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Attn: Mr. Shaun Parsons

Preliminary Geological Investigation
Qualified Person's Review &
Technical Report
Meridian Extraction Area
Sec 7 and 18 T27N R1E &
Sec 12 and 13 T27N R1W WM.
Hood Canal & Coyle Peninsula Area
Jefferson County, Washington
Job No: AthabascaMin.FredHill.RG

1.0 SUMMARY

The subject property area of this evaluation has been designated the Meridian Extraction Area. The subject property is located in the Hood Canal and Coyle Peninsula area of Jefferson County in Western Washington, USA. The approximate location of the site with the surrounding area is illustrated on the Vicinity Maps, Figures 1a, 1b and 1c. The Meridian Extraction Area encompasses approximately 525 acres that is situated within a 690 acre designated Mineral Resource Overlay area (MRL). These are in turn located within and surrounded by an approximate 21,000 acre commercial tree farm that is owned and operated by Pope Resources. The MRL and Meridian Extraction Area and surrounding tree farm area are illustrated on Figure 1c and the Aerial Map (photograph) of the area, Figure 2a.

The Meridian Extraction area is generally located in Sections 7 and 18 of T27N R1E and Sections 12 and 13 of T27N R1W of the Willamette Meridian. The proposed Meridian Extraction area is situated within a generally north-south trending glacial outwash channel complex. The identified aggregate resources of this area were deposited by glacial meltwaters that flowed south-southwest from the Vashon glacial ice in the series of glacial outwash channels between approximately 10,000 15,000 years ago.

Exploration of the aggregate resources in this and the surrounding area has included over one hundred trackhoe test pits (up to 35 feet in depth) and several series of drilling that utilized conventional air rotary equipment. A total of twenty-three borings have been completed to date in the general area, four recently for the purpose of preparing this document. Eleven of the borings were completed within or immediately adjacent to the Meridian Extraction area.

Six-inch steel casings were utilized to complete the borings, and remain in place to be

utilized as groundwater observations wells (piezometers). The recent drilling program (four borings) was completed to verify the aggregate resources within the Meridian Extraction Area and prepare this report. Grab samples were collected from the test pits. Samples were collected on a continuous basis from all twenty-three of the borings completed in the area. Soil samples were selectively tested for grain size distribution, LA Abrasion, Fractured Face, and hydrometer (fine fraction).

For purposes of clarity, we have differentiated the aggregate resources in the Meridian Extraction Area as Resources A through D. These designations are generally based on the depositional environments of the materials. All of the resource materials were deposited by glacial activity. From oldest to youngest, these include the advance outwash sand (Resource D), the advance outwash sand and gravel (Resource C), sandy glacial till (Resource B), and recessional outwash (Resource A). Within the Meridian Extraction area, the recessional outwash material, Resource A, is thin and discontinuous, and was therefore combined with Resource B for the purpose of reserve computations. Within the Puget Sound area, the Vashon glacial till typically consists of silty sand with gravel, cobbles and occasional boulders, and is a common aggregate resource material. Resource C consists of the advance outwash sand and gravel material which grades relatively rapidly to advance outwash sand. The deeper advance sand is identified as Resource D. Where Resource D is below the water table, it is designated as Resource D wet.

The site and surrounding area is primarily commercial forest land. Localized areas of single-family residential and shoreline property occur in the region, but are several miles from the subject site. There are several shallow lakes and wetlands in the general area. Thorndyke Creek, a seasonal fish bearing creek, is located west of the Meridian Extraction Area. A minimum 500 foot vegetated buffer will separate the mine area from the creek. The groundwater resources that underlie the site are considered a local resource that recharges the lower portion of Thorndyke Creek. Deeper underlying regional aquifers are in a confined condition below a thick silt/clay unit.

A summary of our services, as well as data presentation, preliminary conclusions and recommendations, are presented below:

Conclusions and Recommendations

- Based on published geological data and multiple subsurface explorations programs, the subject property and surrounding area have been identified as a long term economic aggregate resource.
- The subject Meridian Extraction Area is located within a larger aggregate resource area identified as a long term mineral resource area, a Mineral Resource Overlay area or MRL per the 1990 Growth Management Act and the 2001 Jefferson County Unified Development Code (UDC).
- Identification of the Meridian Extraction aggregate resource area included over one hundred test pits and nineteen borings.
- Four additional confirmatory borings were completed for this evaluation.
- Six inch observation wells or piezometers were installed in each boring.

