PRELIMINARY GEOTECHNICAL INVESTIGATION
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

July 27, 2006
Project No. 06-192-01

Prepared for:

DNRC Southern Land Office
1371 Rimtop Drive
Billings, Montana 59105

Prepared by:

Rimrock Engineering, Inc.
5440 Holiday Avenue
Billings, Montana 59101

RIMROCK ENGINEERING, INC.

5440 Holiday Avenue • Billings, MT 59101

Phone 406.294.8400
Fax 406.294.8405

July 27, 2006

DNRC Southern Land Office
1371 Rimtop Drive
Billings, MT 59105

Attention: Mr. Jeff Bollman

SUBJECT: Preliminary Geotechnical Investigation Report
Proposed Skyview Ridge Subdivision
Residential and Commercial Lots with Interior Subdivision Streets
Billings, Montana

Dear Mr. Bollman:

The attached report presents the results of our preliminary geotechnical investigation for the proposed Skyview Ridge Subdivision located in Billings, Montana. This preliminary investigation encompasses 288 acres shown on the site map (Plate 2) of this report and recommendations for construction of interior streets and utilities. This report also includes preliminary design parameters for building foundations. Final design for foundations will have to be completed once the type of structures are identified and designed. Our work consisted of subsurface exploration, laboratory testing, engineering analyses, and preparation of this report.

Based on our work completed to date, we have drawn the following general conclusions:

- The 288 acres subdivision encompassed by this report is currently covered by 0.5 feet of topsoil with native grass and some pine trees in the southwest corner. The underlying soils across the site predominantly consist of a thin layer of silty sand ranging in depth from 1.5 to 3 feet. Sandy lean clay was encountered in Boring B-1 from 3 to 5 feet below existing site grades. The remainder of the borings terminated in weathered sandstone or shale which became more competent with depth. Boring depths ranged from 9.0 to 10.0 feet and were terminated at auger refusal in bedrock. Groundwater was not encountered in the borings at the depths explored and is not expected to impact construction.

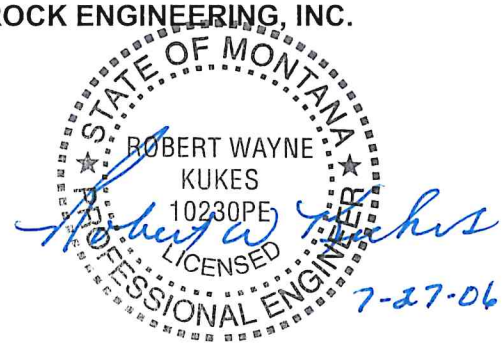
- During excavation for utility lines and street construction, sandstone or shale bedrock will be encountered at shallow depths and in some cases at existing surface elevations. Conventional earthmoving equipment may not be able to excavate the utility trenches in some areas of this site.

- For preliminary foundation design the use of conventional spread and continuous footings to support structural loads is anticipated. Foundations designed and constructed in accordance with the recommendations of this geotechnical report may be placed on native sandstone or may require over-excavation and re-compaction with structural fill if designed in the upper silty sand or weathered shale formations at foundation elevation.

These and other conclusions and recommendations, along with restrictions and limitations on these conclusions, are discussed in the attached report.

We appreciate this opportunity to be of service to you, and look forward to future endeavors. If you have any questions regarding this report or need additional information or services, please feel free to call the undersigned.

Sincerely,
RIMROCK ENGINEERING, INC.



Robert W. Kukes, P.E.
Principal

Wade Reynolds
Staff Geologist

Enclosures: 2 bound copies
2 bound copies - Engineering, Inc. - Attn: Dennis Randall)

TABLE OF CONTENTS

PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS, UTILITIES AND STREETS
BILLINGS, MONTANA

1.0 INTRODUCTION AND SCOPE

1.1 Project Description

This report presents the results of our preliminary geotechnical investigation for the proposed Skyview Ridge Subdivision, that includes both residential and commercial lots shown on the site map, Appendix A (Plate 2). We understand that the project will include construction single familiy, muti-family and commercial buildings. The project will also include construction of interior subdivision streets and associated utilities.

This is a preliminary geotechnical investigation for the purpose of filing a major preliminary plat for the Skyview Ridge Subdivision. At this time site specific structural loads were not available for the future buildings.

1.2 Purpose and Scope of Work

The purpose of this study is to evaluate the feasibility of the proposed development with respect to the observed subsurface conditions, and to provide our geotechnical recommendations and opinions as outlined in our statement of qualifications dated June 15, 2006, and summarized below. General soil and groundwater conditions at the project site, with emphasis on how the conditions are expected to affect the proposed construction;

- Suggested specifications for earthwork construction, including site preparation recommendations, a discussion of reuse of existing near surface soils as structural or non-structural fill, and a discussion of remedial earthwork recommendations, if warranted;
- Recommendations for temporary excavations and trench backfill;
- Preliminary design parameters for conventional shallow spread foundation design including soil bearing values, minimum footing depth and resistance to lateral loads;
- Concrete reactivity potential of site soils;
- Subgrade preparation for slab-on-grade concrete.

Our scope of services consisted of background review, site reconnaissance, field exploration, laboratory testing, engineering analyses, and preparation of this report. This study did not include evaluations of site seismicity, liquefaction, faulting, or other potential geologic or environmental hazards.

1.3 Authorization

Authorization to proceed with our work on this project was provided on June 30, 2006.

1.4 References

The following information was provided to Rimrock Engineering in the course of this study and serves as the basis of our understanding of the project type and scope.

- Preliminary Plat of Skyview Ridge Subdivision, Prepared by: Engineering, Inc. Billings, Montana. This plat was used in the field for boring location determinations.
- Google Earth Maps, Billings, Montana (2005) – Yellowstone Co., (Satellite Image) This map was the basis for the Vicinity Map shown on Plate 1 of this report.

2.0 METHODS OF STUDY

2.1 Field Exploration

Our selection of field exploration locations was based on the anticipated project layout and site access. The subsurface exploration consisted of drilling fifteen (15) test borings in the proposed construction area using a drill rig equipped with hollow stem augers. Boring depths were 9.0 to 10.0 feet below the existing ground surface and were terminated at auger refusal in competent bedrock. Locations of the borings shown on the Site Map (Plate 2, Appendix A), were chosen by Rimrock Engineering, Inc. These locations should be considered accurate only to the degree implied by the method used.

Soil conditions encountered are presented on the boring logs which are included as Plates 3 through 17. A description of the Unified Soil Classification System used to identify the site soils and a boring log legend are presented on Plates 18 and 19 (Appendix A).

Field personnel logged the soil conditions exposed in the borings and collected relatively undisturbed driven penetration samples for laboratory testing. Soil samples were obtained by

driving a 2-inch ID, Standard Penetration Sampler, into the bottom of the boring. The number of blows required to drive the last 12 inches of an 18-inch drive with a 140-pound hammer dropping 30 inches is recorded as the blows per foot (Blow Count) on the boring logs. When the sampler was withdrawn from the boring, samples were removed, examined by the field geologist, labeled and sealed to preserve the natural moisture content for laboratory testing. After borings were completed, they were checked for groundwater and backfilled with excavated soil using the equipment at hand.

