SUNCADIA
WATER COMPANY, LLC

SUNCADIA
ENVIRONMENTAL CO., LLC

June 13, 2019

Kittitas County Community Development Services
411 N. Ruby Street, Suite 2
Ellensburg, Washington 98926

RE: **Winemaker's Cabins at Swiftwater Cellars**
Preliminary Plat
Water and Sewer Utility Infrastructure
A portion of SEC 20, T20N, R15E, Kittitas County, WA
Owner: Swiftwater Cellars Properties, LLC

The purpose of this letter is to address water and sewer availability to service the proposed 26-unit development ("Project") referenced above.

Potable Water

Water service to the Project is provided by Suncadia Water Company, LLC. Water mains have previously been installed that run adjacent to the project and will provide adequate capacity and flow for the anticipated level of development. After necessary mains and service lines are constructed within the Project and conveyed per Suncadia Water Company standards, Suncadia Water Company will provide potable water service to the proposed 26 units.

Sanitary Sewer

Sanitary sewer service to the Project is provided by Suncadia Environmental Company, LLC. Existing sewer mains run adjacent to the Project. Suncadia Environmental Company has capacity to service the Project. After necessary sewer mains and services are constructed and conveyed per Suncadia Environmental Company standards, the Suncadia Environmental Company will provide sanitary sewer service to the proposed 26 units.

Please contact me at 509-649-6352 if you have any questions.

Sincerely

Gary Kittleson
Vice President – Director of Construction and Real Estate Finance

THE LANGDON GROUP | GATEWAY MAPPING INC.

OTHER J-U-B COMPANIES

MEMORANDUM

DATE: 11/08/2019

TO: Paul Inwards, PE
J-U-B Engineers, Inc

FROM: Lisa Siefken, PE
J-U-B Engineers, Inc

SUBJECT: Suncadia Winemaker's Cabins at Swiftwater Cellars

The purpose of this technical memorandum is to document the water distribution system analysis for the proposed Winemaker's Cabins at Swiftwater Cellars at Suncadia Resort near Cle Elum, Washington. The development area is located on the west side of the existing Swiftwater Cellars Winery/Restaurant located at 301 Rope Rider Dr, Cle Elum, Washington. This area encompasses twenty-four residential units and a recreation center. Figure 1 shows the location of the proposed Winemaker's Cabins at Swiftwater Cellars development. The proposed development has ground elevations ranging from approximately 2160 ft to 2245 ft. The development is located in pressure zone "2415."

Model Setup

Bentley WaterCAD software was used to model the developments waterlines and to calculate anticipated system pressures due to peak water use demands and fire flows.

A fire flow test was conducted in the field by Suncadia Water Company to record existing pressures near the development site. The results of the fire flow test are shown in Figure 3. The flow test hydrant used is located near the corner of Black Nugget Lane and Rope Rider Dr. Rope Rider Dr has an existing 8-inch water main. The pressure gauge was located directly in front of Swiftwater Cellars Winery/Restaurant and recorded a static pressure of 82 psi. During the test, the flow recorded was 1656 gpm at 47 psi.

The existing 8-inch water main in combination with a source reservoir and a general-purpose valve were used to model the existing system. The results of the fire flow test were used to create a headloss curve for the general-purpose valve to model the existing pressures in the distribution system.

The demands in Table 1, consistent with the 2013 Water System Plan for Suncadia Water Company, LLC, were used. Per Section 3.4 of the 2013 Water System Plan an Equivalent Residential Unit (ERU) has been defined as a typical single-family residence with 3.75 people and an Average Day Demand (ADD) per person assumed to be 122 gpd. Per Table 5-2 of the DOH Water System Design Manual, the Average Day Demands for the proposed Recreational Center and the existing Swiftwater Cellars Winery/Restaurant were assumed to be 10 gpd/person and 12 gpd/person, respectively. The number of people to visit the proposed Recreational Center was estimated to be 300 people per day. Similarly, the number of people estimated to visit Swiftwater Cellars Winery/Restaurant was 750 people per day.

The following peaking factors based on Table 3.5-1 of the Water System Plan for the Maximum Daily Demand (MDD) and Peak Hourly Demand (PHD) were used:

MDD/ADD = 3.5
PHD/MDD = 1.73 (Based on 2019 forecast year)

The peaking factors were used in calculating the MDD and PHD demands shown in Table 1.

Table 1 – Water Demands

Description	Average Daily Demand (ADD)	Maximum Daily Demand (MDD)	Peak Hourly Demand (PHD)
ERU	0.32 gpm	1.11 gpm	1.93 gpm
Recreational Center	2.08 gpm	7.29 gpm	12.61 gpm
Swiftwater Cellars Winery/Restaurant	6.25 gpm	21.88 gpm	37.84 gpm

Determining Minimum Pipe Size

Two main criteria were used to determine the minimum pipe size required to maintain a safe and reliable system. These two requirements are listed below:

1) Maintain 30 psi during Peak Hourly Demand.
2) Maintain 20 psi during fire flows and Maximum Daily Demands.

Fire flow goals, consistent with the 2013 Water System Plan, are listed in Table 2.

Table 2 – Fire Flow Goals

Flow (gpm)	Duration (hours)
1,500	2

Proposed pipes were originally modeled at the minimum required 8-inch diameter and increased as necessary to meet the two minimum pipe size requirements listed above.

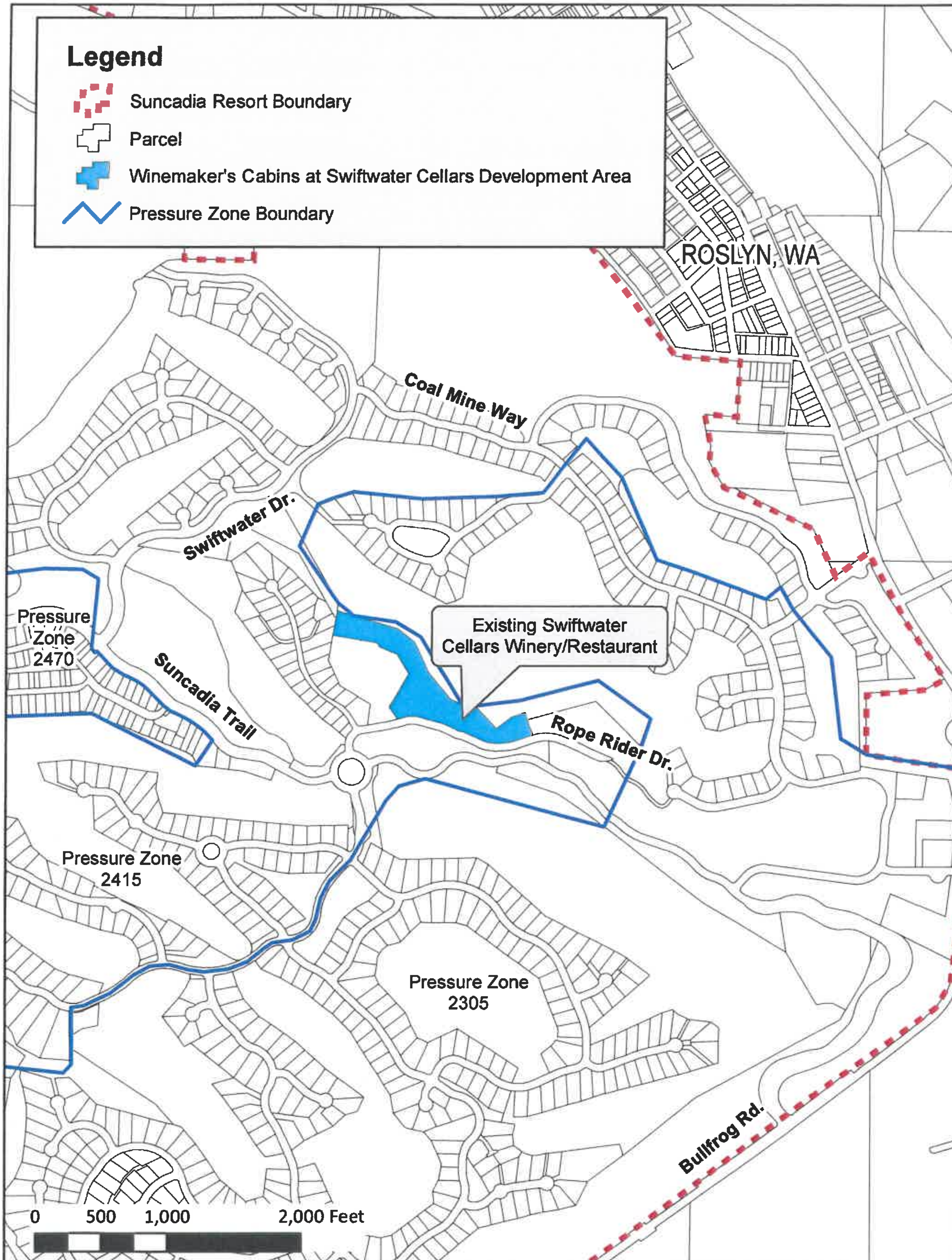
Model Results

The proposed pipe network of the Winemaker's Cabins at Swiftwater Cellars development area is shown in Figure 2. The figure also shows the minimum pipe sizes necessary to meet flow and pressure requirements. Additionally, the figure lists the ADD pressure, PHD pressure, and Available Fire Flow.