- Subsurface data collected from the area has established the approximate depth, thickness, and extent of the aggregate resources.
- Previous work at the subject site and surrounding area included hydrogeological studies, which were utilized in preparation of this evaluation and report.
- Based on the exploration data, the Meridian Extraction Area aggregate resource quantity is approximately 150 million cubic yards (240 million tons).
- Mine and process losses using a cut-slope reclamation process reduce the resource quantity to approximately 112 million cubic yards (179 million tons) of aggregate product. It should be noted that the underlying property owner also owns the adjacent area, allowing for expansions.
- Laboratory analyses of the collected soil samples, in conjunction with the previous explorations/lab test results in the area, determined the aggregate resources are of commercial quality and can be utilized to produce select aggregate products for construction materials and projects.
- Although deeper portions of the aggregate deposit function as a local aquifer that recharges a nearby stream (Thorndyke Creek), mining is not proposed to extend to or below the water table. Washington State regulations specify a minimum 5-foot separation above the seasonal high level of the aquifer zone.
- Mining may occur below the water table based on the results of a site-specific evaluation submitted and approved by Jefferson County and WDOE.
- No down-gradient potable resource or water wells remove water from this aquifer.
- Aggregate resource extraction is occurring in other portions of the project area's gravel resource.
- Athabasca Minerals Inc.'s management team has a proven track record of well managed pit operations, acknowledged by receiving the Alberta Sand and Gravel Association's award for having the "best operated pit on public land" (three times).
- Similarly, Fred Hill Materials has a proven track record of operating in conformance with regulatory guidelines and has been identified by Washington State Department of Natural Resources (Geology Division) as having a model reclamation program.
- Athabasca Minerals Inc. and Fred Hill Materials will work with the community, Jefferson County and Washington State regulatory agencies to develop the site resources in an environmentally responsible way, and in accordance with the appropriate regulations and Best Management Practices (BMP's).
- Development potential of the adjoining and/or surrounding area was considered, but not included, in this evaluation.

2.0 INTRODUCTION AND TERMS OF REFERENCE

2.1 Introduction

GeoResources LLC was retained by Athabasca Minerals Inc. to prepare an independent *Qualified Person's Review and Technical Report* for the Meridian Extraction Area at the Fred Hills/Pope Resources property in Western Washington State. This report is in general conformance with the format and content required by Form 43 – 101F1, Technical Report as outlined in the Canadian Securities Administrators, National Instrument 43-101; *Standards of Disclosure for Mineral Projects*,

We understand that Athabasca Minerals, Inc has signed a "Letter of Intent" with T-ROC to operate the Meridian Extraction mine and process areas, and export the aggregate products. The aggregate resources mined at the site will be processed into select products that will be exported from the site. The current plan is to export the material via an overland conveyor system to an off-shore loading facility in Puget Sound. The completed mine area will be incrementally reclaimed back to commercial forest land for continued timber production.

Bradley P. Biggerstaff, LG/LEG/LHG (Licensed Geologist, Engineering Geologist, and Hydrogeologist) has extensive knowledge and experience regarding aggregate resources in the project region, as well as specific knowledge and experience of the Meridian Extraction Area. Recently, Mr. Biggerstaff conducted additional geologic reconnaissance of the proposed Meridian Extraction area and monitored the completion of four additional deep borings to verify subsurface conditions at the site. The additional borings were completed to verify previous drilling/sampling results in the area, and develop additional information to be utilized for this report. Previous laboratory test results were reviewed, and additional resource testing was completed on the new boring samples collected.

Mineral aggregate resources (sand and gravel) are traditionally the largest consumed mineral resource, with the rate of consumption driven by development trends and ongoing maintenance of existing infrastructure. The active economies of Western Washington, the United States, Canada and the world continue to grow, which require a continuous supply of construction materials, including aggregate resources. Numerous publications, both industry and governmental, predict continued growth for the aggregate resource industry. Aggregate resource producers are facing the daunting and escalating challenge to secure mineral reserves that are economically accessible, mineable, and permitable relative to conflicting land use, conservation designations, environmental constraints, public opposition, and an increasing complex regulatory climate. With many existing mining operations nearing depletion, exploration for new sources provides an opportunity for those with the expertise, vision, determination and finances to see the process through.

Like most areas, public opposition to mining activity, in particular the aggregate industry, has resulted in increased development/permit time and expenses. Similar to Ontario's *Aggregate Resources Act* (1990), Washington State developed the Mineral Resource Overlay designation (Growth Management Act, 1990) that is applied over the existing zoning designation and provides notification that the area has been determined to be a potential mineral resource area for active and/or future development. The

Meridian/Wahl MRL area provides this designation. Fred Hill Materials and Pope Resources continue to work towards expanding the Mineral Resource Area designation for the Thorndyke area.