2.2 Laboratory Testing

Laboratory testing is useful for evaluating both index and engineering properties of soils. Typical index tests evaluate soil moisture content, soil particle gradation and plasticity characteristics. We performed laboratory testing on selected soil samples to assess the following:

- Soil Classification (ASTM D422, D1140, and D4318)
- Moisture Content (ASTM D2216)

In addition, the following analytical tests were performed by Northern Analytical Laboratories.

- Soluble Sulfate Content

Individual laboratory test results can be found on the boring logs and on Plates 20 and 21, Appendix A, at the end of this report.

3.0 DISCUSSION

3.1 Site Conditions

Access to the project site is provided by Wicks Lane and Governors Boulevard. The Skyview Ridge Subdivision, covered by this investigation, is surrounded by residential/commercial development on the north, south and east, with agricultural land on the west. The site is presently undeveloped agricultural land. The ground surface in the area of the proposed subdivision appears to slope to the south and east with a large ravine in the southwest corner which drains toward Alkali Creek. A total relief of approximately 150 feet is currently present at the entire project site. Drainage on the site consisted of sheet flow and infiltration.

3.2 Subsurface Conditions

The following paragraphs summarize the results of our field exploration. The boring logs should be reviewed for a more detailed description of the subsurface conditions at the locations explored.

- The 288 acres subdivision encompassed by this report is currently covered by 0.5 feet of topsoil with native grass and some pine trees in the southwest corner. The underlying soils across the site predominantly consist of a thin layer of silty sand ranging in depth from 1.5 to 3 feet. Sandy lean clay was encountered in Boring B-1 from 3 to 5 feet below existing site grades. The remainder of the borings terminated in weathered sandstone or shale which became more competent with depth. Boring depths ranged from 9.0 to 10.0 feet and were terminated at auger refusal in bedrock. Groundwater was not encountered in the borings at the depths explored and is not expected to impact construction.

- During excavation for utility lines and street construction, sandstone or shale bedrock will be encountered at shallow depths and in some cases at existing surface elevations. Conventional earthmoving equipment may not be able to excavate the utility trenches in some areas of this site.

Fluctuations in the level of the groundwater and soil moisture conditions as noted in this report may occur due to variations in precipitation, land use, irrigation, and other factors.

3.3 Laboratory Test Results

Laboratory testing was performed as previously discussed in Section 2.2. The test data were evaluated in combination with our field exploration information to assess the engineering properties of the predominant soil types. Atterberg limits tests indicated the clayey sand and silty sand have a low plasticity or is granular non-plastic. The sulfate content test results indicated that the soils have a negligible potential for concrete reactivity, except in areas where weathered shale exists. In these areas, the sulfate content is moderate to servere.

3.4 Analytical Methods

Field and laboratory data are useful when combined with engineering fundamentals to assess specific behavior such as bearing capacity, settlement, and other design parameters. The following approaches were used in developing the conclusions and recommendations presented in subsequent sections of this report.

- Allowable bearing pressures were computed using Terzaghi's general bearing capacity formula.

- Settlements were not computed at this time because specific building designs are not yet complete.

4.0 CONCLUSIONS

The following conclusions are based on the data collected during this assessment and are subject to the limitations stated in this report. These conclusions may change if additional information becomes available. Based on the results of our study, no severe soil or groundwater constraints were observed which would preclude development. The following is a summary of our conclusions.

- The 288 acres subdivision encompassed by this report is currently covered by 0.5 feet of topsoil with native grass and some pine trees in the southwest corner. The underlying soils across the site predominantly consist of a thin layer of silty sand ranging in depth from 1.5 to 3 feet. Sandy lean clay was encountered in Boring B-1 from 3 to 5 feet below existing site grades. The remainder of the borings terminated in weathered sandstone or shale which became more competent with depth. Boring depths ranged from 9.0 to 10.0 feet and were terminated at auger refusal in bedrock. Groundwater was not encountered in the borings at the depths explored and is not expected to impact construction.

- During excavation for utility lines and street construction, sandstone or shale bedrock will be encountered at shallow depths and in some cases at existing surface elevations. Conventional earthmoving equipment may not be able to excavate the utility trenches in some areas of this site.

- Preliminary foundation design is expected to use conventional spread and continuous footings to support structural loads. Foundations designed and constructed in accordance with the recommendations of this geotechnical report may be placed on native sandstone or may require over-excavation and re-compaction with structural fill if designed in the upper silty sand or weathered shale formations at foundation elevation.

5.0 RECOMMENDATIONS

5.1 Site Clearing and Preparation

Prior to construction, surface soils and organic soils should be stripped and removed from the site or stockpiled for use in non-structural areas. It appears about 6 inches can be used as a reasonable estimate for average depth of stripping. Deeper stripping/grubbing of organic soils, tree roots, etc., may be required in localized areas. Tree root balls should be removed and the resulting voids backfilled with adequately compacted backfill soil. All man-made debris including **dumped fills or trash** should be removed from the site. The geotechnical engineer should be present during stripping and site preparation operations to observe stripping and grubbing depths, and to evaluate whether buried obstacles such as underground utilities, wells, and foundations are present. Excavations resulting from removal operations should be cleaned of all loose material and widened as necessary to permit access to compaction equipment.

5.2 Earthwork

5.2.1 General Site Grading

Site preparation and grading should conform to the requirements contained in this report and in the suggested specifications which are provided as Appendix B of this report. **We anticipate that site grading can be performed with conventional earthmoving equipment, however areas of shallow bedrock may require specialized excavation equipment**. Prior to fill placement, the exposed native soils should be scarified to a minimum depth of six inches, moisture conditioned as necessary, and compacted to a minimum of 95% relative compaction in accordance with the ASTM D698 compaction test method.

Where fill is necessary, it should meet the requirements for structural fill found in Appendix B. It appears that the existing soils at foundation elevations are generally capable of meeting recommended requirements for structural fill, except areas containing weathered shale. Fill placement and compaction requirements presented in Appendix B should be followed.

5.2.2 Temporary Unconfined Excavations

The contractor is ultimately responsible for the safety of workers and should strictly observe federal and local OSHA requirements for excavation shoring and safety. All temporary slopes should comply with OSHA requirements for Type A soils. During wet weather, runoff water should be prevented from entering excavations.

5.2.3 Temporary Trench Excavation and Backfill

It appears that conventional backhoe or excavating equipment may not be capable of excavating footings and utility trenches in the native soil/bedrock. We expect the walls of the footing trenches in the near surface fine grained soils to stand near vertically without significant sloughing. If trenches are extended deeper than five feet or are allowed to dry out, the excavations may become unstable and should be evaluated to verify their stability prior to occupation by construction personnel. Shoring or sloping of any deep trench walls may be necessary to protect personnel and provide temporary stability. All excavations should comply with current OSHA safety requirements for Type A soils. (Federal Register 29 CFR, Part 1926).