Recommendations

Figure 2 depicts the recommended pipe sizes to serve the Winemaker's Cabins at Swiftwater Cellars. As shown, a portion of the pipe in the West Development will need to be a minimum of 10-inch diameter to obtain minimum fire flows. It should be noted, that available fire flows do not include demand for fire sprinklers as this demand was unknown. The Uniform Plumbing Code and the DOH Water System Design Manual recommend a maximum pressure of 80 psi in residential uses. The model results indicate water pressures are close to the 80 psi threshold.

If higher water pressures are experienced, individual pressure reducing valves should be installed at each home. Finally, it is recommended that a blow-off assembly or fire hydrant be installed on all dead-end runs as stated in Section 7.3 of Suncadia Water Company's, 2013 Water System Plan.



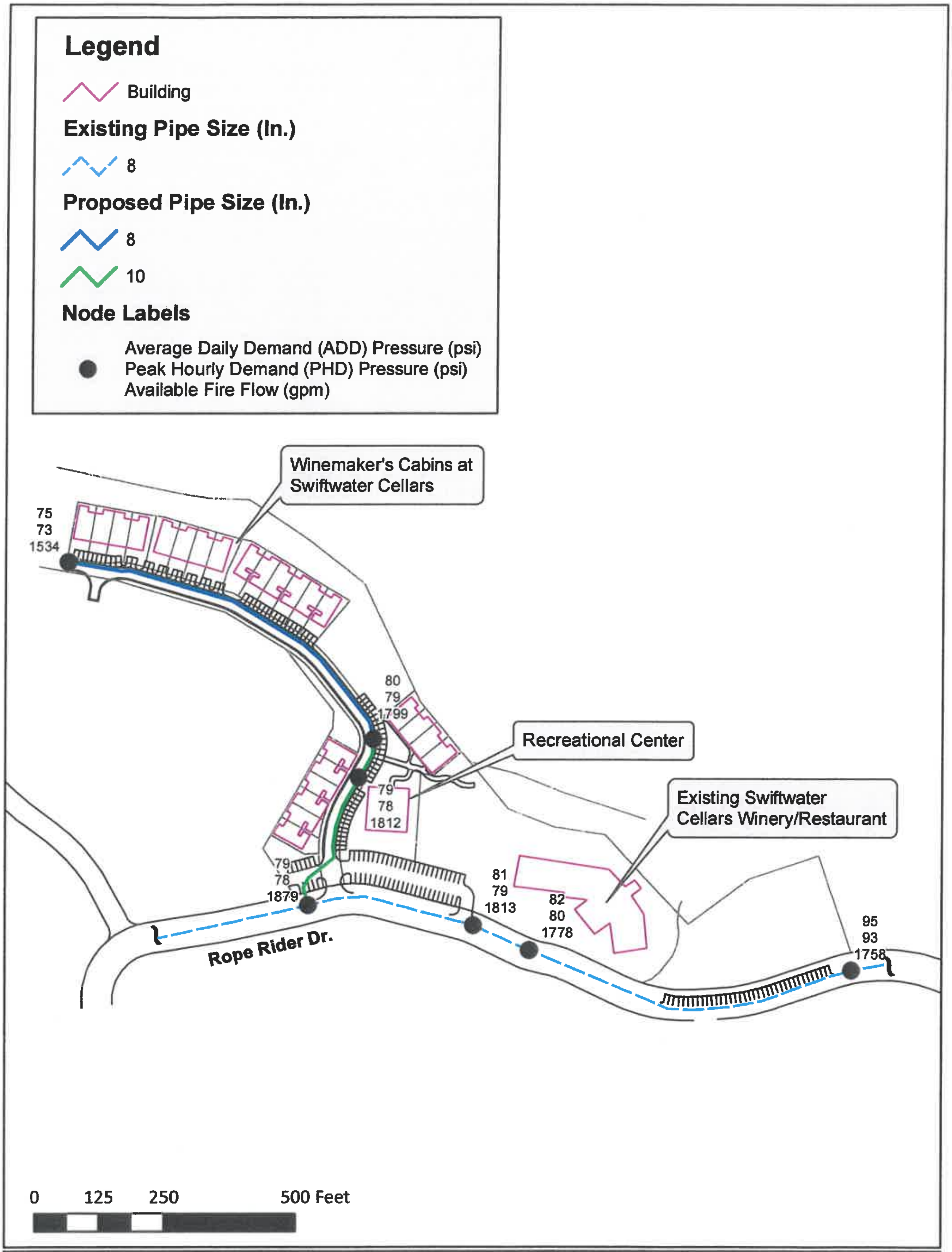
SUNCADIA WATER COMPANY, LLC

J-U-B

WINEMAKER'S CABINS AT SWIFTWATER CELLARS LOCATION

Updated: 7/11/2019

FIGURE 1

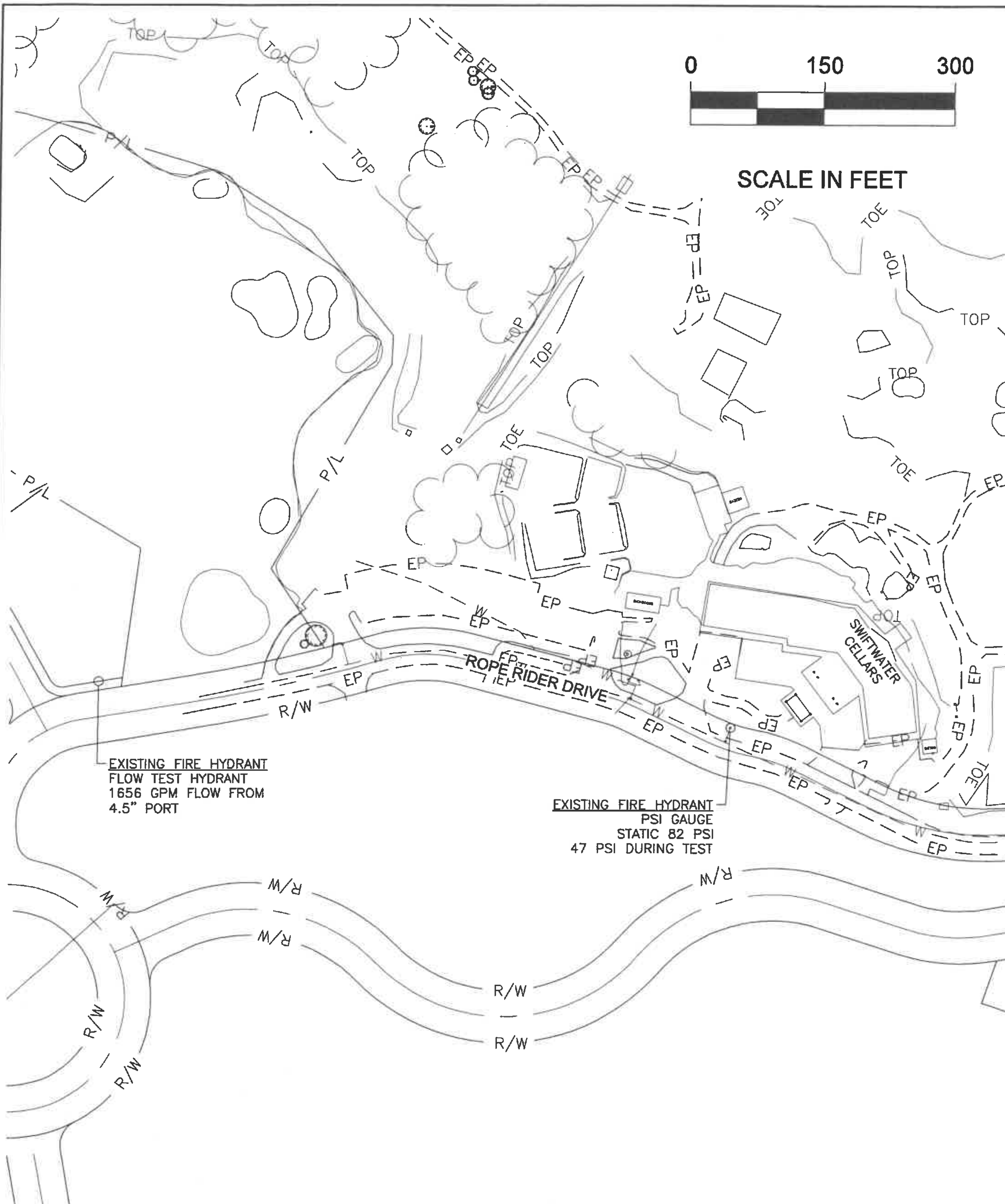


N

RECOMMENDED PIPE SIZE

Updated: 11/5/2019

FIGURE 2



NOTE: EXHIBIT REFORMATTED USING THE HYDRANT FLOW TEST DATA PROVIDED JUNE 7, 2019 BY DARIAN OSIADACZ, SUNCADIA UTILITIES MANAGER.

J-U-B ENGINEERS, INC.

LAST UPDATE: 11/5/2019

FILE: 30-15-078 FH FLOW TEST EXB

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WINEMAKER'S CABINS AT SWIFTWATER CELLARS
SUNCADIA, WA

EXISTING WATER SYSTEM
HYDRANT FLOW TEST DATA

FIGURE
3

Plot Date: 11/5/2019 2:36 PM Plotted By: Tirzah Eyre
Date Created: 11/5/2019 \\WKFILES\PUBLIC\PROJECTS\JUB\30-15-078 - WINEMAKERS CABINS AT SWIFTWATER CELLARS\CAD\RESOURCES\30-15-078 FH FLOW TEST EXB.DWG

GEOTECHNICAL REPORTS

Listed in chronological order:

1. Report Geological Engineering Services, Coal Mine Hazard Assessment Ground Proofing Program, Suncadia Phase 1, Proposed Rope Rider Ridge Residential Development Area, Kittitas County, Washington; February 8, 2007 by Icicle Creek Engineers, Inc.
2. Coal Mine Hazard Assessment & Geotechnical Evaluation Report, Winemaker's Cabins at Swiftwater Cellars; December 4, 2017 by GN Northern, Inc.
3. Supplemental Coal Mine Hazards Assessment, Winemaker's Cabins at Swiftwater Cellars; June 4, 2018 by GN Northern, Inc.
4. Memo: Geosynthetic Mitigation Option of Sinkhole Hazard Risk, Winemaker's Cabins at Swiftwater Cellars; October 16, 2018 by GN Northern, Inc.

Report
Geological Engineering Services
Coal Mine Hazard Assessment
Ground Proofing Program
Suncadia Phase 1
Proposed Rope Rider Ridge
Residential Development Area
Kittitas County, Washington

February 8, 2007
Project No. 0523-027

Prepared For:
Suncadia, LLC

Prepared By:
Icicle Creek Engineers, Inc.

ICICLE CREEK
ENGINEERS
Geotechnical, Geologic and Environmental Services

February 8, 2007

Art Solbakken
Suncadia, LLC
P.O. Box 887
Roslyn, Washington 98941-0887

Icicle Creek Engineers (ICE) is pleased to submit six copies of our "Report, Geological Engineering Services, Coal Mine Hazard Assessment, Ground Proofing Program, Suncadia Phase 1, Proposed Rope Rider Ridge Residential Development Area, Kittitas County, Washington." Our services were provided in general accordance with our Scope of Services and Fee Estimate dated August 8, 2006, and with Suncadia/ICE Contract #42, Change Order #25.

Please contact us if you require additional information. We appreciate the opportunity to be of service to you.

Yours very truly,

Icicle Creek Engineers, Inc.

