.0804, 2689773.9539
L7		41.65	N47° 12' 05.16"E	7+85.40	8+27.04	642748.2914, 2689805.7420
L8		72.23	N72° 35' 03.58"E	8+27.04	8+99.27	642776.5860, 2689836.2990
L9		70.01	N55° 15' 38.42"E	8+99.27	9+69.28	642798.2050, 2689905.2192
C4	219.87	108.74	N69° 25' 41.66"E	9+69.28	10+78.02	642838.0991, 2689962.7492
L10		75.94	N83° 35' 44.90"E	10+78.02	11+53.95	642875.9183, 2690063.5164
C5	150.00	5.84	N82° 28' 49.16"E	11+53.95	11+59.80	642884.3884, 2690138.9792
L11		118.41	N81° 21' 53.41"E	11+59.80	12+78.20	642885.1527, 2690144.7693
C6	150.00	19.94	N77° 33' 23.89"E	12+78.20	12+98.14	642902.9304, 2690261.8327
L12		36.07	N73° 44' 54.38"E	12+98.14	13+34.21	642907.2237, 2690281.2896
L13		57.47	N88° 02' 50.21"E	13+34.21	13+91.68	642917.3186, 2690315.9202

DRAINAGE WAY 5 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L14		76.31	N88° 27' 10.46"W	5+98.22	6+74.53	642178.8475, 2689815.0061
L15		212.62	S81° 05' 30.77"W	3+85.60	5+98.22	642211.7723, 2690025.0646
L16		385.60	N83° 58' 06.39"W	0+00.00	3+85.60	642171.2554, 2690408.5251

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DETAILS - ALIGNMENT TABLES
ROSEBUD COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
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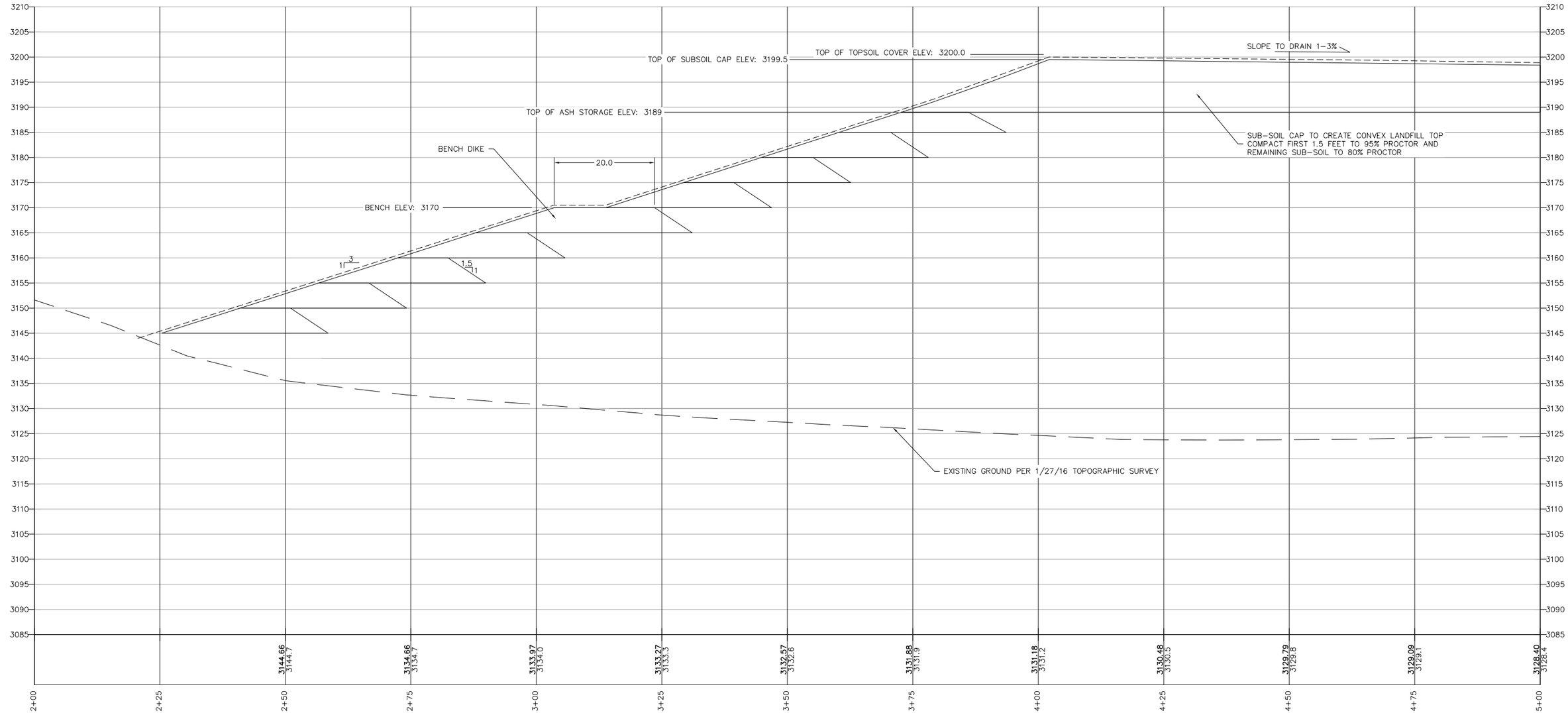
PROJECT #: 15-125
DATE: 9/15/2016

SHEET
C3-3

DETAILS - TABLES



PROFILE VIEW - LANDFILL CONTAINMENT BERMS AND TOP

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NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 10 20