Backfills for trenches or other excavations within pavement areas should be compacted in six to eight inch layers with mechanical tampers. Jetting and flooding should not be permitted. We recommend all backfill be compacted to a minimum compaction of 97% of the maximum dry density as determined by ASTM D698. The moisture content of compacted backfill soils should be within 2% of the optimum. Poor compaction in utility trench backfill may cause excessive settlements resulting in damage to the pavement structural section or other overlying improvements. Compaction of trench backfill outside of improvement areas should be a minimum of 90% relative compaction

5.3 Foundations

Alternative deep foundation systems were not considered, since spread footing foundations bearing on native sandstone may be used. Areas where foundation elevations are in silty sand or weathered shale will require over-excavated and re-compacted structural fill. An allowable bearing pressure of 3,000 pounds per square foot for foundations founded on native sandstones may be used. An allowable bearing pressure of 2,000 pounds per square foot may be used for foundations placed on compacted structural fill. Foundation settlement analysis was not performed for this preliminary report.

Site drainage should follow the requirements listed in the International Residential Code. Rain gutters with extended downspouts should be installed and irrigated landscape should be maintained two feet away from all foundations.

Exterior foundations should be embedded a minimum of 3.5 feet below lowest adjacent exterior finish grade for frost protection and confinement. Interior footings should be bottomed at least 12 inches below lowest adjacent finish grade for confinement. Wall foundation dimensions should satisfy the requirements listed in the latest edition of the International Residential Code. Reinforcing steel requirements for foundations should be provided by the design engineer.

The allowable bearing pressures, indicated above, are net values, therefore, the weight of the foundation and backfill may be neglected when computing dead loads. Allowable bearing pressures may be increased by one-third for short-term loading such as wind or seismic.

Resistance to lateral loads in the upper silty sand and sandy clay soils may be calculated using an allowable passive equivalent fluid unit weight of 205 pounds per cubic foot and an allowable coefficient of friction of 0.35 applied to vertical dead loads. Both passive and frictional resistances may be assumed to act concurrently. An allowable active equivalent fluid pressure of 42 pounds per cubic foot may be used.

The International Building Code Site Class for this project is Class C.

5.4 Compaction Requirements

The following table lists the compaction requirements for the different types of fill recommended in this report.

TABLE 1 COMPACTION REQUIREMENTS	
Structure Fill Beneath Foundations	98% of ASTM D698
Backfill for Foundations	95% of ASTM D698
Trench Backfill	97% of ASTM D698

5.5 Concrete Slab-on-Grade Construction

Prior to constructing concrete slabs, the upper six inches of slab subgrade should be scarified, moisture conditioned to within 2% of optimum, and uniformly compacted to at least 95% of maximum dry density as determined by ASTM D698. Scarification and compaction will not be required if floor slabs are to be placed directly on undisturbed compacted structural fill.

All concrete floor slabs should have a minimum thickness of four inches. Slab thickness and structural reinforcing requirements within the slab should be determined by the design engineer. At least four inches of crushed base aggregate should be placed beneath slab-on-grade floors to provide uniform support. The aggregate base should be compacted to a minimum of 95% relative compaction.

We recommend that the base course be placed within three to five days (depending on the time of year) after moisture conditioning and compaction of the subgrade soil. The subgrade should be protected against drying until the concrete slab is placed.

In floor slab areas where moisture sensitive floor coverings are planned, an impermeable membrane (e.g. 10-mil thick polyethylene) should be placed over the base course to reduce the migration of moisture vapor through the concrete slabs. The impermeable membrane should be protected by two inches of fine, moist sand placed both above and below the membrane. The

sand cover will provide protection for the membrane and will promote uniform curing of the concrete slab. The sand cover should be moistened and tamped prior to slab placement.

5.6 Pavement Sections

Designing structural asphalt pavement sections for interior streets was not included in the scope of services of this contract and will be performed when design parameters are available.

5.7 Site Drainage

Final elevations at the site should be planned so that drainage is directed away from all foundations. Parking areas should be sloped and drainage gradients maintained to carry all surface water off the site. In parking lot areas, curbs adjacent to landscaping should be deepened to act as a cutoff, or a sub-drain system should be constructed to collect excessive water from landscaping irrigation.

5.8 Concrete Reactivity

Analytical testing of selected soil samples was performed to assess the potential for adverse reactivity with concrete. Soluble sulfate tests were performed to evaluate potential sulfate attack against Portland Cement Concrete. Soluble sulfate contents were observed to be less than 0.01% for near surface silty sand and sandstone. Therefore, the potential for sulfate attack appears to be negligible and conventional Type II cement may be used according to Table 1904.3 of the 2000 International Building Code. Areas which contain weathered shale were observed to have higher sulfate contents and should be evaluated during specific investigations for the future buildings.

6.0 ADDITIONAL SERVICES

6.1 Project Bid Documents

It has been our experience during the bidding process, that contractors often contact us to discuss the geotechnical aspects of the project. Informal contacts between Rimrock Engineering and an individual contractor could result in incorrect or incomplete information being provided to the contractor. Therefore, we recommend a pre-bid meeting be held to answer any questions about the report prior to submittal of bids. If this is not possible, questions or clarifications regarding this report should be directed to the project Owner or his designated representative. After consultation with Rimrock Engineering, the project Owner (or

his representative) should provide clarifications or additional information to all contractors bidding the job.

6.2 Construction Observation/Testing and Plan Review

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during construction to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Observations and testing during site preparation and earthwork.
- Observation of footing trench excavations.
- Observation and testing of construction materials.
- Consultation as may be required during construction.

We also recommend that project plans and specifications be reviewed by us to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

The review of plans and specifications and the field observation and testing by Rimrock Engineering are an integral part of the conclusions and recommendations made in this report. If we are not retained for these services, the Client agrees to assume Rimrock Engineering's responsibility for any potential claims that may arise during construction.

7.0 LIMITATIONS

Recommendations contained in this report are based on our field explorations, laboratory tests, and our understanding of the proposed construction. The study was performed using a mutually agreed upon scope of work. It is our opinion that this study was a cost-effective method to evaluate the subject site and evaluate some of the potential geotechnical concerns. More detailed, focused, and/or thorough investigations can be conducted. Further studies will tend to increase the level of assurance, however, such efforts will result in increased costs. If the Client wishes to reduce the uncertainties beyond the level associated with this study, Rimrock Engineering should be contacted for additional consultation.

The soils data used in the preparation of this report were obtained from borings made for this investigation. It is possible that variations in soils exist between the points explored. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at this site which are different from those described in this report, our firm

should be immediately notified so that we may make any necessary revisions to our recommendations. In addition, if the scope of the proposed project, locations of structures, or building loads change from the description given in this report, our firm should be notified.