2.2 Terms of Reference

Exploration Information: geological, geophysical, geochemical, sampling, drilling, trenching, analytical testing, assaying, mineralogical, metallurgical and other similar information concerning a particular property that is derived from activities undertaken to locate, investigate, define or delineate a mineral prospect or mineral deposit.

It is recognized that in the review and compilation of data on a project or property, previous or historical estimates of tonnage and grade, not meeting the minimum requirement for classification as Mineral Resource, may be encountered. If a Qualified Person reports Exploration Information in the form of tonnage and grade, it must be clearly stated that these estimates are conceptual or order of magnitude and that they do not meet the criteria of a Mineral Resource.

Mineral Resource: a concentration or occurrence of material of intrinsic economic interest in or on the Earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge. Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories.

Inferred Mineral Resource: that part of a Mineral Resource for which tonnage, grade and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological and/or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes which may be limited or of uncertain quality and reliability.

Indicated Mineral Resource: that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a reasonable level of confidence. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are too widely or inappropriately spaced to confirm geological and/or grade continuity but are spaced closely enough for continuity to be assumed.

Measured Mineral Resource: that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence. It is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are spaced closely enough to confirm geological and grade continuity.

Ore Reserve: the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur

when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction could reasonably be justified. Ore Reserves are sub-divided in order of increasing confidence into Probable Ore Reserves and Proved Ore Reserves.

Probable Ore Reserve: the economically mineable part of an Indicated, and in some circumstances, a Measured Mineral Resource. It includes diluting materials and allowances for losses which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction could reasonably be justified.

Proved Ore Reserve: the economically mineable part of a Measured Mineral Resource. It includes diluting materials and allowances for losses which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction could reasonably be justified.

Preliminary Feasibility Study

The CIM (Canadian Institute of Mining) Definition Standards requires the completion of a Preliminary Feasibility Study as the minimum prerequisite for the conversion of Mineral Resources to Mineral Reserves. A Preliminary Feasibility Study is a comprehensive study of the viability of a mineral project that has advanced to a stage where the mining method, in the case of underground mining, or the pit configuration, in the case of an open pit, has been established and an effective method of mineral processing has been determined, and includes a financial analysis based on reasonable assumptions of technical, engineering, legal, operating, economic, social, and environmental factors and the evaluation of other relevant factors which are sufficient for a Qualified Person, acting reasonably, to determine if all or part of the Mineral Resource may be classified as a Mineral Reserve.

2.3 Resource OR Reserve Classification – Additional Discussion

Technical Reports dealing with estimates of Mineral Resources and Mineral Reserves use specific terms and the definitions contained herein. Table 1 below displays the relationship between the Mineral Resource and Mineral Reserve categories.

The Canadian CIM Definition Standards provide for a direct relationship between Indicated Mineral Resources and Probable Mineral Reserves and between Measured Mineral Resources and Proven Mineral Reserves. In other words, the level of geoscientific confidence for Probable Mineral Reserves is the same as that required for the in situ determination of Indicated Mineral Resources and for Proven Mineral Reserves is the same as that required for the in situ determination of Measured Mineral Resources.

Table 1 sets out the framework for classifying tonnage and grade estimates so as to reflect different levels of geological confidence and different degrees of technical and economic evaluation. Mineral Resources can be estimated by a Qualified Person, with input from persons in other disciplines, as necessary, on the basis of geoscientific information and reasonable assumptions of technical and economic factors likely to influence the prospect of economic extraction. Mineral Reserves, which are a modified sub-set of the Indicated and Measured Mineral Resources (shown within the dashed outline in Table 1), require consideration of factors affecting profitable extraction, including mining, processing, metallurgical, economic, marketing, legal, environmental, socio-economic and governmental factors, and should be estimated with input from a range of disciplines. Additional test work, e.g. metallurgy, mining, environmental is required to reclassify a resource as a reserve.

In certain situations, Measured Mineral Resources could convert to Probable Mineral Reserves because of uncertainties associated with the modifying factors that are taken into account in the conversion from Mineral Resources to Mineral Reserves. This relationship is shown by the dashed arrow in Table 1 (although the trend of the dashed arrow includes a vertical component, it does not, in this instance, imply a reduction in the level of geological knowledge or confidence). In such a situation these modifying factors should be fully explained. Under no circumstances can Indicated Resources convert directly to Proven Reserves.