VERTICAL SCALE FEET 0 10 20

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DETAILS - LANDFILL TOP
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BOZEMAN, MT 59718
PHONE (406) 582-0221
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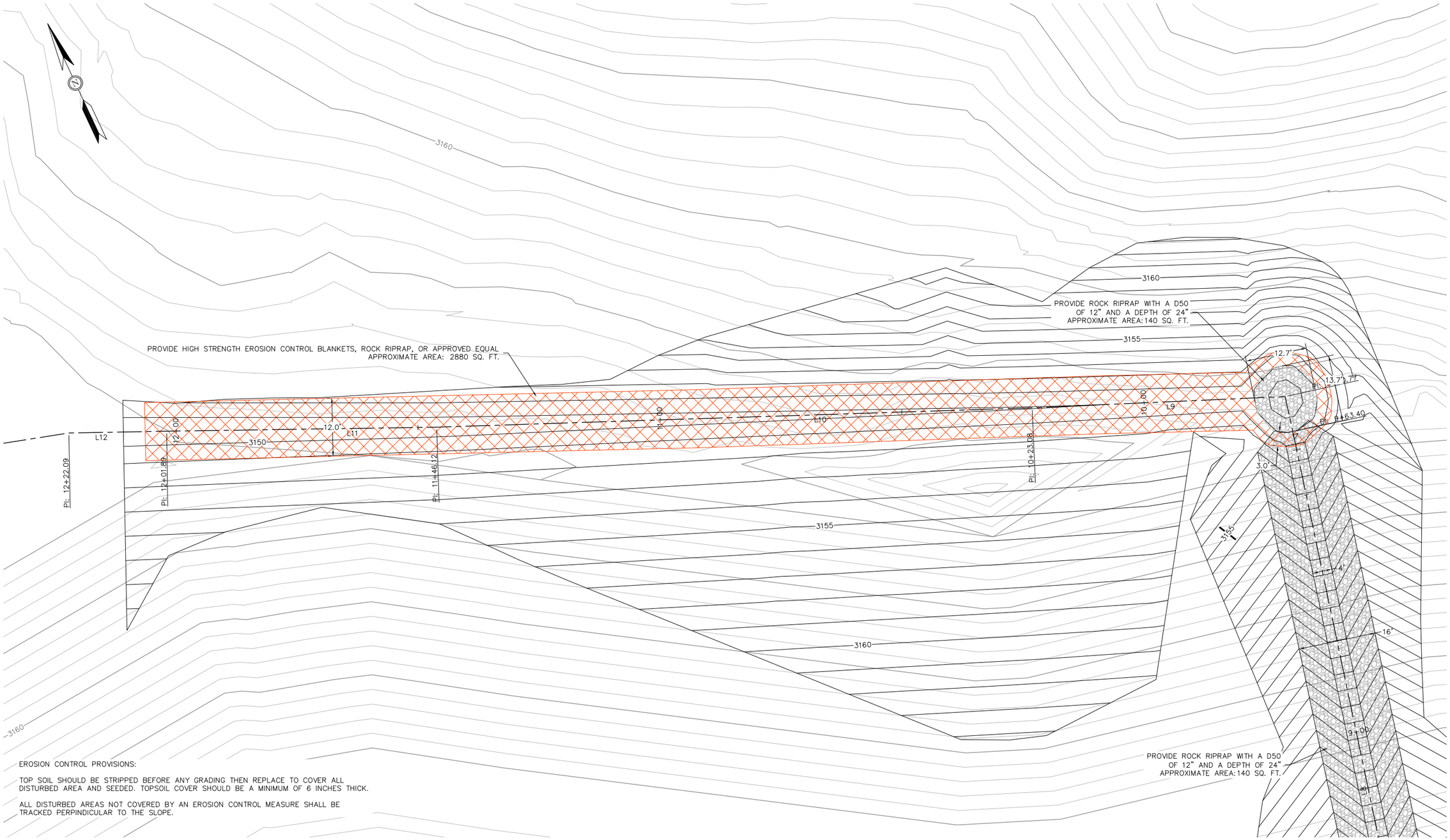
DATE: 9/15/2016	C3-4
	DETAILS - LANDFILL TOP



EROSION CONTROL PROVISIONS:

TOP SOIL SHOULD BE STRIPPED BEFORE ANY GRADING THEN REPLACE TO COVER ALL DISTURBED AREA AND SEEDED. TOPSOIL COVER SHOULD BE A MINIMUM OF 6 INCHES THICK.

ALL DISTURBED AREAS NOT COVERED BY AN EROSION CONTROL MEASURE SHALL BE TRACKED PERPINDICULAR TO THE SLOPE.

NO.	REVISIONS	DRAWN BY	DATE

0 10 20 30
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EROSION CONTROL - DRAINAGE WAY 3
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32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
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DATE: 9/15/2016	C4-1

EROSION CONTROL

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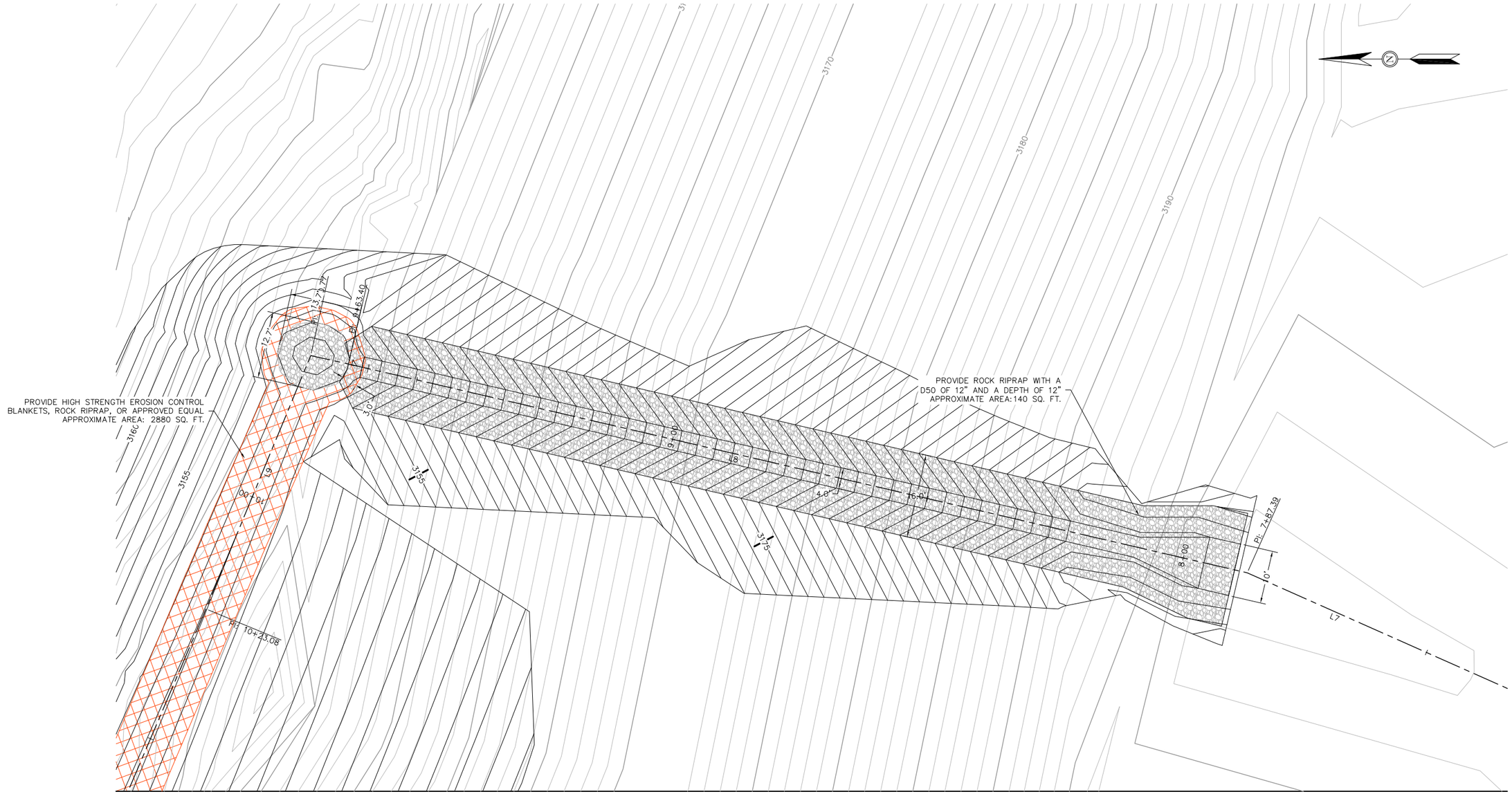