Brian R. Beaman, P.E., L.G.
Principal Engineer/Geologist

Document ID: 0523027.cvl

cc: Brian Fields, P.E. (one copy)
Hugh G. Goldsmith & Associates, Inc.
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PROPOSED ROPE RIDER RIDGE RESIDENTIAL DEVELOPMENT AREA
KITTITAS COUNTY, WASHINGTON

INTRODUCTION

This report summarizes Icicle Creek Engineers (ICE's) coal mine hazard assessment and ground proofing program of a Moderate and Very Low Risk Sinkhole Hazard Area within Suncadia's Phase 1, proposed Rope Rider Ridge residential development area (Rope Rider Ridge) located near Roslyn in Kittitas County, Washington. Rope Rider Ridge is currently located within the Short Iron Range parcel between the proposed Phase 1, Division 10 area and the proposed Rope Rider golf clubhouse area.

ICE previously completed detailed coal mine hazard assessments of this general area associated with the abandoned underground mine workings of the No. 9 Mine that underlie this area. The most recent of these assessments are dated October 10, 2006 and December 8, 2004 (other reports are referenced later in this report). The project area is shown relative to nearby physical features on the Vicinity Map, Figure 1.

PROJECT AND COAL MINE HAZARDS DESCRIPTION

We understand that Suncadia is currently considering residential development in the Rope Rider Ridge area; primarily along the northeast perimeter paralleling a northeast-facing slope as shown on the Site Plan, Figure 2 (referred to on Figure 2 as the "Proposed Rope Rider Ridge Residential Development Area). Access to this area has not been determined at this time.

Our December 2004 study delineated this area as a Moderate to Very Low Risk Sinkhole Hazard Area. The Moderate Risk Sinkhole Hazard Area designation indicates that the abandoned underground coal mine is about 50 to 100 feet below the ground surface. A Very Low Risk Sinkhole Hazard Area indicates that, based on historic mine maps, the coal seam was not mined at this location.

We indicated in our December 2004 report that it is possible to complete additional subsurface exploration (ground proofing) in these areas which could result in mine hazard reclassification if the abandoned underground coal mine is observed to be substantially collapsed or if the coal seam is not mined.

SCOPE OF SERVICES

The purpose of our services was to conduct a ground proofing program in the Rope Rider Ridge area as a means to further evaluate and reclassify, if appropriate, the previous coal mine hazards designation. Specifically, our services included the following:

- Evaluate subsurface soil, bedrock, void and ground water conditions by drilling six test borings (Borings B-24 through B-29) to depths ranging from 56 to 99 feet using subcontracted top-drive, air rotary drilling equipment.
- Revise our characterization of the Moderate and Very Low Risk Sinkhole Hazard Area, as appropriate, based on the results of the ground proofing program.
- Provide mitigation, as appropriate, for development in coal mine hazard areas.

INFORMATION REVIEW

The following information was reviewed for this report.

- American Engineering Corporation, April 17, 1997, "Preliminary Geology and Geotechnical Investigation for Project X, Cle Elum Site," prepared for Trendwest Resorts, Inc., 21 pages, 9 figures.
- Applied Geotechnology, Inc. June 12, 1992, "Soil, Slope and Mining Hazards, Cle Elum River Project, Kittitas County, Washington," prepared for Plum Creek Timber Company, 24 pages, 6 plates.