This report has been prepared for design purposes for specific application to the Skyview Ridge Subdivision project in accordance with the generally accepted standards of practice at the time the report was written. No warranty, express or implied, is made.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

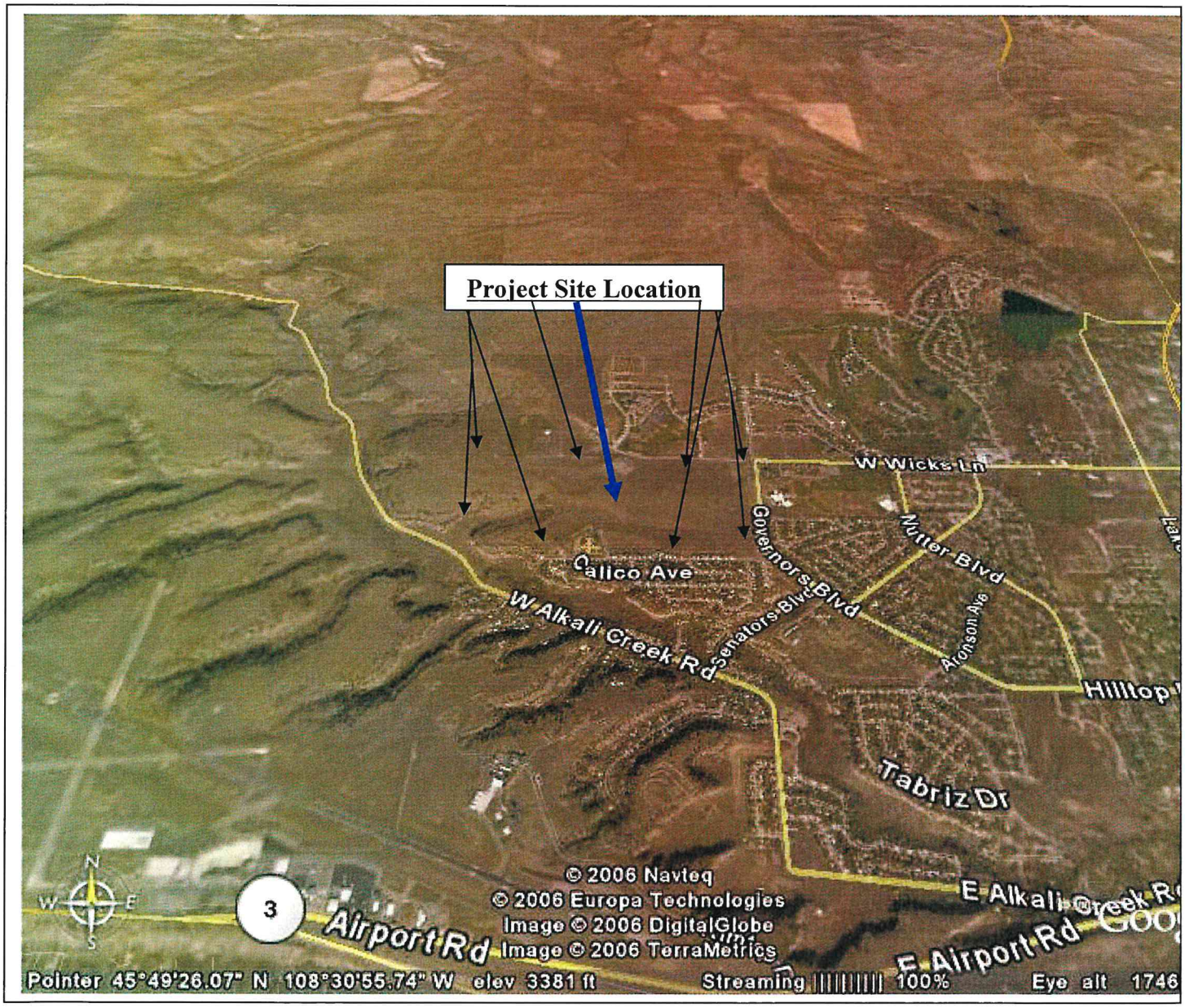
This report may be used only by the Client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on- and off-site), or other factors including advances in man's understanding of applied science may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 36 months from its issue. Rimrock Engineering should be notified if the project is delayed by more than 24 months from the date of this report so that a review of site conditions can be made, and recommendations revised if appropriate.

It is the Client's responsibility to see that all parties to the project including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk. Any party other than the Client who wishes to use this report shall notify Rimrock Engineering of such intended use by executing the "Application for Authorization to Use" which follows this document as an appendix. Based on the intended use of the report, Rimrock Engineering may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release Rimrock Engineering from any liability resulting from the use of this report by any unauthorized party.