EROSION CONTROL PROVISIONS:

TOP SOIL SHOULD BE STRIPPED BEFORE ANY GRADING THEN REPLACE TO COVER ALL DISTURBED AREA AND SEEDED. TOPSOIL COVER SHOULD BE A MINIMUM OF 6 INCHES THICK.

ALL DISTURBED AREAS NOT COVERED BY AN EROSION CONTROL MEASURE SHALL BE TRACKED PERPENDICULAR TO THE SLOPE.

ALL DISTURBED AREAS ARE TO BE SEEDED.

NO.	REVISIONS	DRAWN BY	DATE

0 10 20 30
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EROSION CONTROL - DRAINAGE WAY 3
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32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
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DATE: 9/15/2016	C4-2

EROSION CONTROL

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NOTE:
SEE SHEET C3-3 FOR ALIGNMENT TABLE.

PROVIDE HIGH STRENGTH EROSION CONTROL BLANKETS, ROCK RIPRAP, OR APPROVED EQUAL
APPROXIMATE AREA: 2,314 SQ. FT.

2' DEEP PLUNGE POOL W/
3:1 SIDE SLOPES

PROVIDE ROCK RIPRAP WITH A D50
OF 12" AND A DEPTH OF 12"
APPROXIMATE AREA: 3,423 SQ. FT.

DRAINAGE WAY 5

EP: 6+74.53

L14

L15

16.0'

15.3'

16.4'

10.0'

4:1 OS

6.0'

4.0'

PI: 3+85.60

OMW-6

37.3%

2.3%

9.5%

32.1%

3130

3135

3140

3160

170

PLAN VIEW - DRAINAGE WAY 5 (STA 3+60 - STA 6+75)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0 40 80
VERTICAL SCALE FEET: 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EROSION CONTROL - DRAINAGE WAY 5
ROSEBUD COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
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SHEET
C4-3

P & P - DRAINAGE WAY 4

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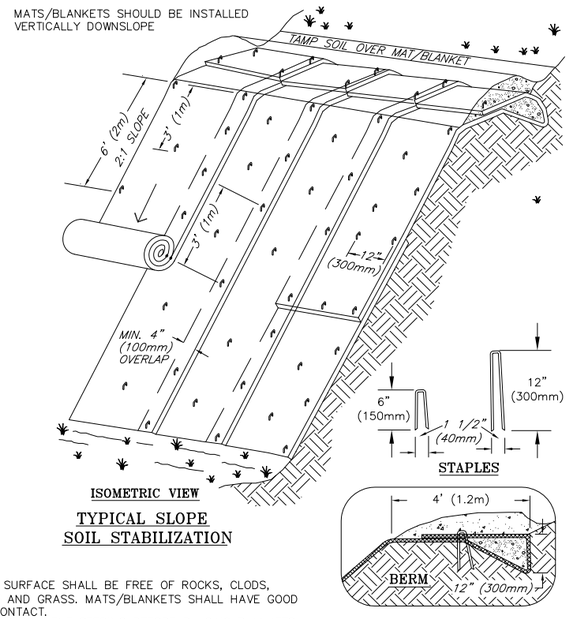
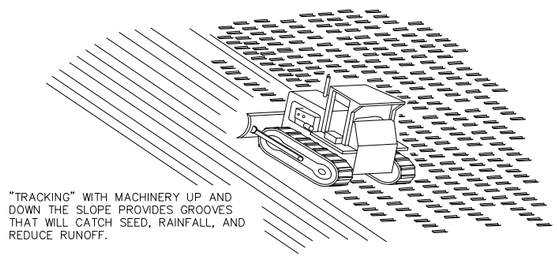


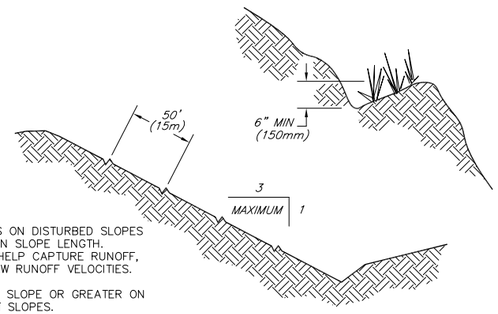
TYPICAL SLOPE
SOIL STABILIZATION

NOTES:
1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH SOIL. DO NOT STRETCH.



"TRACKING" WITH MACHINERY UP AND DOWN THE SLOPE PROVIDES GROOVES THAT WILL CATCH SEED, RAINFALL, AND REDUCE RUNOFF.

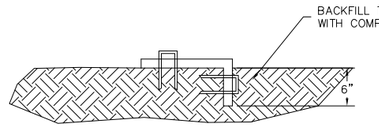
TRACKING



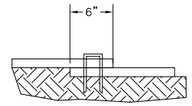
PLACE FURROWS ON DISTURBED SLOPES OVER 50 FEET IN SLOPE LENGTH. FURROWS WILL HELP CAPTURE RUNOFF, SEEDS AND SLOW RUNOFF VELOCITIES.