- Ferro, John, 1997 and 2006, personal communication, on-site conversation with John Ferro, a retired miner from Roslyn.
- Gasparich, George, 1997, personal communication, on-site conversation with George Gasparich, a retired miner from Roslyn.
- George E. Maddox & Associates, June 1, 1984, "Final Report, Abandoned Coal Mine Hazards in the Roslyn Coal Field, Kittitas County, Washington," prepared for the U.S. Department of Interior Office of Surface Mining, 45 pages, 4 plates.
- ICE, December 8, 2004, "Report, Geological Engineering Services, Coal Mine Hazard Assessment, Ground Proofing Program, Suncadia Phase 1, Kittitas County, Washington," prepared for Suncadia, LLC, 9 pages.
- ICE, November 28, 2000, "Report, Geological Engineering Services, Coal Mine Hazard Assessment, Ground Proofing Program, MountainStar Property, Access Roads, Kittitas County, Washington," prepared for Trendwest Development, Inc., 8 pages.
- ICE, August 21, 2000, "Report, Geological Engineering Services, Coal Mine Hazard Assessment, Low/Moderate Coal Mine Hazard Area, Regional Ground Subsidence, MountainStar Property, Kittitas County, Washington," prepared for Trendwest Development, Inc., 7 pages.
- ICE, June 5, 2000, "Report, Geological Engineering Services, Coal Mine Hazard Assessment, High Coal Mine Hazard Area, MountainStar Property, Kittitas County, Washington," prepared for Trendwest Development, Inc., 5 pages.
- Jenkins, Mary, 1997, personal communication, discussion with Mary Jenkins at the Roslyn Museum.
- Northwestern Improvement Co. (NWI), 1978, No. 9 Mine, looking west on line of haulage slopes (cross section), Scale 1:2,400.
- NWI, 1963, Map of Roslyn No. 9 Mine, scale 1:1,200.
- NWI, 1963, Map of Roslyn No. 9 Mine, Big Seam, scale 1:1,200.
- NWI, 1947, N.W.I. Co. Map of the Roslyn No. 9 Mine, scale 1:1,200.
- NWI, 1940, Cross section of the No. 9 Mine dome, scale 1:600.
- NWI, 1932, Cross sections of the Roslyn bed at No. 9 Mine, scale 1:6.
- Walker & Associates, 1970, Aerial photographs of the area between Lake Cle Elum and the city of Cle Elum, scale 1:1,200.

GEOLOGIC SETTING

The Rope Rider Ridge area is underlain by bedrock at various depths, typically less than 100 feet below the ground surface. The bedrock, late Miocene in age, is referred to as the Roslyn formation and is approximately 9,000-feet thick. The Roslyn formation consists of stratified (horizontally layered) sandstone, siltstone, shale and coal (sedimentary rock). Typically, the bedrock is compact, massive (not fractured in its undisturbed condition), poorly cemented and is geologically referred to as "soft rock." The bedrock has been uplifted and deformed (folded and tilted) over time resulting in the sedimentary bedding being tilted less than 5 to 20 degrees below horizontal.

During the Pleistocene epoch (the geologic time period that lasted from about 1.8 million to 11,000 years ago), periodic climate changes caused glaciation of the area with mountain glaciers filling the prehistoric Cle Elum River valley. Streams carrying meltwater from the glacier eroded the bedrock and mantled the underlying bedrock with silt, sand, gravel and boulders across the project area. These sediments are collectively referred to as "outwash" and are typically normally consolidated (medium dense to dense) in their undisturbed condition.

Since the last glaciation, a thin layer of wind-blown silt, referred to as "loess," blanketed the project area. The loess typically forms a surficial layer about 2- to 4-feet thick. Locally, the loess is absent or more than 10-feet thick. Erosion, sedimentation and weathering of the surficial soils have continued to modify the land surface. Past logging and mining activities and recent grading included some localized modification (cuts and fills) of the ground surface.

SITE CONDITIONS

Brian Beaman of ICE has conducted periodic site visits to the Suncadia site, including the area subject to this report, since 1997. Detailed reconnaissance of the Rope Rider Ridge area was most recently conducted by Mr. Beaman in September 2006.

The Rope Rider Ridge area occupies a gently sloping area along the northeast side of a northwest-southeast trending elongate hill. The proposed residential development area is located along the northeast side of this area where it parallels a northeast-facing hillside overlooking the Rope Rider golf course and development area. The ground surface ranges from about Elevation 2,210 to 2,240 feet. Currently, the area has been rough-graded (no vegetation) with the exception of the northwest end of the proposed development area which is forested with scattered Ponderosa pine and Douglas fir trees, brush and grass. In the area that was rough-graded, it appears that the ground surface has been lowered (cut) several feet from the original ground surface. Photographs of the proposed development area along the northeast side of the Rope Rider Ridge area are shown on the Photographs, Figures 3, 4 and 5.

No surface water was observed in the Rope Rider Ridge and adjacent areas in September 2006.

We did not observe any mining-related surface features, such as sinkholes or mine rock fill in the Rope Rider Ridge area. Abandoned foundations for mining-related operations are present to the south and east of this area.

ABANDONED UNDERGROUND COAL MINES

NO. 9 MINE

The Rope Rider Ridge area is underlain by abandoned underground mine workings that were completed on the Big Seam and the Roslyn Seam (the Roslyn Seam is about 200 feet deeper than the Big Seam). The Big Seam consists of a 20- to 25-foot-thick layer (locally thicker or thinner) of interlayered coal and carbonaceous shale; only the lower 5 or 6 feet of the Big Seam was of commercial value at the time of mining. The Big Seam is relatively shallow (less than 200 feet below the ground surface - bgs) within the Rope Rider Ridge area.

The No. 9 Mine was developed on the Big Seam and was active from the early 1900s to 1963. The No. 9 Mine was mined on an approximately 5- to 6-foot thick layer of coal at the base of the Big Seam. The extraction (coal removal) ratio was apparently very high in production areas; estimated at 80 percent extraction and higher. However, networks of reinforced tunnels for general access were created. The production areas typically collapsed within a few days to weeks following coal extraction. The access tunnels tend to remain open, but typically fill with caved material over time (several decades). Based on our review of the historic mine maps, the mining under the Rope Rider Ridge area occurred in 1962 and 1963. There were no surface entries (mine portals and air shafts) to the No. 9 Mine in this area; these mine entries were located south and southeast of the Rope Rider Ridge area.

OTHER UNDOCUMENTED MINE WORKINGS

It is not likely that other undocumented mining-related prospects and surface features exist within the Rope Rider Ridge area. However, if mining-related features such as excavated bedrock, coal spoils or a prospect opening are observed during site preparation, then they should be individually evaluated.

MINE ROCK FILL

Mine rock fill consists of mining by-products such as rock fragments, cinders and coal fines that were extracted from the underground coal mines and typically stockpiled on the ground surface but had no economic value. Mine rock fill is typically unsuitable for building foundation support. No mine rock fill was observed in the Rope Rider Ridge area.

GROUND PROOFING PROGRAM SUMMARY

GENERAL

The ground proofing program was conducted by drilling six test borings (Borings B-24 through B-29) to depths ranging from 56 to 99 feet between September 19 and 22, 2006. The details of our ground proofing program are presented in Appendix A.

Our current ground proofing program was supplemented by previous drilling in the project area in 2000, 2004 and July 2006 including Borings B-7, B-8, B-9, B-12, B-13, B-14, B-15 and B-18 through B-23 within and adjacent to the Rope Rider Ridge area. The approximate locations of the test borings for the current and previous studies are shown on the Abandoned Underground Coal Mine Map, Figure 6.

The soil classification system and explanation for the boring logs are shown in Figure A-1. Logs of the test borings pertinent to this study are included as Figures A-2 through A-20. A profile showing the interpreted subsurface conditions across the proposed residential development area is shown on the Geologic Cross-Section A-A', Figure 7. A summary of the subsurface conditions observed in the borings is presented in the following table:

Test Boring Number	Total Depth (feet)	Depth to Bedrock (feet)	Depth to Mine (feet)	Collapsed	Partially Collapsed	Uncollapsed	Unmined
B-7	105	27	101	X			
B-8	90	44	86	X			
B-9	50	19	46	X			
B-12	157	8	152		3 ft void		
B-13	170	7	167.5	X			
B-14	75	17	--				X
B-15	75	21	--				X
B-18	80	19	70			10 ft void	
B-19	60	21	48		2 ft void		
B-20	87	18	84	X			
B-21	66	22.5	55			11 ft void	
B-22	70	33	--				X
B-23	86.5	22	76			10.5 ft void	
B-24	60	16	52.5			7.5 ft void	
B-25	87	43	85	X			
B-26	99	43	97	X			
B-27	87	45	78	X			
B-28	56	19	--				X
B-29	57	21	--				X

TEST BORING DESCRIPTIONS

Boring B-7

Boring B-7 was targeted to encounter the No. 9 Mine in an area of production mining (open mined-out rooms). Boring B-7 encountered Roslyn formation bedrock at a depth of about 27 feet. Soils overlying the bedrock consisted of sand with variable amounts of silt and gravel (outwash). No ground water was observed in the overburden soils. However, the soils were wet, but did not appear to be saturated, from a depth of about 13 feet to 27 feet.