APPENDIX A

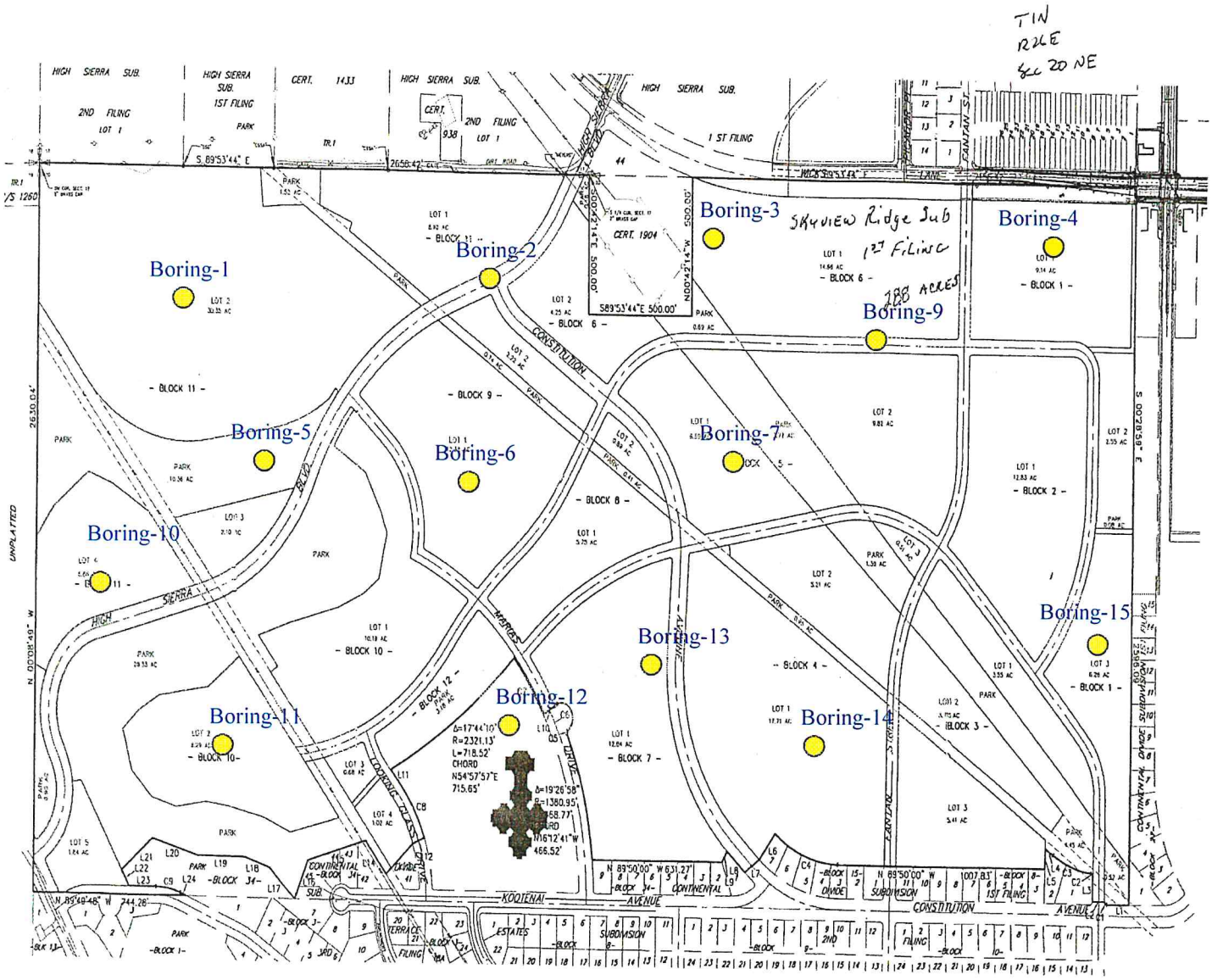
Plates

Preliminary Geotechnical Investigation Report:
SKYVIEW RIDGE SUBDIVISION – 1st Filing



Rimrock Engineering, Inc. 5440 Holiday Avenue Billings, MT 59102 Tel. (406) 294-8400 **PROJECT NO. 06-192-01**	**VICINITY MAP** SKYVIEW RIDGE SUBDIVISION RESIDENTIAL & COMMERCIAL LOTS UTILITIES AND STREETS Billings, Montana **DNRC SOUTHERN LAND OFFICE**	**PLATE** Page 1 of 1 **1**

Preliminary Geotechnical Investigation Report:
SKYVIEW RIDGE SUBDIVISION – 1st Filing



Rimrock Engineering, Inc. 5440 Holiday Avenue Billings, MT 59102 Tel. (406) 294-8400 **PROJECT NO. 06-192-01**	**SITE MAP** **SKYVIEW RIDGE SUBDIVISION RESIDENTIAL & COMMERCIAL LOTS UTILITIES AND STREETS** **Billings, Montana** **DNRC SOUTHERN LAND OFFICE**	**PLATE** Page 1 of 1 **2**

Date Completed: 7/20/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE

F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Sandy Lean Clay Brown, Moist, Stiff, Medium Plasticity, Completely Weathered Shale, Friable, (CL)	
95	5			18	12			**Shale** Brown and Grayish Brown, Highly Weathered, Weak to Moderately Strong, Soil Classification Sandy Lean Clay, Moist, Hard, Medium Plasticity, (CL)	
90	10			41/.5	1.0			**Eagle Sandstone** Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
								End of Boring - Refusal	

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01

Date: 7/27/2006 File Number:

LOG OF BORING B-01

SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE 1 of 1

3

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/24/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE

F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
				50/.4	.5			**Eagle Sandstone** Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
95	5								
90	10							**End of Boring - Refusal**	

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01

Date: 7/27/2006 File Number:

LOG OF BORING B-02

SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE 1 of 1

4

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/24/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Shale Brown and Grayish Brown, Highly Weathered, Weak to Moderately Strong, Soil Classification Sandy Lean Clay, Moist, Hard, Medium Plasticity, (CL)	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
95	5			50/.5	.5				
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-03
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
5

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/14/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
				50/.5	.5				
95	5								
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-04
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
6

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/20/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE

F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
				50/.3	.5				
95	5								
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01

Date: 7/27/2006 File Number:

LOG OF BORING B-05

SKYVIEW RIDGE SUBDIVISION

RESIDENTIAL & COMMERCIAL LOTS

UTILITIES AND STREETS

BILLINGS, MONTANA

PLATE 1 of 1

7

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/24/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Shale Brown and Grayish Brown, Highly Weathered, Weak to Moderately Strong, Soil Classification Sandy Lean Clay, Moist, Hard, Medium Plasticity, (CL)	
				35/.5	.5				
95	5							**Eagle Sandstone** Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-06
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
8

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/20/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
				50/.4	.5				
95	5								
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-07
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
9

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/24/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
				35/.4	.5				
95	5								
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-08
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
10

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/24/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
				45/.5	.5				
95	5								
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-09
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
11

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/20/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
				50/.4	.5				
95	5								
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-10
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
12

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/20/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
				44/.5	.5				
95	5								
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-11
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
13

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/14/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Silty Sand Brown, Dry/Moist, Loose, Granular Non-Plastic, (SM)	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
95	5			31/.5	.5				
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-12
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
14

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/17/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
				42/.5	.5				
95	5								
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-13
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
15

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/17/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
				55/.5	.5				
95	5								
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-14
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
16

Rimrock Engineering

DNRC SOUTHERN LAND OFFICE

Date Completed: 7/17/2006 Logged By: W. REYNOLDS

Boring Location: SEE SITE MAP, PLATE 2, APPENDIX A

Driller: W. REYNOLDS Drilling Method/Size: 3.25" I.D. HOLLOW STEM AUGER

Elev. Top of Hole: 100 Total Depth: 9.0 Groundwater Depth: I ▽ NONE
F ▼ NONE

ELEVATION, ft.	DEPTH, ft.	SAMPLE TYPE	SAMPLE/BOX NUMBER	BLOWS PER FOOT	RECOVERY, ft.	RQD	Graphic Log	DESCRIPTION	NOTES
								Topsoil Prairie Vegetated Silty, Clayey Sand, Brown	
								Eagle Sandstone Brown, Grayish Brown and Olive Brown, Highly to Moderately Weathered, Closely Fractured, Moderately Strong and Strong Soil Classification Silty Sand, Moist, Very Dense, Granular Non-Plastic, (SM)	
95	5			35/.5	.5				
								End of Boring - Refusal	
90	10								

RIMROCK SOIL/ROCK LOG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: R. Kukes Project No.: 06-192-01
Date: 7/27/2006 File Number:

LOG OF BORING B-15
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
17

DNRC SOUTHERN LAND OFFICE

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
LOAMS				UNDER USDA SOIL CLASSIFICATION SYSTEM, SOIL OF APPROXIMATELY EQUAL SAND/SILT/CLAY

RIMROCKUSCS 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: W. Reynolds
Date: 7/27/2006
Project No.: 06-192-01
File Number:

UNIFIED SOIL CLASSIFICATION SYSTEM
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
18