USE 3H:1V SIDE SLOPE OR GREATER ON ALL PERMANENT SLOPES.

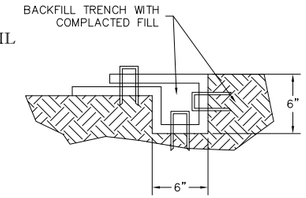
CONTOUR FURROWS



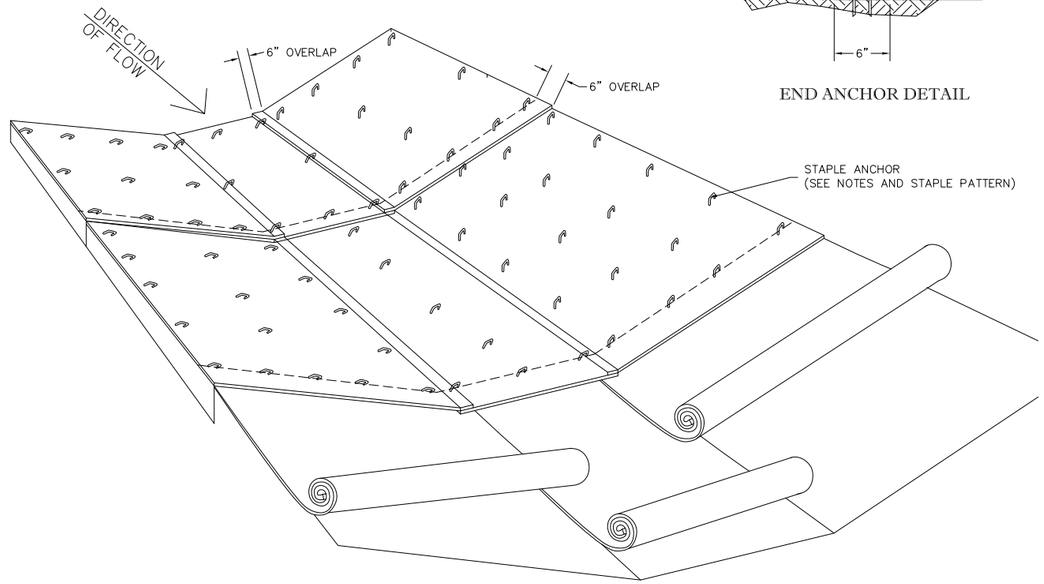
SIDE ANCHOR DETAIL



OVERLAP ANCHOR DETAIL



END ANCHOR DETAIL



ISOMETRIC VIEW

CONSTRUCTION NOTES:

1. PREPARE SOIL SO THAT AREA IS SMOOTH, THEN ADD SEED. AND FERTILIZER AS NEEDED.
2. START BY STAPLING THE BLANKET AT THE TOP OF THE CHANNEL IN A 6" DEEP X 6" WIDE TRENCH. BACKFILL AND COMPACT TRENCH SO THAT THE WATER WILL FLOW EVENLY ONTO THE BLANKET.
3. ROLL CENTER BLANKET IN THE BOTTOM OF THE CHANNEL AND PLACE 4 STAPLES EVENLY SPACED PER SQUARE YARD.
4. PLACE ADJOINING ENDS (SHINGLE STYLE) OVERLAPPING 6" SECURING THE OVERLAP WITH A DOUBLE ROW OF STAPLES STAGGERED 4" APART. OVERLAP EDGES OF BLANKET A MINIMUM OF 6" WITH PARALLEL BLANKETS.
5. THE FULL LENGTH OF THE BLANKET AT THE TOP OF THE CHANNEL MUST BE ANCHORED IN A 6"X6" TRENCH THEN BACKFILLED AND COMPACTED AFTER PLACING STAPLES IN THE TRENCH 3 FEET APART. INSURE COMPACTION SO THAT WATER CAN FLOW EVENLY ONTO THE BLANKETS FROM THE SIDES OF THE CHANNEL.
6. PLACE A DOUBLE ROW OF STAGGERED STAPLES 4" APART EVERY 33 FEET.
7. INSURE BLANKET IS PLACED ON SIDE BANKS OF CHANNEL 1 FOOT ABOVE FLOW LINE.
8. AT THE TERMINAL END OF THE CHANNEL, THE BLANKET MUST BE ANCHORED SUCH THAT THE WATER WILL FLOW TO THE DESIRED AREA. IF THE END OF THE CHANNEL IS A CULVERT, THE BLANKET BUST BE PLACED UNDER THE CULVERT AND SECURED WITH STAPLES 4" APART IN A STAGGERED PATTER. IF THE TERMINAL END IS A ROCK OUTFALL, THE BLANKET BUST BE PLACED IN A 6" WIDE X6" DEEP TRENCH STAPLED THE BACKFILLED, COMPACTED THE ROCKS PLACED ON THE TRENCH TO CREATE A SMOOTH TRANSITION.

1 DETAIL
EROSION CONTROL BLANKETS ON A SLOPE
NTS

2 DETAIL
SLOPE TEXTURING
NTS

3 DETAIL
EROSION BLANKETS IN A CHANNEL
NTS

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

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EROSION CONTROL DETAILS
ROSEBUD COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
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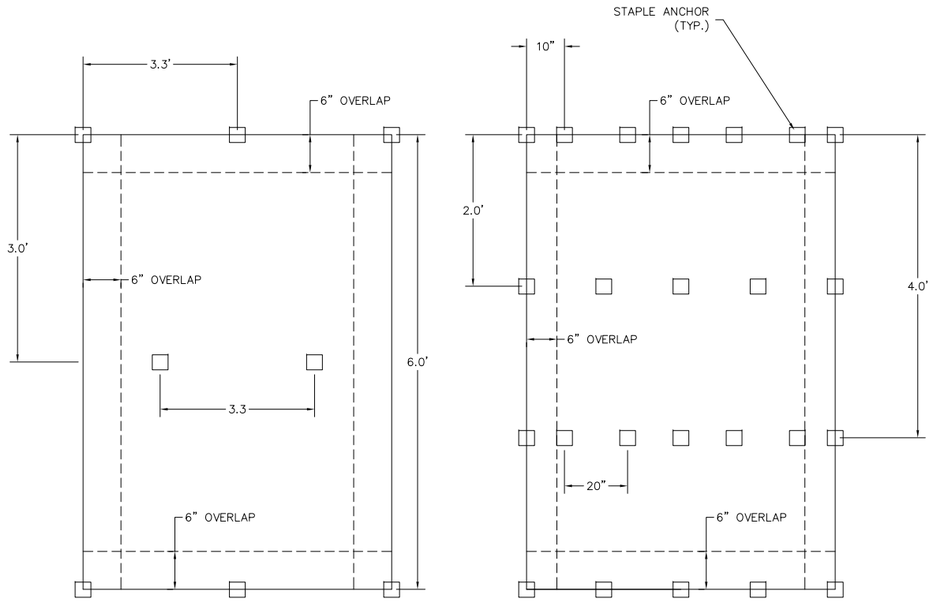
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C4-4
EROSION CONTROL	