Bedrock overlying the Big Seam consisted of siltstone and shale. At a depth of about 82.5 feet, the rock changed to carbonaceous shale (top of the Big Seam). The No. 9 Mine was completely collapsed at a depth of about 101 feet; no caved rock was encountered in the No. 9 Mine area based on the drill penetration rate and resistance. Sandstone was encountered underlying the Big Seam to the completion depth of 105 feet. No ground water was observed in the bedrock at the time of drilling Boring B-7.

Boring B-8

Boring B-8 was targeted to encounter the No. 9 Mine in an area of production mining (open mined-out rooms). Boring B-8 encountered Roslyn formation bedrock at a depth of about 44 feet. Soils overlying the bedrock consisted of sand and gravel with variable amounts of silt (outwash). No ground water was observed in the overburden soils. However, the soils were wet, but did not appear to be saturated, from a depth of about 22 feet to 44 feet.

Bedrock overlying the Big Seam consisted of siltstone and shale. At a depth of about 67.5 feet, the rock changed to carbonaceous shale (top of the Big Seam). The No. 9 Mine was completely collapsed at a depth of about 86 feet; no caved rock was encountered in the No. 9 Mine area based on the drill penetration rate and resistance. Sandstone was encountered underlying the Big Seam to the completion depth of 90 feet. No ground water was observed in the bedrock at the time of drilling Boring B-8.

Boring B-9

Boring B-9 was targeted to encounter the No. 9 Mine in an area of production mining (open mined-out rooms). Boring B-9 encountered Roslyn formation bedrock at a depth of about 19 feet. Soils overlying the bedrock consisted of sand and gravel with variable amounts of silt (outwash). No ground water was observed in the overburden soils. However, the soils were wet, but did not appear to be saturated, from a depth of about 18 feet to 19 feet.

Bedrock overlying the Big Seam consisted of carbonaceous shale. At a depth of about 23 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). The No. 9 Mine was completely collapsed at a depth of about 46 feet; no caved rock was encountered in the No. 9 Mine area based on the drill penetration rate and resistance. Sandstone was encountered underlying the Big Seam to the completion depth of 50 feet. No ground water was observed in the bedrock at the time of drilling Boring B-9.

Boring B-12

Boring B-12 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-12 encountered Roslyn formation bedrock at a depth of about 8 feet. Soils overlying the bedrock consisted of silt, sandy silt and silty fine sand (loess and weathered bedrock).

Bedrock overlying the Big Seam consisted of sandstone, carbonaceous shale and shale. At a depth of about 142 feet, the rock changed to coal (top of the Big Seam). The No. 9 Mine was partially collapsed resulting in a remnant mine opening (void) from a depth of about 152 feet to 155 feet. A complete loss of drilling fluid circulation was encountered at a depth of 152 feet, also indicating the existence of a void. Based on drilling resistance, it appears that a portion of the mined-out area was filled with loose caved rock from a depth of about 155 feet to 157 feet. Also, based on drilling resistance, it appears that the sandstone that typically forms the floor of the No. 9 Mine was encountered at a depth of about 157 feet.

It was not possible to evaluate for the presence of ground water in Boring B-12 because water was used as the primary means to remove drill cuttings (mud-rotary drilling method).

Boring B-13

Boring B-13 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-13 encountered Roslyn formation bedrock at a depth of about 7 feet. Soils overlying the bedrock consisted of silt with a trace of sand and organic matter and silty fine sand with a trace of gravel (loess and weathered bedrock).

Bedrock overlying the Big Seam consisted of sandstone, carbonaceous shale and shale. At a depth of about 142 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). Within the bedrock overlying the Big Seam, a zone of highly-fractured sandstone was encountered at a depth of about 46 feet to 52 feet. During the drilling through this zone, a partial loss of drilling fluid circulation was encountered indicating that the fractures are somewhat open. Similar highly-fractured bedrock conditions resulting in a partial loss of drilling fluid circulation was also encountered at a depth of 136 to 145 feet. Complete loss of drilling fluid circulation was encountered at a depth of 140 feet, but was reestablished by a depth of 145 feet. Drilling fluid circulation was again partially lost from a depth of 153.5 to 170 feet. The No. 9 Mine area was encountered at a depth of about 167.5 feet and was fully collapsed. However, the previously described highly-fractured bedrock that overlies the mine is indicative that the bedrock materials over the mine have caved, resulting in the fractured bedrock; however, no open voids were encountered. Sandstone was encountered from about 167.5 feet to the completion depth of about 170 feet.

It was not possible to evaluate for the presence of ground water because water was used as the primary means to remove drill cuttings (mud-rotary drilling method).

Boring B-14

Boring B-14 was targeted to encounter the Big Seam (mine area) in an area that had not been mined (coal seam intact). Boring B-14 encountered Roslyn formation bedrock at a depth of about 17 feet. Soils overlying the bedrock consisted of silty sand with variable amounts to gravel and silt with a trace of sand (outwash). No ground water was observed in the overburden soils at the time of drilling Boring B-14.

Bedrock overlying the Big Seam consisted of siltstone and shale. At a depth of about 37 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). Intact coal (unmined Big Seam) was encountered from a depth of about 52 feet to 58 feet (the No. 9 Mine does not exist in this area). Sandstone was encountered underlying the Big Seam to the completion depth of 75 feet. No ground water was observed in the bedrock at the time of drilling Boring B-14.

Boring B-15

Boring B-15 was targeted to encounter the Big Seam (mine area) in an area that had not been mined (coal seam intact). Boring B-15 encountered Roslyn formation bedrock at a depth of about 21 feet. Soils overlying the bedrock consisted of sand with variable amounts of silt and gravel and silt with variable amounts of sand (outwash). A thin (2-foot-thick) layer of mine rock fill (silt with sand, coal and brick fragments) mantles the ground surface. No ground water was observed in the overburden soils at the time of drilling Boring B-15.

Bedrock overlying the Big Seam consisted of siltstone and shale. At a depth of about 39 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). Intact coal (unmined Big Seam) was encountered from a depth of about 56 feet to 63 feet (the No. 9 Mine does not exist in this area). Sandstone was encountered underlying the Big Seam to the completion depth of 75 feet. No ground water was observed in the bedrock at the time of drilling Boring B-15.

Boring B-18

Boring B-18 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-18 encountered Roslyn formation bedrock at a depth of about 19 feet. Soils overlying the bedrock consisted of silty sand with gravel and occasional cobbles (outwash). Ground water was observed at a depth of 18 to 19 feet in the overburden soils at the time of drilling Boring B-18.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 60 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). A complete loss of drilling fluid circulation was encountered at a depth of 70 feet where the No. 9 Mine was encountered. The No. 9 Mine was uncollapsed as indicated by a 10-foot-thick void extending from 70 to 80 feet, the completion depth of the boring. No ground water was observed in the bedrock at the time of drilling Boring B-18.

Boring B-19

Boring B-19 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-19 encountered Roslyn formation bedrock at a depth of about 21 feet. Soils overlying the bedrock consisted of silty sand with gravel and occasional cobbles (outwash). No ground water was observed in the overburden soils at the time of drilling Boring B-19.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 37.5 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). A complete loss of drilling fluid circulation was encountered at a depth of 48 feet where the No. 9 Mine was encountered. The No. 9 Mine was partially collapsed as indicated by a 2-foot-thick void extending from 48 to 50 feet. Drilling continued in intact rock (likely sandstone) to the completion depth of 60 feet. No ground water was observed in the bedrock at the time of drilling Boring B-19.

Boring B-20

Boring B-20 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-20 encountered Roslyn formation bedrock at a depth of about 18 feet. Soils overlying the bedrock consisted of silty sand with gravel and occasional cobbles (outwash). No ground water was observed in the overburden soils at the time of drilling Boring B-20.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 68 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). The fully-collapsed zone of the No. 9 Mine was encountered at a depth of about 84 feet. Sandstone was encountered underlying the Big Seam to the completion depth of 87 feet. No ground water was observed in the bedrock at the time of drilling Boring B-20.