2.2.2 Aggregate Resources

Aggregate resources, consisting of "pit run" sand and gravel, processed select aggregates, and crushed rock, are required materials used by the construction industry in infrastructure development and maintenance (fill, concrete, asphalt, for roads, buildings, etc.). The Puget Sound's recent geologic history included the Vashon glacial period that resulted in numerous sand and gravel deposits distributed across the region. Local and State regulators in Washington recognized the importance of protecting those aggregate resources by developing Mineral Resource Areas and associated management strategies.

These natural sand and gravel resources have historically been used to meet the specifications for use in fill, concrete, asphalt, and other construction materials. The alternative resource, crushed stone produced from bedrock quarries, is typically a more costly option. In addition, there are specific design and performance elements of sand and gravel products that cannot be duplicated by crushed stone.

Sand and gravel deposits are typically deposited geologically by rapid surface water flows that transport and concentrate the material as deposits of varying extents and thicknesses. The sand and gravel deposition that occurred during the Vashon "Ice Age" are referred to as "glacial" deposits. The glacial deposits of the Puget Sound are known for their high quality attributes that meet or exceed construction material specifications. Where these natural deposits are concentrated into deposits with extensive reserves, they are highly desirable from an economic perspective. Typically, where the most economic aggregate resources have not been depleted, they are near urban areas and the ability to mine them is being increasingly restricted by land use/conservation

designations. Every increasing haul distances are the result of the present land management and public framework. It is considered a "Win – Win" for the operator and the public where large aggregate deposits are located in isolated areas with limited public surroundings, but with good transportation and market access.

The aggregate resources in the Thorndyke area, including the Meridian Extraction area, were deposited in outwash or stream channels by meltwaters from the Vashon glacial ice between approximately 10,000 and 15,000 years ago. Outwash channel deposits in the Puget Sound region are characteristically low in fine soil material and of high quality. The Washington State DNR has assessed the MRL (Thorndyke area) deposits and concluded the resource quantity and quality is a "valuable economic resource", and designated the area with a Mineral Resource Overlay. This was subsequently confirmed by Jefferson County.

2.2.3 Properties of Aggregate Resources

The construction industry relies on the sand and gravel (aggregate) resources to supply a number of products (concrete, asphalt, fill material) to match the requirements of clients who range from local and state agencies, private and commercial infrastructure developers, to individuals. Sand and gravel deposits vary in composition depending on the origin of the materials and depositional environment. Because of this, an aggregate deposit can vary in chemical and physical attributes within itself or when compared to other deposits. Sand and gravel deposits also vary in makeup relative to grain sizes and distributions, but can be separated and blended in different ratios to meet specifications for different products and projects. Generally, deposits that consist of chemically inert, physically hard minerals, and with a low percentage of fine material (material passing the US No. 200 Sieve size) will meet the specifications for most construction applications.

2.2.4 Aggregate Specifications and Testing

Glacial sand and gravel deposits in the Puget Sound area are considered high quality aggregate resources. Various laboratory tests are typically utilized to verify the quality or performance of the material. These tests typically include gradation (sieve) analysis, LA abrasion, soundness, density, absorption, and detection of deleterious materials. Laboratory tests for this evaluation were performed by Mayes Testing Services, a licensed and certified laboratory testing company. Select confirmatory tests were performed by GeoResources, LLC. Specific testing criteria and results are discussed in Section 13, "Sample Preparation and Analyses Results".

2.2.5 Other Mineral Values

Previous resource evaluations throughout the Puget Sound area have indicated that there are little or no other mineral resources included within the natural aggregate materials of the Vashon deposits. We expect that the gold and other precious or industrial minerals that occur in gravel deposits, are absent from the southern Puget Sound Vashon soils because of the distance the materials were transported from the sources.

3.0 DISCLAIMER

We have prepared this Preliminary Geological Investigation Report for use by Athabasca Minerals Inc. This report and the data are based on our review of published and unpublished documents and data, the available literature and geologic mapping, our observations of the surface and subsurface conditions observed, and the result of the recent borings and laboratory test results. Although variations in subsurface conditions are possible between the explorations, it is our opinion that the developed information and conclusions presented herein is accurate and reliable to the extent possible with the available data and our experience in the area.

The follow-up drill program, supervised by the author, builds on the previous test pit and drilling programs conducted by Pope Resources and Fred Hill Materials. The author previously worked with the underlying property owner in identifying and inventorying potential aggregate resources in the region. That information was provided to Fred Hill Materials. Based on the resources identified, the MRL area with the Wahl and Meridian Extraction areas. Jefferson County determined that an EIS (Environmental Impact Statement) was required for the project(s). Jefferson County retained GeoEngineers, Inc. to evaluate the potential environmental impacts of the prospects and the MRL in accordance with the county required process. The information is being utilized in the preparation of a Draft Environmental Impact Statement/ Environmental Impact Statement (DEIS/EIS).