EROSION BLANKET ANCHORING PATTERNS



3:1 SIDE SLOPES

CHANNEL BOTTOM/HIGH FLOW AREAS

ANCHORING NOTES:

CHOICE OF STAPLES WILL DEPEND ON SOIL TYPE AND COMPACTION. STAPLES PLACED IN SOIL SHOULD NOT COME OUT EASILY BY HAND. STANDARD 6" STAPLES WILL BE USED IN MOST CONDITIONS. LONGER STAPLES 8"–12" MAY BE NEEDED IN SANDY SOILS. FOR VERY LOOSE SOILS A LONG PIN WITH WASHER MAY BE USED TO ANCHOR BLANKET.

BLANKET SHALL BE OVERLAPPED A MINIMUM OF 6" WITH THE UPSTREAM BLANKET COMING OVER THE DOWNSTREAM BLANKET (SHINGLE STYLE).

1 DETAIL
EROSION BLANKETS ANCHORING PATTERNS
NTS

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EROSION CONTROL DETAILS
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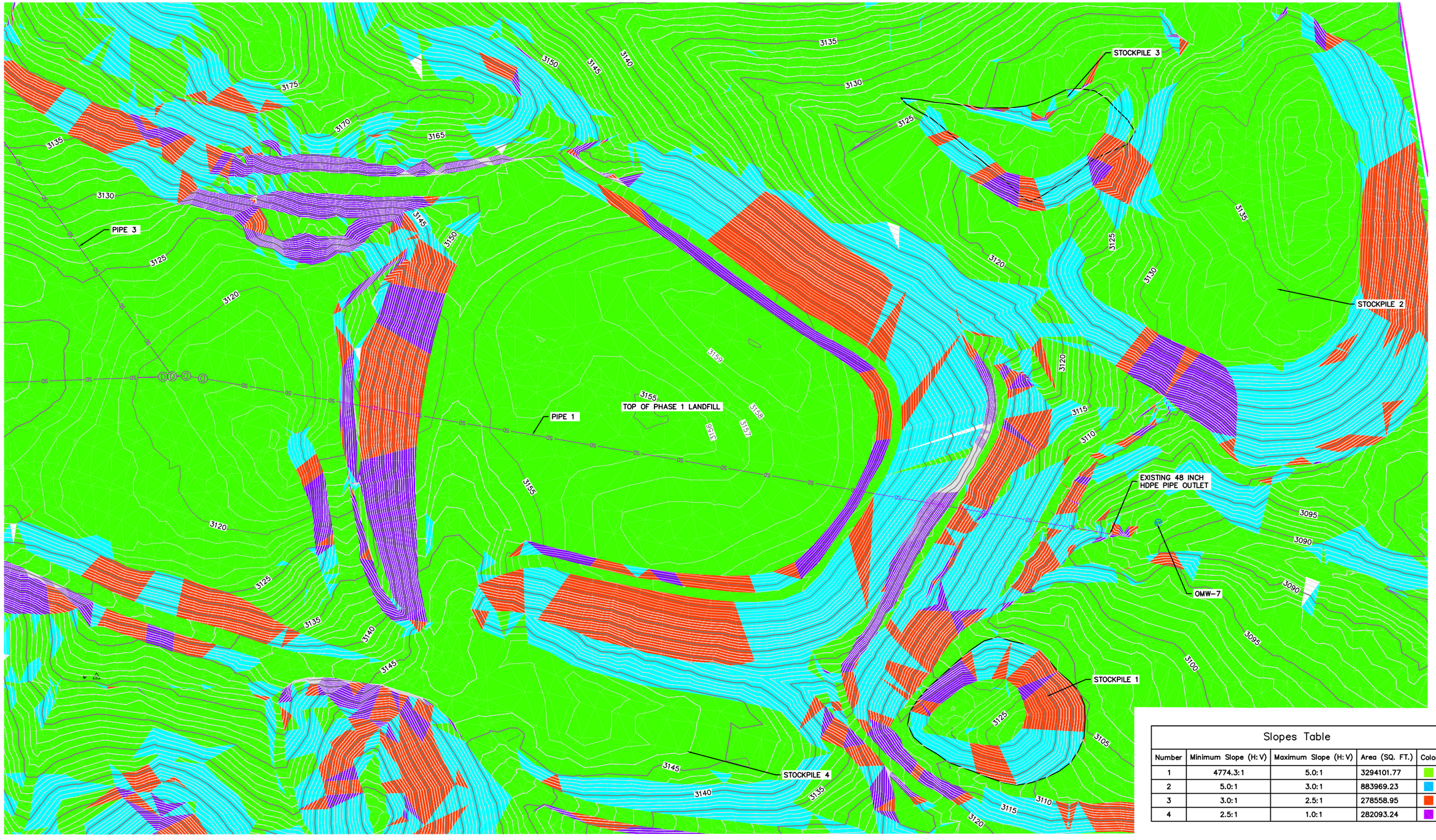
DATE: 9/15/2016	C4-5

EROSION CONTROL



Slopes Table				
Number	Minimum Slope (H:V)	Maximum Slope (H:V)	Area (SQ. FT.)	Color
1	4774.3:1	5.0:1	3294101.77	
2	5.0:1	3.0:1	883969.23	
3	3.0:1	2.5:1	278558.95	
4	2.5:1	1.0:1	282093.24	

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SLOPE FIGURE.dwg

NO.	REVISIONS	DRAWN BY	DATE

0 50 100 150
SCALE (FEET)