Boring B-21

Boring B-21 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-21 encountered Roslyn formation bedrock at a depth of about 22.5 feet. Soils overlying the bedrock consisted of silty sand with gravel and occasional cobbles (outwash). No ground water was observed in the overburden soils at the time of drilling Boring B-21.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 48.5 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). A complete loss of drilling fluid circulation was encountered at a depth of 55 feet where the No. 9 Mine was encountered. The No. 9 Mine was uncollapsed as indicated by an 11-foot-thick void extending from 55 to 66 feet, the completion depth of the boring. No ground water was observed in the bedrock at the time of drilling Boring B-21.

Boring B-22

Boring B-22 was targeted to encounter the Big Seam (mine area) in an area that had not been mined (coal seam intact). Boring B-22 encountered Roslyn formation bedrock at a depth of about 33 feet. Soils overlying the bedrock consisted of silty sand with gravel and occasional cobbles (outwash). No ground water was observed in the overburden soils at the time of drilling Boring B-22.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 48 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). Intact coal (unmined Big Seam) was encountered from a depth of about 63 feet to 69 feet (the No. 9 Mine does not exist in this area). Sandstone was encountered underlying the Big Seam to the completion depth of 70 feet. No ground water was observed in the bedrock at the time of drilling Boring B-22.

Boring B-23

Boring B-23 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-23 encountered Roslyn formation bedrock at a depth of about 22 feet. Soils overlying the bedrock consisted of silty sand with gravel and occasional cobbles (outwash). No ground water was observed in the overburden soils at the time of drilling Boring B-23.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 67 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). A complete loss of drilling fluid circulation was encountered at a depth of 76 feet where the No. 9 Mine was encountered. The No. 9 Mine was uncollapsed as indicated by a 10.5-foot-thick void extending from 76 to 86.5 feet, the completion depth of the boring. No ground water was observed in the bedrock at the time of drilling Boring B-23.

Boring B-24

Boring B-24 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-24 encountered Roslyn formation bedrock at a depth of about 16 feet. Soils overlying the bedrock consisted of silty gravel with sand and cobbles (outwash). Ground water was observed at a depth of about 9 feet at the time of drilling Boring B-24.

Bedrock overlying the Big Seam consisted of siltstone, shale and a thin layer of coal. At a depth of about 43 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). A complete loss of drilling fluid circulation was encountered at a depth of 52.5 feet where the No. 9 Mine was encountered. The No. 9 Mine was uncollapsed as indicated by a 7.5-foot-thick void extending from 52.5 to 60 feet, the completion depth of the boring. No ground water was observed in the bedrock at the time of drilling Boring B-24.

Boring B-25

Boring B-25 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-25 encountered Roslyn formation bedrock at a depth of about 43 feet. Soils overlying the bedrock consisted of silty gravel with sand and cobbles (outwash). No ground water was observed in the overburden soils. However, the soils were wet, but did not appear to be saturated, from a depth of about 20 to 43 feet.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 70 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). The fully-collapsed zone of the No. 9 Mine was encountered at a depth of about 85 feet. Sandstone was encountered underlying the Big Seam to the completion depth of 87 feet. No ground water was observed in the bedrock at the time of drilling Boring B-25.

Boring B-26

Boring B-26 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-26 encountered Roslyn formation bedrock at a depth of about 43 feet. Soils overlying the bedrock consisted of a surficial (3 foot thick) layer of silty fine sand (loess) underlain by silty gravel with sand and cobbles (outwash). No ground water was observed in the overburden soils. However, the soils were wet, but did not appear to be saturated, from a depth of about 30 to 43 feet.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 79 feet, the rock changed to carbonaceous shale (top of the Big Seam). The fully-collapsed zone of the No. 9 Mine was encountered at a depth of about 97 feet. Siltstone was encountered underlying the Big Seam to the completion depth of 99 feet. No ground water was observed in the bedrock at the time of drilling Boring B-26.

Boring B-27

Boring B-27 was targeted to encounter the No. 9 Mine in an area of production mining. Boring B-27 encountered Roslyn formation bedrock at a depth of about 45 feet. Soils overlying the bedrock consisted of silty gravel with sand and cobbles (outwash) to a depth of about 39.5 feet underlain by silty sand (outwash) to a depth of about 45 feet. No ground water was observed in the overburden soils. However, the soils were wet, but did not appear to be saturated, from a depth of about 30 to 45 feet.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 62 feet, the rock changed to carbonaceous shale with thin layers of coal (top of the Big Seam). The fully-collapsed zone of the No. 9 Mine was encountered at a depth of about 78 feet. Sandstone was encountered underlying the Big Seam to the completion depth of 87 feet. No ground water was observed in the bedrock at the time of drilling Boring B-27.

Boring B-28

Boring B-28 was targeted to encounter the Big Seam (mine area) in an area that had not been mined (coal seam intact). Boring B-28 encountered Roslyn formation bedrock at a depth of about 19 feet. Soils overlying the bedrock consisted of silty gravel with sand and cobbles (outwash) to a depth of about 12 feet underlain by silty sand (outwash) to a depth of about 19 feet. No ground water was observed in the overburden soils. However, the soils were wet, but did not appear to be saturated, from a depth of about 6 to 19 feet.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 36 feet, the rock changed to carbonaceous shale with thin layers of siltstone (top of the Big Seam). Intact coal (unmined Big Seam) was encountered from a depth of about 49 to 55 feet (the No. 9 Mine does not exist in this area). Sandstone was encountered underlying the Big Seam to the completion depth of 56 feet. No ground water was observed in the bedrock at the time of drilling Boring B-28.

Boring B-29

Boring B-29 was targeted to encounter the Big Seam (mine area) in an area that had not been mined (coal seam intact). Boring B-29 encountered Roslyn formation bedrock at a depth of about 21 feet. Soils overlying the bedrock consisted of gravel with variable amounts of silt, sand and cobbles (outwash) and silty sand (outwash) to a depth of about 21 feet. No ground water was observed in the overburden soils. However, the soils were wet, but did not appear to be saturated, from a depth of about 10 to 21 feet.

Bedrock overlying the Big Seam consisted of siltstone. At a depth of about 37.5 feet, the rock changed to carbonaceous shale (top of the Big Seam). Intact coal (unmined Big Seam) was encountered from a depth of about 37.5 to 55 feet (the No. 9 Mine does not exist in this area). Sandstone was encountered underlying the Big Seam to the completion depth of 57 feet. No ground water was observed in the bedrock at the time of drilling Boring B-29.

CONCLUSIONS

Based on our review of available information, ground proofing and analysis of coal mine hazards in the Rope Rider Ridge area, we have developed the following findings:

- Based on the results of the ground proofing program (2000, 2004, October 2006 and current study), we conclude that the historic mine maps are accurate to within 5 feet (lateral and vertical) in this area.
- The primary borings for this evaluation within the proposed residential development area included Borings B-19, B-22, and B-24 through B-29. The remaining borings (Borings B-7, B-8, B-9, B-12 through B-15, B-18, B-20, B-21 and B-23 were completed adjacent to the proposed residential development area, but were used to supplement our evaluation of the potential coal mine hazards.
- A substantial thickness (more than 100 feet) of overburden soil and bedrock occurs between the No. 9 Mine and the ground surface in the northwest portion of the proposed residential development area as shown on Figure 7. The overburden soil and bedrock thin (50 to 100 feet) to the east and southeast to a degree where sinkhole potential is a concern. However, Borings B-25, B-26 and B-27 encountered collapsed conditions at the level (85, 97 and 78 feet, respectively) of the No. 9 Mine.
- Borings B-22, B-28 and B-29, located in the central portion of the proposed residential development area, encountered intact coal (unmined Big Seam) in the areas shown on the historic mine maps where pillars of coal were left in-place. The purpose of these borings was to ground proof that the pillars of coal were in-place and not mined.
- Borings B-19 and B-24, located in the southeast portion of the proposed residential development area, encountered partially collapsed (2-foot void in Boring B-19) and uncollapsed (7.5-foot void in Boring B-24) conditions at the level (48 feet and 52.5 feet, respectively) of the No. 9 Mine.