DNRC SOUTHERN LAND OFFICE

LOG SYMBOLS

	BULK / BAG SAMPLE	-4	PERCENT FINER THAN THE NO. 4 SIEVE (ASTM Test Method C 136)
	MODIFIED CALIFORNIA SAMPLER (2-1/2 inch outside diameter)	-200	PERCENT FINER THAN THE NO. 200 SIEVE (ASTM Test Method C 117)
	CALIFORNIA SAMPLER (3 inch outside diameter)	LL	LIQUID LIMIT (ASTM Test Method D 4318)
	STANDARD PENETRATION SPLIT SPOON SAMPLER (2 inch outside diameter)	PI	PLASTICITY INDEX (ASTM Test Method D 4318)
	GEOPROBE	EI	EXPANSION INDEX (UBC STANDARD 29-2)
	ROCK CORE	COL	COLLAPSE POTENTIAL
	WATER LEVEL (level where first encountered)	UC	UNCONFINED COMPRESSION (ASTM Test Method D 2166)
	WATER LEVEL (level after completion)		
	SEEPAGE	MC	MOISTURE CONTENT (ASTM Test Method D 2216)

GENERAL NOTES

1. *Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.*
2. *No warranty is provided as to the continuity of soil conditions between individual sample locations.*
3. *Logs represent general soil conditions observed at the point of exploration on the date indicated.*
4. *In general, Unified Soil Classification System designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.*

RIMROCKLOGKEY 06-192-01.GPJ 7/27/06

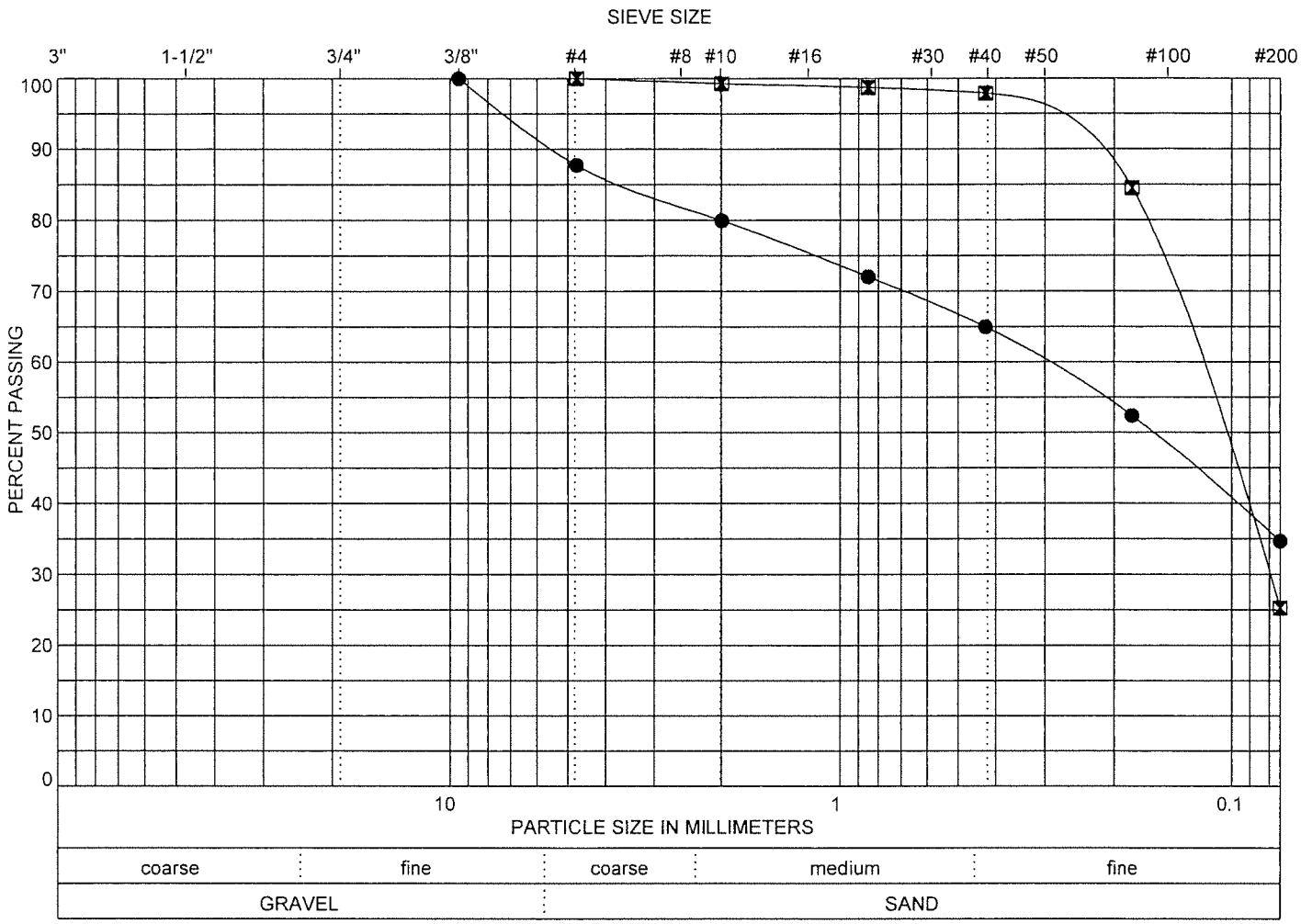
Rimrock Engineering

Drafted By: W. Reynolds
Date: 7/27/2006
Project No.: 06-192-01
File Number:

LOG KEY
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
19

DNRC SOUTHERN LAND OFFICE



LEGEND:	SOURCE	DEPTH (ft)	COBBLES (%)	GRAVEL (%)	SAND (%)	FINES (%)	DESCRIPTION
●	B-01	8.5	0	12	53	35	CLAYEY SAND(SC)
⊠	B-08	2.0	0	0	75	25	SILTY SAND(SM)

Rimrock Engineering

Drafted By: W. Reynolds
Date: 7/27/2006

Project No.: 06-192-01
File Number:

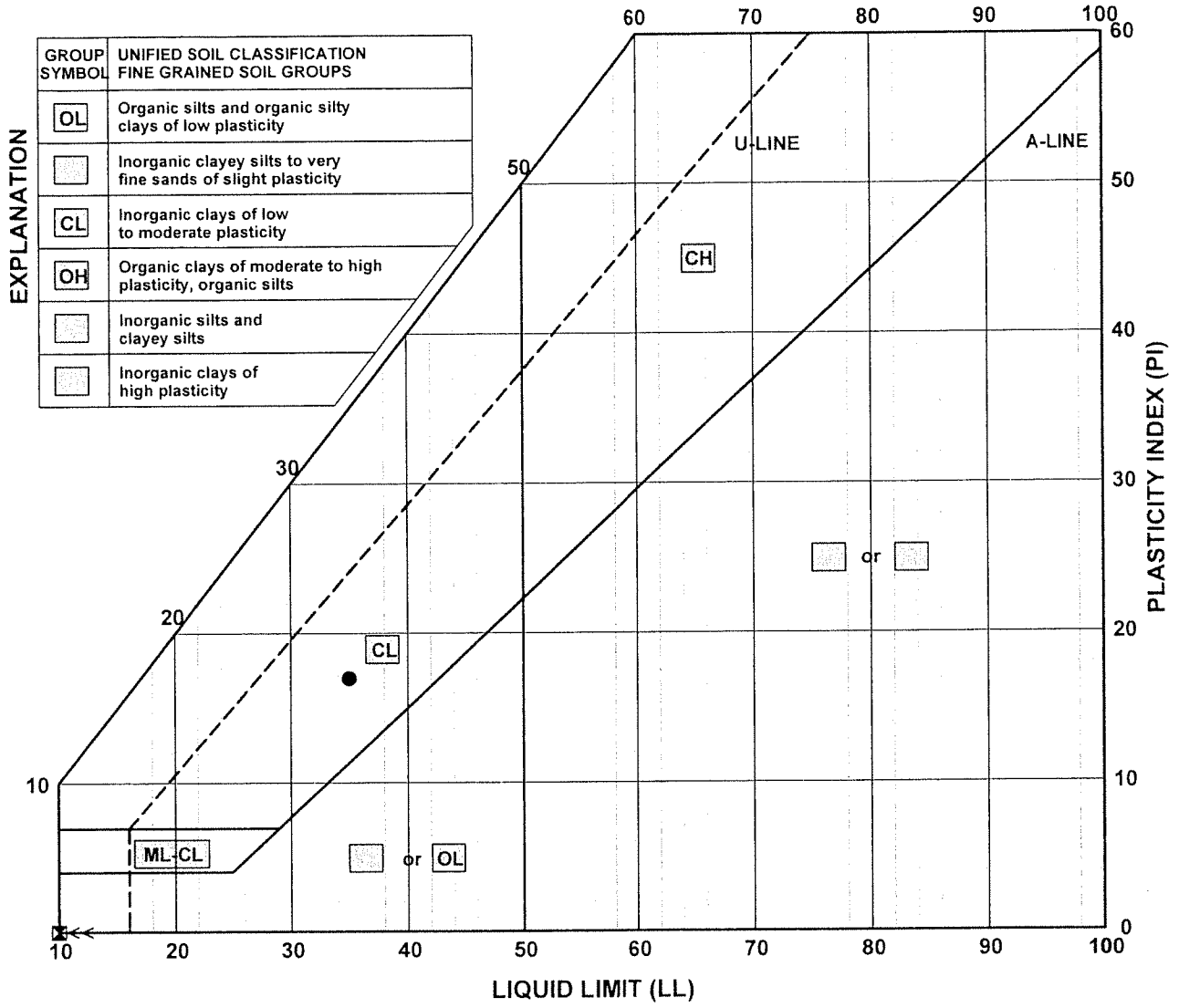
SIEVE ANALYSIS

SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
20

DNRC SOUTHERN LAND OFFICE

RIMROCKSIEVE 06-192-01.GPJ 7/27/06



LEGEND:	SOURCE	DEPTH	LL	PL	PI	DESCRIPTION
●	B-01	8.5	35	18	17	CLAYEY SAND(SC)
⊠	B-08	2.0	NP	NP	NP	SILTY SAND(SM)

RIMROCK ATTERBURG 06-192-01.GPJ 7/27/06

Rimrock Engineering

Drafted By: W. Reynolds
Date: 7/27/2006
Project No.: 06-192-01
File Number:

PLASTICITY CHART
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS
UTILITIES AND STREETS
BILLINGS, MONTANA

PLATE
1 of 1
21

DNRC SOUTHERN LAND OFFICE

APPENDIX B

Suggested Specifications
For
Earthwork Construction

APPENDIX B

SUGGESTED SPECIFICATIONS FOR EARTHWORK CONSTRUCTION SKYVIEW RIDGE SUBDIVISION BILLINGS, MONTANA

1.0 GENERAL

1.1 **Scope** - The work done under these specifications shall include clearing, stripping, removal of unsuitable material, excavation, preparation of natural soils, placement and compaction of on-site and imported structural fill material, and placement and compaction of pavement materials.

1.2 **Contractor's Responsibility** - A geotechnical investigation was performed for the project by Rimrock Engineering dated July 27, 2006. The Contractor shall attentively examine the site in such a manner that he can confirm existing surface conditions with those presented in the geotechnical report. He shall satisfy himself that the quality and quantity of exposed materials and subsurface soil or rock deposits have been satisfactory represented by the Geotechnical Engineer's report and Civil Engineer's drawings. Any discrepancy that may be of prior knowledge to the Contractor or that is revealed through his investigations shall be made available to the Owner. It is the Contractor's responsibility to review the attached report prior to construction. The selection of equipment for use on the project and the order of work will similarly be his responsibility such that the requirements included in following sections have been met.

1.3 **Geotechnical Engineer** - The work covered by these specifications shall be observed and tested by the Geotechnical Engineer, Rimrock Engineering, who shall be hired by the Owner. The Geotechnical Engineer will be present during the site preparation and grading to observe the work and to perform the tests necessary to evaluate material quality and compaction. The Geotechnical Engineer shall submit a report to the Owner, including a tabulation of all tests performed. The costs of retesting of unsuitable work performed by the Contractor shall be deducted from the payments to the Contractor.

1.4 **Standard Specifications** - Where referred to in these specifications, "Standard Specifications" shall mean the current Montana Public Works Standard Specifications dated March 2003, with City of Billings Modifications dated August 19, 2003.

1.5 **Compaction Test Method** - Where referred to herein, relative compaction shall mean the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by ASTM D698 Compaction Test Procedure. Optimum moisture content shall mean the moisture content at maximum dry density as determined above.

2.0 SITE PREPARATION

2.1 **Clearing** - Areas to be graded shall be cleared and grubbed of all vegetation and debris. These materials shall be removed from the site by the Contractor.

2.2 **Stripping** - Surface soils containing roots and organic matter shall be stripped from areas to be graded and stockpiled or discarded as directed by the Owner. In general, the depth of stripping of the topsoil will be approximately six inches. Deeper stripping, where required to remove weak soils or accumulations or organic matter, shall be performed when determined by the Geotechnical Engineer. Strippings shall be removed from the site or stockpiled at a location designated by the Owner.

2.3 **Removal of Existing Fill** - Existing fill soils, trash, and debris in the areas to be graded shall be removed prior to the placing of any compacted fill. Portions of any existing fills that are suitable for use in compacted fill may be stockpiled for future use. All organic material, topsoil, expansive soils, oversize material or other unsuitable material shall be removed from the site by the Contractor or disposed of at a location on site, if so designated by the Owner.

2.4 **Ground Surface** - The ground surface exposed by stripping shall be scarified to a depth of six inches, moisture conditioned to the proper moisture content for compaction, and compacted as required for compacted fill. Recompaction shall be approved by the Geotechnical Engineer prior to placing fill.

3.0 EXCAVATION

3.1 **General** - Excavations shall be performed to the lines and grades indicated on the plans. The data presented in the geotechnical investigation report is for information and only the Contractor shall make his own interpretation with regard to the methods and equipment necessary to perform the excavation and to obtain material suitable for fill.

3.2 **Materials** - Soils which are removed and are unsuitable for fill should be placed in non-structural areas of the project. When necessary, these soils may be placed in deeper fills if approved by the Geotechnical Engineer.