The previous exploration programs established the preliminary extent, depths and quality of the aggregate resources. The recent drilling program (4 additional borings) was utilized to confirm and expand the subsurface information and quality data specifically for the Meridian Extraction Area.

The scope of our services does not include services related to environmental contamination and/or remediation. 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 this report was prepared. No other conditions, expressed or implied, should be understood.

4.0 PROPERTY DESCRIPTION AND LOCATON

4.1 Project Description

The Meridian Extraction Area consists of and is surrounded by commercial timberlands. The proposed mine area is 525 acres. The ground surface at the subject site and the surrounding area generally slopes to the west and south, with a gently sloping and rolling ground surface. The southwest corner of the site steepens to moderately sloping, 20 to 30 percent. The topography is lowest in the southwest, Elevation 200 (MSL), and highest in the east central area, Elevation 420. A topographic map of the site area is included as Figure 2c.

Vegetation at the site ranges from mature second growth timber to recently harvested and replanted areas. The forested areas have a moderate to dense understory of native grass and brush. Isolated small lakes and wetlands are located north and northeast of

the Meridian Extraction Area. The lakes in the general area include Lost Lake, Wahl Lake and Mud Lake. A local seasonal creek is located west of the site, Thorndyke Creek. The shoreline of the Puget Sound is located several miles to the east and south. The water resources that underlie the site are considered a local resource, specific to the seasonal recharge of Thorndyke Creek.

4.2 Location

The Meridian Extraction Area is located), is located in Sections 7 and 18 of Township 27 North Range 1 East and Sections 12 and 13 of Township 27 North Range 1 West of the Willamette Meridian, in the northeast portion of the Hood Canal Peninsula, western Washington State. See Figures 1a, 1b and 1c. The subject site is situated within and totally underlain by the Thorndyke Resource Area and the designated MRL. The boundaries of the Meridian Extraction Area were previously located by a licensed Professional Land Surveyor in Washington State. The property boundaries will be located and verified prior to mine activity. As previously noted, the Meridian Extraction Area is situated within a large commercial timber farm owned by the same owner, Pope Resources.

4.2 Approval and Agreement

The underlying landowner, Pope Resources, also owns and operates the surrounding area, approximately 21,000 acres, as a commercial tree farm. Mining has occurred on the property since the 1930s to supply small amounts of gravel for timber road construction and maintenance. The owner has and continues to operate gravel borrow pits on the site for timber road construction. Fred Hill Materials has operated the Shine aggregate production facility on an adjacent property to the east under a lease agreement since 1979. The owner has been active in the regulatory process for designation of the site area as an MRL, and in the procurement of the mining permits. Fred Hill Materials has maintained its lease agreement and expanded it to include the MRL and surrounding area. Athabasca Minerals Inc. has signed a "Letter of Intent" with Fred Hill Materials and the property owner for the Meridian Extraction Area. A royalty is paid to the underlying property owner for material exported from the site. The operators of the mining area are responsible for reclamation of the mine site.

Prior to mining activity, Site Development and any related development/environmental permits from Jefferson County, with the appropriate supporting documents, are required. In addition, Washington State DNR and DOE will require reclamation and stormwater management plans. Reclamation of the site will occur following mining of the aggregate resources, in accordance with Washington State DNR regulations. The current proposal is to reclaim and continue to operate the property as a commercial timber farm.

4.3 Area History

The Thorndyke Resource Block is a commercial forest area that was logged in the early 1900s, with most of the logging having taken place in the 1930s. After a significant forest fire in 1939, much of the forest area re-seeded naturally. Currently, the area is managed as commercial forestland with periodic logging of small acreage units and predominant replanting of Douglas fir. The Meridian Extraction Area is located within forestlands that have been generally logged within the past 15 years. Old tree stumps, small Douglas firs, forest brush, and shrubs dominate the landscape in areas that were recently logged. Mature second growth Douglas fir stands are located in the in east portion of the project area.

Mining of sand and gravel has occurred in small borrow pits for timber road construction since the early 1900s. Commercial mining began in the general area in 1959 at the Shine Pit to supply materials to build the west Jefferson County side revetment for the Hood Canal Bridge. Since that time, various operators have mined sand and gravel in the same vicinity and provided truck delivery of materials to the surrounding region. Several small borrow pits have continued to operate in the timber area for construction and maintenance of the timber roads.