RECOMMENDATIONS

- In our opinion, the northwestern, central and far southeast portions of the proposed residential development area are underlain by the No. 9 Mine that is substantially collapsed or is unmined (in-place coal pillars) such that this area could be reclassified as either a Declassified Coal Mine Area with Mitigation or as a Declassified Coal Mine Area as shown on the Coal Mine Hazards Map, Figure 8.
- The southeastern portion of the proposed residential development area should be classified as a High Risk Sinkhole Hazard Area as shown on Figure 8.
- An access road may cross the High Risk Sinkhole Hazard Area, provided that the community is aware that this road may be damaged in the future by the formation of the sinkhole. Underground utilities should be routed outside of High Risk Sinkhole Hazard Areas. ICE should be contacted if a sinkhole forms in this area for evaluation of repair. Typically, sinkhole damage to roads can be repaired by backfilling the sinkhole feature, should it occur.
- Portions of the north edge of the proposed residential development area remain as a Moderate Risk Coal Mine Hazard Area. These areas are in sloping areas and are somewhat removed from the test borings completed for this study.

MITIGATION

Conceptual mitigation measures for structures, roads and utilities within the Declassified Coal Mine Area with Mitigation should include the following:

- Use of rigid foundations (conventional reinforced concrete spread footings) supporting a flexible superstructure (metal or wood-frame).
- Concrete slab-on-grade construction should use "rebar" rather than wire mess for added strength.
- No brick or rock construction other than for fireplaces, nonstructural facades or landscape features.

USE OF THIS REPORT

We have prepared this report for Suncadia, LLC and their architects and engineers for use in design of a portion of this project. The data and report should be provided to prospective contractors for their bidding or estimating purposes, but our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

When the design has been finalized, we recommend that the final design and specifications be reviewed by our firm to see that our recommendations have been interpreted and implemented as intended.

There are possible variations in subsurface conditions between the locations of the explorations and also with time. A contingency for unanticipated conditions should be included in the project budget and schedule. We recommend that our firm be retained to provide sufficient monitoring, testing and consultation during construction to evaluate whether the conditions encountered are consistent with those indicated by the explorations and to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranties or other conditions, express or implied, should be understood.

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We trust this report meets your present needs. Please call if you have any questions concerning our coal mine hazard assessment of the proposed Rope Rider Ridge residential development area.

Yours very truly,
Icicle Creek Engineers, Inc.

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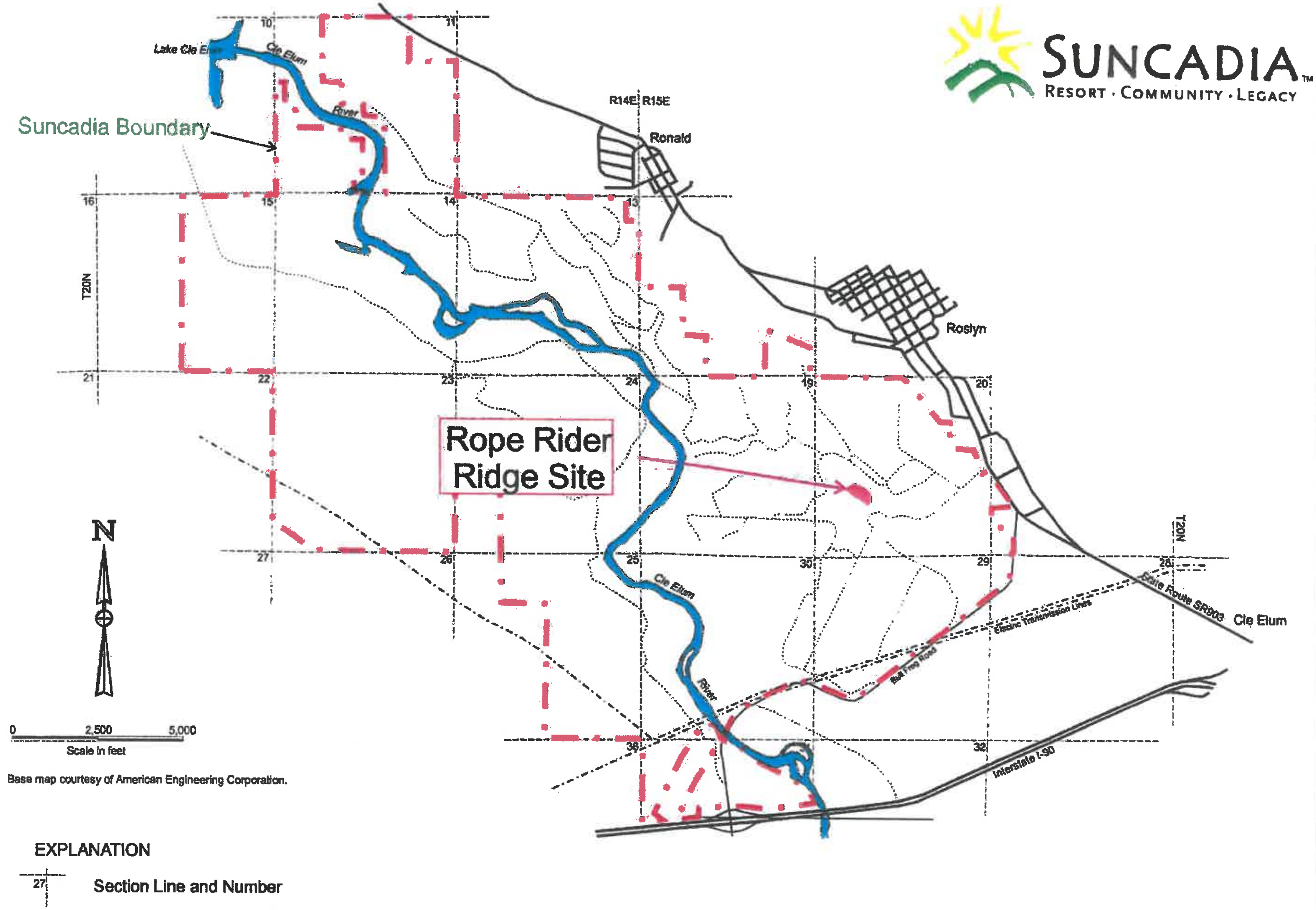
FIGURES

ICE File No. 0523-027

BRB:01/12/07



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Vicinity Map - Figure 1

Explanation

- Short Iron Range Parcel
- Proposed Rope Rider Ridge Residential Development Area

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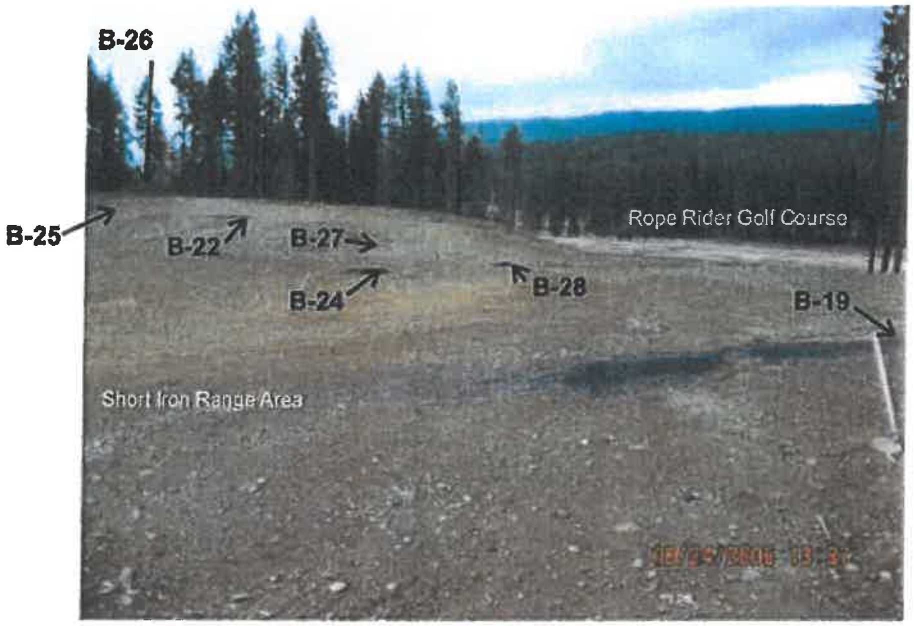

View looking northwest across the proposed residential development area with the test boring locations (October 24, 2006)

View looking northwest across the proposed residential development area and the slope/Rope Rider Golf Course to the northeast (October 24, 2006)