PROJECT ENGINEER: **DSC**	DRAWN BY: **ASG**
DESIGNED BY: **ASG**	REVIEWED BY: **DSC, BDA**

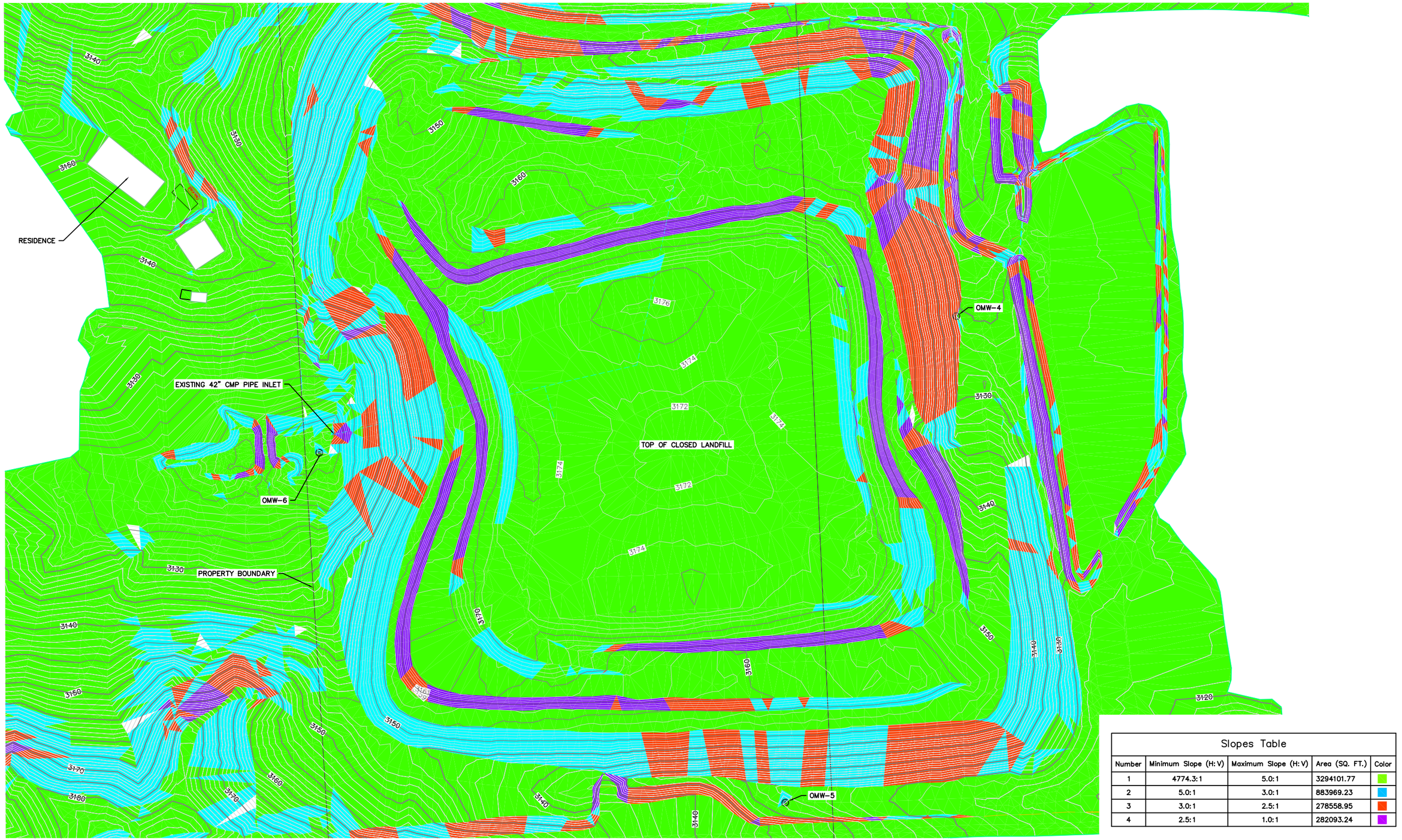
ROSEBUD POST-CLOSURE DESIGN
PHASE 1 LANDFILL SLOPES
ROSEBUD COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
www.alliedengineering.com

Civil Engineering
Geotechnical Engineering
Land Surveying

ALLIED ENGINEERING SERVICES, INC.
Diverse Projects

PROJECT #: **15-125**	SHEET
DATE: **09/15/16**	**S-1**



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3	3.0:1	2.5:1	278558.95	
4	2.5:1	1.0:1	282093.24	

NO.	REVISIONS	DRAWN BY	DATE

0 60 120 180
SCALE (FEET)

PROJECT ENGINEER: **DSC** | DRAWN BY: **ASG**
DESIGNED BY: **ASG** | REVIEWED BY: **DSC, BDA**

ROSEBUD POST-CLOSURE DESIGN
EXISTING CLOSED LANDFILL SLOPES
ROSEBUD COUNTY, MT

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PROJECT #: **15-125**
DATE: **09/15/2016**
SHEET **S-2**

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SLOPE FIGURE.dwg

Appendix B: **Soil Hydraulic Conductivity Testing Results**

PIONEER TECHNICAL SERVICES, INC.

September 13, 2016

Mr. Ron Orton
Allied Engineering Services, Inc.
32 Discovery Drive
Bozeman, MT 59718

RE: Job #15-125

Dear Mr. Orton,

On August 15, two samples were delivered to our Bozeman, MT laboratory. The samples were identified as B-1 (composite base) and SP-1 (composite stockpile). The samples were given Lab Nos. G16344 and G16345 respectively. The requested testing was performed in general accordance with the following Standards:

- Standard Proctor (ASTM D698); and
- Hydraulic Conductivity using a Flexible Wall Permeameter (ASTM D5084).

The hydraulic conductivity values are provided in Table 1. The proctor results and hydraulic conductivity sheets are attached with this report.

Table 1.

Lab No.	Sample Identification	Hydraulic Conductivity (cm/sec)
G16344	B-1 (composite base)	2.1×10^{-07}
G16345	SP-1 (composite stockpile)	4.5×10^{-08}

The hydraulic conductivity samples were screened over the ½" sieve and passing material was used to construct the specimen. At the request of Allied Engineering, the hydraulic conductivity samples were re-molded by compacting the specimens at optimum moisture to a dry unit weight equal to 95% of the uncorrected standard proctor value corrected for ½" minus material. Allied Engineering also requested a confining pressure of zero, but a minimum of 3 psi confining pressure was applied in order to perform the testing.

Please contact us at (406)388-8578 if you have any questions or require any additional information regarding this report.