In 1979, Fred Hill Materials took over operation of the Shine Pit and obtained a Surface Mine Reclamation Permit from the Washington State Department of Natural Resources (WSDNR). Since then, FHM has continuously operated that mining operation and processing facility.

In preparation of depleting the remaining sand and gravel resources at the existing Shine Pit, Fred Hill Materials worked with the property owner to submit a preliminary application for the 156-acre Wahl Extraction Area (located north of the Meridian Extraction Area) to WSDNR. Material from the Wahl Extraction Area will be transported via a overland conveyor system to the existing Shine processing facilities. Further exploration of the Thorndyke area also identified the Meridian Extraction Area aggregate resources, south of the Wahl site.

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, AND PHYSIOGRAPHY

5.1 Accessibility

The Meridian Extraction Area is located south of Washington State Highway SR 104. SR 104 is a two lane paved highway with paved shoulders and occasional center left-turn lanes. Between the Hood Canal Bridge (east of the site) and the main turn-off to Port Townsend (west of the site), there are several sections that the uphill road also includes paved passing lanes. A blinking caution/stop light is located at the entry to the Thorndyke timber farm and SR 19, which extends to the northwest towards Port Ludlow and Port Townsend, Washington.

The north entrance to the Pope Resources property at SR 104 is a controlled entry. As previously indicated, a blinking caution/stop light restricts entry onto SR 104 from the site. Once on the property, access to the Meridian Extraction Area is via an existing well-maintained gravel road system with entry control structures (steel gates). An extensive

network of gravel roads provide access to and within the site area. Many of the gravel roads are visible on the attached aerial photographs of the site area, Figures 2 and 3.

5.2 Climate

The Meridian Extraction Area is listed as having a Marine Temperate climate (Cfb) according to Koppen Climate Classification. Port Ludlow, Washington is the nearest community with historical weather data, which is collected at the Quilcene 2 SW Weather Station located approximately 25 miles from the site area. The proximity of the site and similar geographic, geologic, and meteorological conditions provide for similar meteorological conditions.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Max Temp (F)	45.0	50.1	55.8	61.3	67.1	71.8	77.4	78.6	73.2	62.0	50.5	44.2	61.4
Mean Temp (F)	38.0	41.4	45.3	49.8	55.2	59.7	64.0	64.6	59.5	50.8	42.6	37.8	50.7
Min Temp (F)	30.9	32.6	34.8	38.2	43.2	47.6	50.6	50.5	45.7	39.6	34.7	31.4	40.0
Precip (in)	7.39	7.38	5.93	3.81	2.82	2.13	1.29	1.24	1.60	4.13	7.99	8.65	54.36

(<http://www.idcide.com/weather/wa/quilcene.htm>)

5.3 Local Resources

Aggregate resources are essential to and are continually being consumed by rural and urban development and maintenance. Because large volumes of aggregate resources are required for the required maintenance and continued growth and development, traffic volumes (trucks), haul distances between the source and the market place, and increasing energy costs play significant roles in determining the potential impacts and profitability of each mining operation. Therefore, the location of a subject resource site must be assessed for its proximity to existing and potential future market demands relative to existing and/or other resource sites, as well as the potential impacts to the local environmental and social resources.

To accommodate a holistic view and an integrated and active resource management strategy for the area into the project, each resource sector can be assessed from the economic, environmental, and social perspectives. This report provides a preliminary assessment of these issues to establish the quantity and quality of the deposit and areas of opportunities/concern.

5.3.1.1 Mineral Resources

As described above, aggregate resources are an essential component to rural and urban development and maintenance. Based on the surface and subsurface conditions observed at the site, the quantity and quality of the aggregate material at the Meridian Extraction site are sufficient to be economically viable. The resource is situated in a commercial timber area. The current proposal is to export the material from the site via a conveyor and off-shore marine loading facility for transport. Therefore, there will be little or no impact to the traffic/road systems in the area. Environmental issues and considerations at the site and the potential loading facilities have been and are being addressed by a team of professionals in conjunction with local, County, State and Federal agencies.

Relative to other mineral resources in the area, Figure 2a illustrates other historic and active aggregate resource sites (sand and gravel or basalt quarry) in the area. The Thorndyke aggregate deposits compose an unusually large glacial outwash channel deposit in an area where aggregate resources have been historically scarce. Other than those aggregate deposits in the Thorndyke/Shine area, the closest other resources are located more than 1 hour away.