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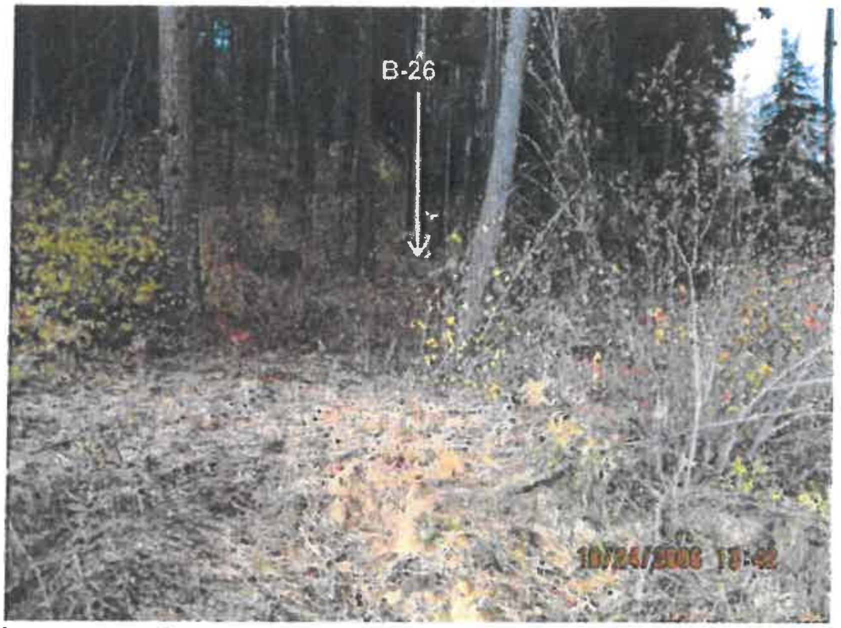

View looking west at the west end of the proposed residential development area
(October 24, 2006)

View looking northwest at the west end of the proposed residential development area along the slope/Rope Rider Golf Course area
(October 24, 2006)

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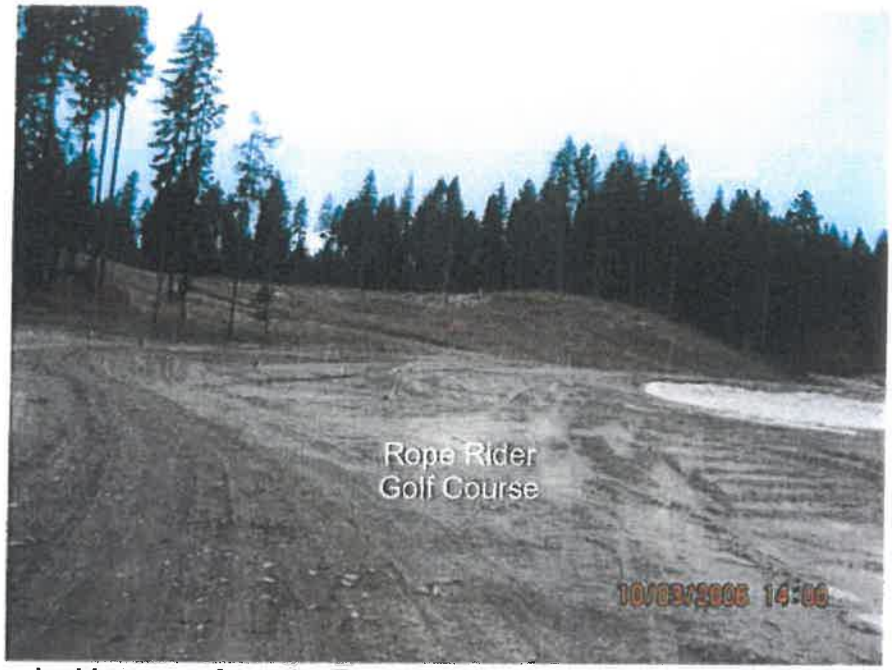
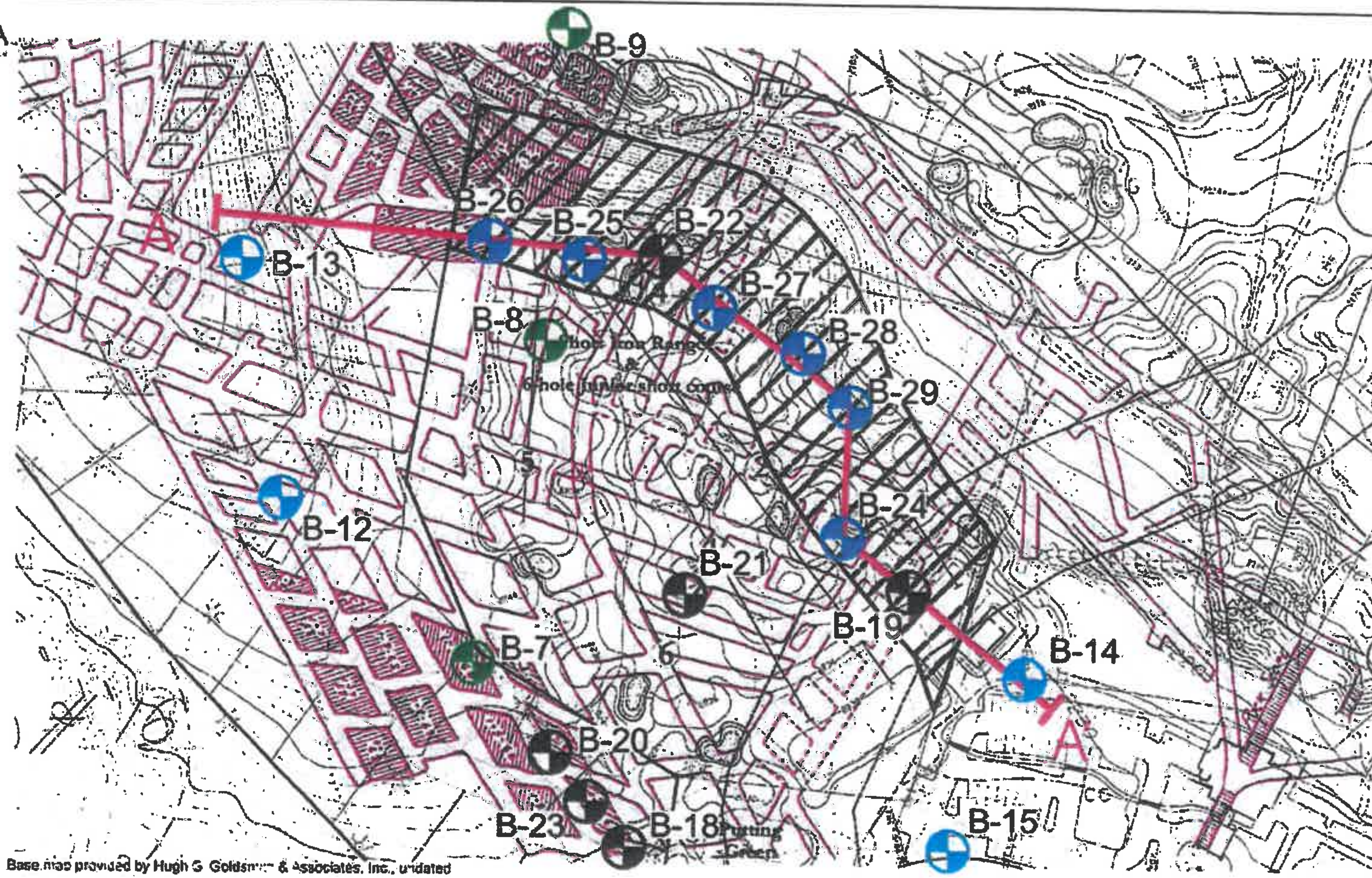


View looking west from the Rope Rider Golf Course at the hillside that borders the proposed residential development area
(October 24, 2006)

View looking southeast from the Rope Rider Golf Course at the hillside that borders the proposed residential development area
(October 24, 2006)

BRB:01/12/07



Explanation

- B-25 Boring Location (2006b) (current study)
- B-18 Boring Location (2006a)
- B-12 Boring Location (2004)
- B-7 Boring Location (2000)

No. 9 Mine Workings (in purple)

A — A' Location of Geologic Cross-Section (see Figure 7)

Proposed Rope Rider Ridge Residential Development Area

0 200 400
Scale in Feet

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Abandoned Underground Coal Mine Map - Figure 6