Sincerely,
PIONEER TECHNICAL SERVICES, INC

Niki Griffis
Project Scientist/Laboratory Manager

HYDRAULIC CONDUCTIVITY FOR FLEXIBLE-WALLED TEST SAMPLES
FALLING HEAD APPARATUS, ASTM D5084

Client:	Allied Engineering						**Project:**	#15-125			
Sample Description:	G16344	B-1									
Test Specimen											
Dry Density (pcf):		102.1									
Standard Proctor (ASTM D698)		95%									
Specimen Length (cm):		15.24									
Specimen Diameter (cm):		7.112									
				Testing Equipment							
				Height Inlet Above Floor (cm):							
				Height Outlet Above Bench (cm):		21.9					
				Area of Standpipe (cm^2):		0.912					

Increment Number	Initial Reading Influent (cm^3)	Inital Reading Effluent (cm^3)	Final Reading Influent (cm^3)	Final Reading Effluent (cm^3)	Time Increment (min.)	Applied Pressure Differential (psi)	Initial Head (cm)	Final Head (cm)	Average Hydraulic Gradient (cm/cm)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity at 20 C (cm/sec)
1	2.5	41.4	6.9	37.9	554	1.6	147.96	140.75	9.47	2.6E-07	2.4E-07
2	6.9	37.9	12.3	33	886	1.5	133.72	124.33	8.47	2.4E-07	2.3E-07
3	12.3	33	14.9	30.6	572	1.6	131.36	126.80	8.47	1.8E-07	1.7E-07
4	14.9	30.6	19.3	26.4	968	1.6	126.80	118.96	8.06	1.9E-07	1.9E-07

Average Hydraulic Conductivity of Last Four Test Increments = **2.1E-07** **cm/sec**

k = (aL/At) ln (h1/h2)

Water Content Before Test		Water Content After Test	
Tare #		Tare #	
Wet Soil + Tare (grams)	1136.00	Wet Soil + Tare (grams)	1332.30
Dry Soil + Tare (grams)	982.18	Dry Soil + Tare (grams)	1093.20
Tare Weight (grams)	0.00	Tare Weight (grams)	111.02
Water Content (%)	15.66	Water Content (%)	24.34
Source	Specimen	Source	Specimen

HYDRAULIC CONDUCTIVITY FOR FLEXIBLE-WALLED TEST SAMPLES
FALLING HEAD APPARATUS, ASTM D5084

Client:	Allied Engineering						**Project:**	#15-125			
Sample Description:	G16345	SP-1									
Test Specimen											
Dry Density (pcf):		97.1									
% Max ASTM (D698)		95%									
Specimen Length (cm):		15.24									
Specimen Diameter (cm):		7.112									
				Testing Equipment							
				Height Inlet Above Floor (cm):							
				Height Outlet Above Bench (cm):		21.9					
				Area of Standpipe (cm^2):		0.912					

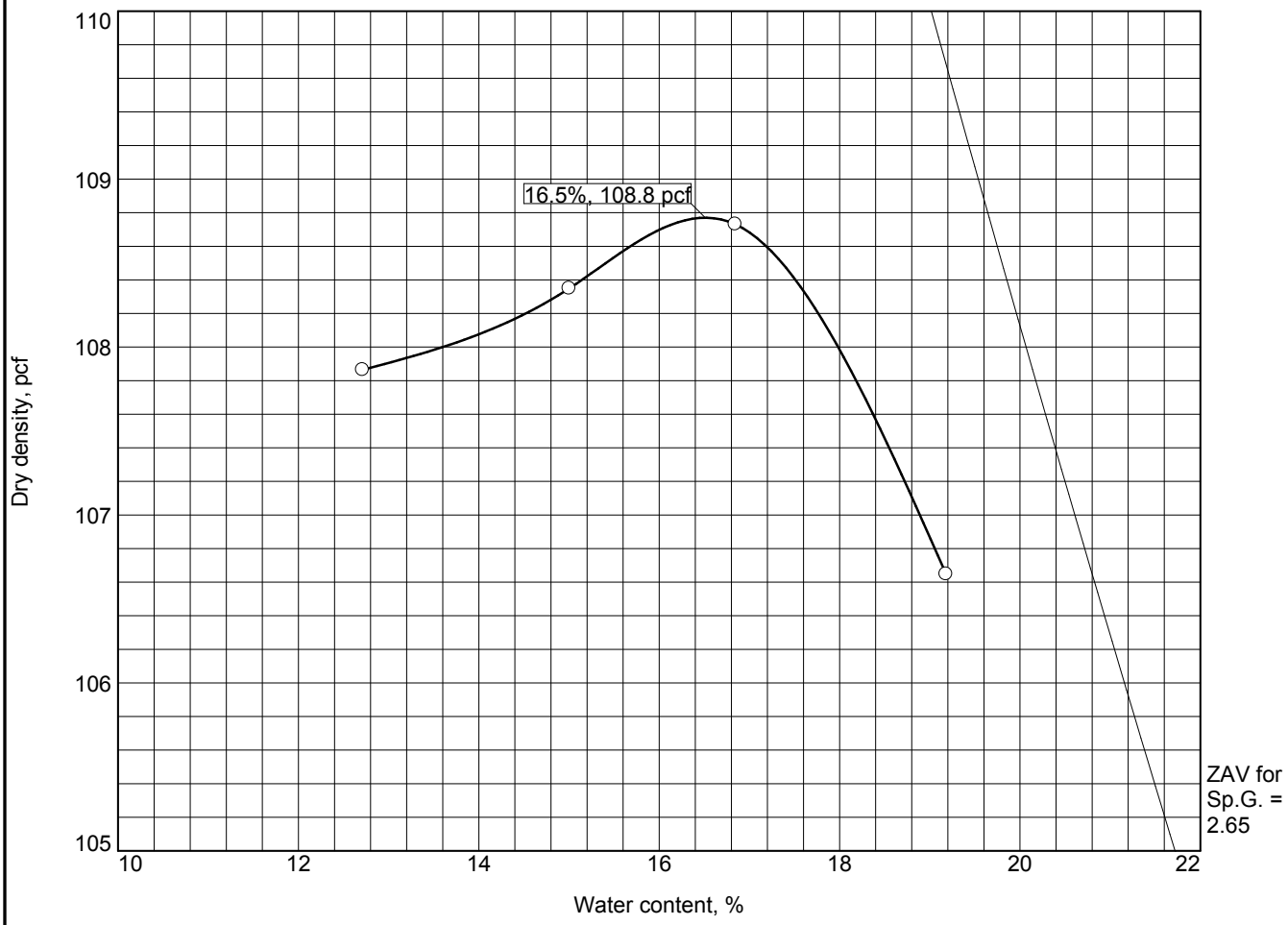
Increment Number	Initial Reading Influent (cm^3)	Inital Reading Effluent (cm^3)	Final Reading Influent (cm^3)	Final Reading Effluent (cm^3)	Time Increment (min.)	Applied Pressure Differential (psi)	Initial Head (cm)	Final Head (cm)	Average Hydraulic Gradient (cm/cm)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity at 20 C (cm/sec)
1	1.9	43.2	5.4	42.6	547	2.0	178.27	174.53	11.57	1.1E-07	1.0E-07
2	5.4	42.6	7.1	41.8	888	1.1	111.26	108.98	7.23	6.8E-08	6.6E-08
3	7.1	41.8	11.9	41.1	512	2.3	193.34	188.32	12.52	1.5E-07	1.4E-07
4	15	39.2	16.6	38	949	2.2	176.73	174.18	11.51	4.5E-08	4.3E-08
5	16.6	38	17.4	37.5	476	2.2	174.18	172.99	11.39	4.2E-08	4.0E-08
6	18.1	37.4	19.3	36.6	506	2.3	179.29	177.47	11.70	5.9E-08	5.7E-08
7	19.3	36.6	20.7	35.5	914	2.3	177.47	175.19	11.57	4.1E-08	4.0E-08