Current truck-based operations are expected to deplete the sand and gravel extraction area at the existing Shine Pit by 2012. The current plan is to supply the existing processing and asphalt plant with material excavated from the Wahl Extraction Area, north of the Meridian Extraction Area. The analysis of geological resources within the Thorndyke Block, combined with the public concern with the visual impacts of existing mining operations, led to proposed new extraction area. The Wahl Extraction Area is outside the public's general viewshed.

Other mineral resource potential that could impact the extraction area has not been fully inventoried, as far as we know. Natural gas and oil development has seen some limited activity in the region. Several hard rock quarries are located north of the property (see Figure 2a).

5.3.1.2 Water Resources

Surface water resources within the Meridian Extraction Area occur as local lakes, wetlands and a seasonal drainage area, Thorndyke Creek. The lakes in the project area include Lost Lake, Wahl Lake and Mud Lake. Thorndyke Creek is located southwest of the site, a minimum of 500 feet from the proposed mine site. The shoreline of the Puget Sound is located several miles to the east.

The groundwater resources that underlie the site are considered a local resource, specific to the recharge of Thorndyke Creek. Based on the exploration results and preliminary mine plan, the lower mining limits will be above the nearby channel bottom elevations of Thorndyke Creek. In addition, mining will not extend below the water table.

The seasonal water in the isolated lake and wetland areas is perched on localized layers of fine-grained soil (silty/clay) and organic debris that accumulated since the retreat of the Vashon glacial ice. These materials have a low permeability and perched surface water accumulates in these low-lying areas. These wetlands and lakes are not in direct continuity with the underlying aquifer systems. Mining will be setback from these surface

water areas, and although mining will be below the surface water levels, no changes in the surface water levels are expected, because of the perched condition.

Two deep aquifers have been identified in the region. Water supply wells in the region typically produce water from the lower of the two aquifers, or from even deeper pre-Vashon sediments like the Bridgehaven community. The upper aquifer encountered north of the Meridian Extraction site occurs within the Vashon outwash materials. Based on the water levels measured in the observation wells, groundwater flow of this aquifer is to the south. We expect that this aquifer provides spring flow along portions of Thorndyke Creek and the south shoreline Hood Canal (approximately Elevation 100).

The older pre-Vashon aquifer system encountered in the Thorndyke Mineral Resource area is overlain by an impermeable silt/clay layer (aquitar) and is therefore a confined aquifer. This is evidenced by water levels in OB-14 (located near Wahl Lake) and the Fred Hill process water well, which rose approximately 150 feet (artesian condition) after the wells were completed. This aquifer was not encountered in a deep well completed in the southeast portion of the TMR (Boring OB-18). The Bridgehaven wells are completed in an aquifer that is an additional 100 feet or more below the pre-Vashon aquifer in the site area.

5.3.1.3 Soil Resources

The Natural Resource Conservation Service Soil Survey for Jefferson County (Web site) indicates that the Meridian Extraction Area is underlain by a variety of soil types. A copy of the NRCS (Natural Resource Conservation Service – SCS) map and soil descriptions for the site area are included as Figures 3a and 3b. According to descriptions for the various soil types mapped in the area, the soil types include the following:

- Alderwood gravelly sandy loam (Alc): These soils are derived from glacial till and form on slopes of 0 to 15 percent under a mixed conifer and deciduous forest. The Alderwood soils are moderately well drained and have a very slowly permeable cemented layer at a typical depth of 20 to 40 inches. Elevation ranges from 100 to 800 feet.
- Dabob very gravelly sandy loam (DaC, DaD): The Dabod soils are moderately well drained, very gravelly soils that have a very slowly permeable cemented layer at a depth of 20 to 36 inches. These soils form on slopes of 0 to 15 and 15 to 30 percent, and on broad glacial terraces. Elevation ranges from 100 to 800 feet. The Dabob soils form under a coniferous-deciduous forest with vegetation primarily consisting of Douglas Fir, Western Hemlock, Willow, Madrone, Rhododendron, Salal and Evergreen Huckleberry.
- Everett gravelly sandy loam (EvC, EvD): These soils consist of somewhat excessively drained gravelly soils that are derived from glacial outwash. These soils form on slopes of 0 to 15 and 15 to 30 percent, and on steep escarpments at elevations that vary from sea level to about 500 feet. These soils typically form under Douglas Fir, Western Hemlock, Western Red Cedar, Rhododendron, Madrone, Salal, Huckleberry and Oregon Grape.