3.3 **Treatment of Exposed Surface** - The ground surface exposed by excavation shall be scarified to a depth of six inches, moisture conditioned to the proper moisture content for compaction, and compacted as required for compacted fill. Recompaction shall be approved by the Geotechnical Engineer prior to placing fill.

4.0 STRUCTURAL FILL

4.1 **Limits** – Imported structural fill, if required, will be used for fill beneath foundations for exterior continuous footings and interior column footings. In this area, the existing silty sand and sandstone can be used as structural fill. Areas containing weathered shale may require imported dense gravel with sand for structural fill.

4.2 **Material** – Structural fill material for areas containing weathered shale shall consist of medium dense to dense gravels. We recommend the gradation for structural fill be 100% passing the 3-inch sieve, 25 to 65% passing the No. 4 sieve, and no more than 20% minus No. 200 sized material. The structural fill should have a liquid limit less than 25 and a plasticity index less than 15.

4.3 **Placement** - All fill materials shall be placed in layers of eight inches or less in loose thickness and uniformly moisture conditioned. The lift should then be compacted with approved compaction equipment to achieve at least 98% relative compaction in areas under structure foundations. No fill material shall be placed, spread, or rolled while it is frozen or thawing, or during unfavorable weather conditions.

4.4 **Benching** - Fill placed on slopes steeper than 5 horizontal to 1 vertical shall be keyed into firm, native soils or rock by a series of benches. Benching can be conducted simultaneously with placement of fill. However, the method and extent of benching shall be checked by the Geotechnical Engineer.

4.5 **Compaction Equipment** - The Contractor shall provide and use sufficient equipment of a type and weight suitable for the conditions encountered in the field. The equipment shall be capable of obtaining the required compaction in all areas, including those that are inaccessible to ordinary rolling equipment.

4.6 **Recompaction** - When, in the judgment of the Geotechnical Engineer, sufficient compaction effort has not been used, or where the field density tests indicate that the required compaction or moisture content has not been obtained, or if "pumping" or other indications of instability are noted, the fill shall be reworked and recompacted as needed to obtain a stable fill at the required density and moisture content prior to placing additional fill materials.

4.6 **Responsibility** - The Contractor shall be responsible for the maintenance and protection of all embankments and fills made during the contract period and shall bear the expense of replacing any portion which has become displaced due to carelessness, negligent work, or failure to take proper precautions.

5.0 UTILITY TRENCH BEDDING AND BACKFILL

5.1 **Material** - Pipe bedding shall be defined as all material within six inches of the perimeter of the pipe. Backfill shall be classified as all material within the remainder of the trench. Material for use as bedding shall consist of clean, granular materials, and shall conform to requirements for bedding material listed in the Standard Specifications.

5.2 **Placement and Compaction** - Pipe bedding shall be placed in thin layers not exceeding eight inches in loose thickness, and conditioned to the proper moisture content for compaction.

All other trench backfill shall be placed in thin layers not exceeding eight inches in loose thickness, conditioned to the proper moisture content, and compacted as required for adjacent fill. **If not specified, backfill should be compacted to at least 97% relative compaction in areas under structures, utilities, roadways, parking areas, concrete flatwork, and to 90% relative compaction in undeveloped areas.**

6.0 AGGREGATE BASE FOR CONCRETE SLABS

6.1 **Material** - Aggregate base for concrete slabs shall consist of crushed base rock conforming to requirements of the Standard Specifications.

6.2 **Placement** - Aggregate base shall be compacted and kept moist until placement of concrete. Compaction shall be by suitable vibrating compactors. Aggregate base shall be placed in layers not exceeding eight inches in thickness. Each layer shall be compacted by at least four passes of the vibratory compaction equipment or until 95% relative compaction has been obtained.

7.0 SUBGRADE AND AGGREGATE BASE FOR PAVED AREAS

7.1 **Subgrade Preparation** - After completion of the utility trench backfill and prior to placement of aggregate base, the upper six inches of subgrade soil shall be uniformly compacted to at least 95% relative compaction. This may require scarifying, moisture conditioning, and compacting in both cut and fill areas.

7.2 **Aggregate Base** - Aggregate materials shall meet the requirements of the appropriate sections of the "Standard Specifications" for 1 ½ Minus Crushed Base Rock. The aggregate base materials must be approved by the Geotechnical Engineer prior to use.

After the subgrade is properly prepared, the aggregate base shall be placed in layers, moisture conditioned as necessary, and compacted by rolling to at least 95% relative compaction. The compaction thickness of aggregate base shall be as shown on the approved plans.

8.0 ASPHALT CONCRETE PAVEMENT

8.1 **Thickness** - The compacted thickness of asphalt concrete shall be shown on the approved plans.

8.2 **Materials** - Aggregate materials for asphalt concrete shall conform to the requirements listed for Type B or Type S-3 bituminous aggregates in Section 02503-2.2.3 of the "Standard Specifications." Asphalt concrete mixes shall utilize asphalt cement meeting the requirements of Section 02501 of "Standard Specifications". The Contractor shall submit a proposed asphalt concrete mix design to the Owner for review and approval prior to paving. The mix design shall be based on the Marshall Method.

8.3 **Placement and Compaction** - The asphalt concrete material and placement procedures shall conform to appropriate sections of the "Standard Specifications." The asphalt concrete material shall be compacted to a minimum of 92% of the Theoretical Maximum Rice Specific Gravity.

APPENDIX C

Application for Authorization to Use

APPENDIX C
APPLICATION FOR AUTHORIZATION TO USE
SKYVIEW RIDGE SUBDIVISION
RESIDENTIAL & COMMERCIAL LOTS, UTILITIES AND STREETS
BILLINGS, MONTANA

Rimrock Engineering, Inc.
5440 Holiday Avenue
Billings, MT 59101

To whom it may concern:

Applicant understands and agrees that the "Geotechnical Investigation Report, Skyview Ridge Subdivision," dated July 27, 2006, Job No. 06-192-01, for the subject site is a copyrighted document, that Rimrock Engineering, Inc. is the copyright owner and that unauthorized use or copying of said document for the subject site is strictly prohibited without the express written permission of Rimrock Engineering, Inc. Applicant understands that Rimrock Engineering, Inc. may withhold such permission at its sole discretion, or grant permission upon such terms and conditions as it deems acceptable.

Applicant agrees to accept the contractual terms and conditions between Rimrock Engineering, Inc. and DNRC Southern Land Office originally negotiated for preparation of this document. Use of this document without permission releases Rimrock Engineering, Inc. from any liability that may arise from use of this report.

To be Completed by Applicant

_____
(company name)

_____
(address)

_____
(city, state, zip)

_____ _____
(telephone) *(FAX)*

By: _____

Title: _____

Date: _____

For Rimrock Engineering, Inc.'s use only

_____ approved for re-use with additional fee of $ _____
_____ disapproved, report needs to be updated

By: _____
(Rimrock Engineering, Inc. project manager)

Date: _____