Average Hydraulic Conductivity of Last Four Test Increments = **4.5E-08** **cm/sec**

k = (aL/At) ln (h1/h2)

Water Content Before Test		Water Content After Test	
Tare #		Tare #	
Wet Soil + Tare (grams)	1082.50	Wet Soil + Tare (grams)	1297.90
Dry Soil + Tare (grams)	921.68	Dry Soil + Tare (grams)	1033.10
Tare Weight (grams)	0.00	Tare Weight (grams)	111.42
Water Content (%)	17.45	Water Content (%)	28.73
Source	Specimen	Source	Specimen

COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method C Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
							4.25	

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 108.8 pcf Optimum moisture = 16.5 %	Clay with sand, CL (visual)

Project No. **Client:** Allied Engineering

Project: Job #15-125

○**Source of Sample:** B-1 **Sample Number:** G16344

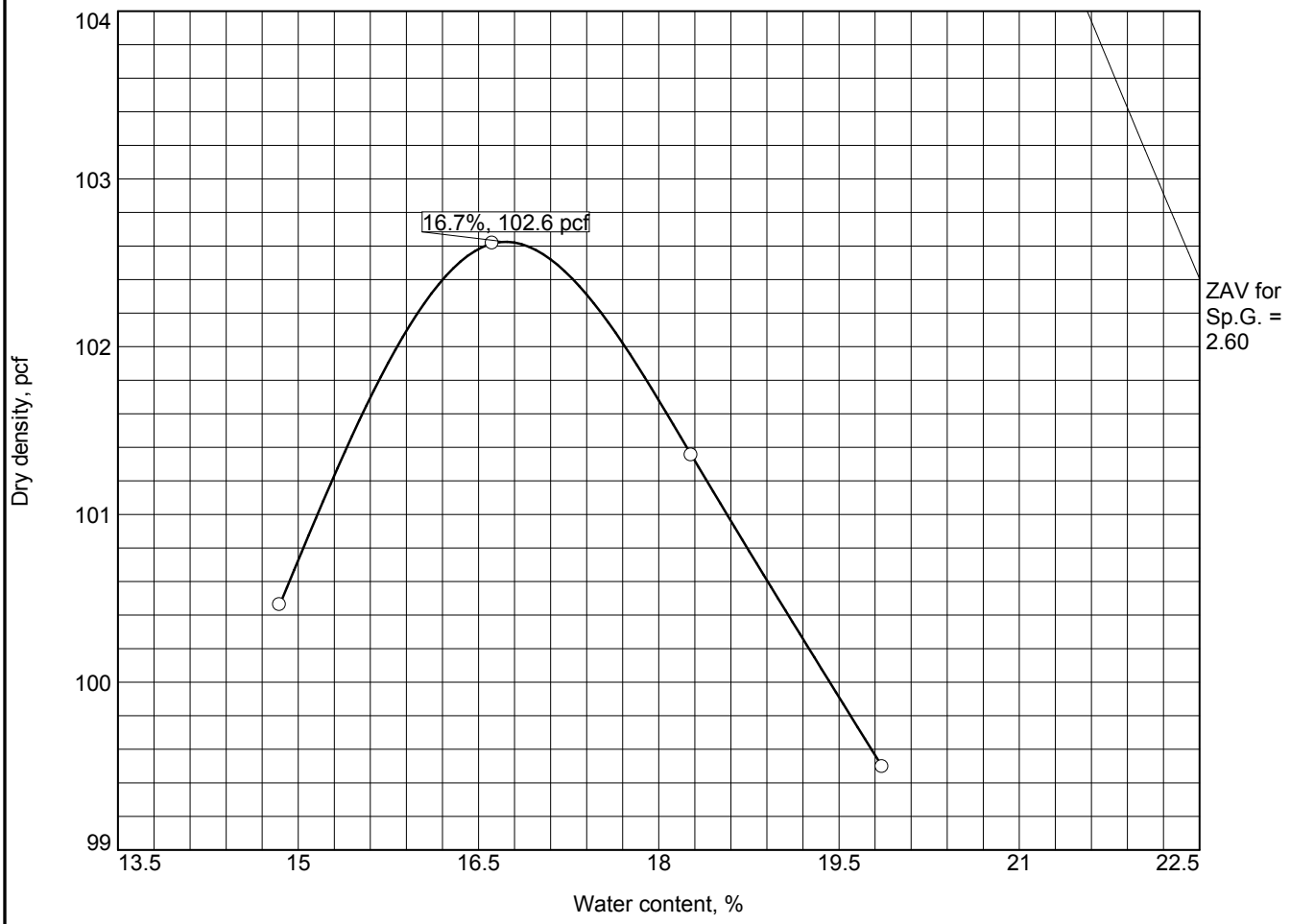
Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: RG/SJ **Checked By:** NG

COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method C Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
							3.07	

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 102.6 pcf Optimum moisture = 16.7 %	Sandy Clay w/ Gravel (visual)

Project No. **Client:** Allied Engineering

Project: Job #15-125

○**Source of Sample:** SP-1 **Sample Number:** G16345

Remarks:

Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: SJ **Checked By:** NG