- Indianola loamy sand (InC): The Indianola soils typically consist of excessively well drained sand soils that are derived from glacial outwash. The soils typically form on slopes of 15 to 30 percent. These soils typically form under Douglas Fir, Western Hemlock, Western Red Cedar, Rhododendron, Madrone, Salal, Huckleberry and Oregon Grape.
- Sinclair gravelly sandy loam (SnC, SnD): The Sinclair series soils are moderately well drained soils that are derived from glacial till. These soils have a very slow permeability and are underlain by a cemented/indurate zone at a depth of 20 to 40 inches below original ground surfaces. These soils form on slopes of 0 to 15 and 15 to 30 percent respectively, under a mixed forest of Douglas Fir, Western Red Cedar, Red Alder, Willow, Rhododendron, and Salal.
- Swantown gravelly sandy loam (StB): These somewhat poorly drained gravelly soils form on slopes of 0 to 8 percent. Like the Sinclair soils, they have a very slowly permeability and a cemented layer at typical depths of 18 to 24 inches. The Swantown soils form on broad glacial uplands under a forest of Douglas Fir, Western Red Cedar, Maple, Alder, and Willow.

5.3.1.4 Wildlife Resources

Wildlife resources for the project area were previously evaluated by wildlife and habitat resource specialists for the MRL and Extraction areas. Copies of the cover page of each of the reports is presented in **Appendix "B"**.

5.3.1.5 Historic Resources

Public and Native American resources in the project area have also been previously evaluated. The historic and cultural attributes of the project area are presented in those previous studies. Copies of the study cover pages are included in **Appendix "B"**.

5.3.2 Environmental Considerations

Efficient energy consumption equates to reduced greenhouse gas emissions, therefore this condition can be assessed similar to economic consideration. The proposed excavation, processing and export of the aggregate resources from the site will likely be via conveyor to an offshore marine loading facility, for export to active market areas. The use of marine traffic for the project will minimize the use of land-based trucks and mitigate that potential impact. No adverse impact is expected to the surface or groundwater resources at the site. The potential surface and groundwater impacts at the site will be mitigated by avoidance. In addition, the pit development will increase recharge to the shallow groundwater system providing additional recharge to Thorndyke Creek during the summer and fall seasons.

5.3.3 Social Considerations

Noise, dust, truck traffic are commonly associated with surface mining, therefore operating in locations away from development or residential sites is a prime consideration. As previously indicated, the material to be exported from the site will be moved via overland conveyors and marine traffic. Therefore, this location and operation possesses little social impact.

6.0 HISTORY

As previously discussed, the 21,000 acre forestlands of the Thorndyke Resource Block was originally logged in the early 1900's, with most of the logging occurring in the 1930's. A significant forest fire in 1939 resulted in much of the forest area being re-seeded naturally. The area continues to be managed as commercial forestlands, with periodic logging of small acreage units and predominant replanting of Douglas fir. The Meridian Extraction Area is located within forestland areas that have been generally logged within the past 15 years. Old tree stumps, small Douglas firs, forest brush, and shrubs dominate the landscape in areas that were recently logged. Mature second growth Douglas fir stands are located in the extreme east portion of the project area.

The mining of sand and gravel has occurred in small borrow pits throughout the area for timber road construction since the early 1900s. Commercial mining began in the area in 1959 at the Shine Pit in order to supply materials to build the Jefferson County west side revetment for the Hood Canal Bridge. Since that time, various operators have mined sand and gravel in the vicinity and provided truck delivery of materials to the surrounding region. Several small borrow pits have continued to operate within the timber area for the construction and maintenance of the timber roads.

In 1979, Fred Hill Materials took over operation of the Shine Pit and obtained a Surface Mine Reclamation Permit from the Washington State Department of Natural Resources (WSDNR). Since then, FHM has continuously operated that mining operation and processing facility.

In 1999, Ace Paving obtained a Jefferson County Conditional Use Permit to operate a portable asphalt batch plant located on five acres within the 144-acre Operations Hub/Shine Pit area. In 2001, to prepare for the depletion of the sand and gravel supplies at Shine Pit, Fred Hill Materials submitted a preliminary application for the 156-acre Wahl Extraction Area (located north of the Meridian Extraction Area) to WSDNR as an expansion of the existing Shine Pit. Excavated material is to be transported via an overland conveyor to the Shine processing area.

In 2002, Fred Hill Materials submitted a Mineral Resource Lands Overlay (MRL) application to Jefferson County to identify and protect the underlying aggregate resources. The submission complied with the requirements of the Jefferson County Unified Development Code (UDC) and Washington State Growth Management Act.

In December 2002, Jefferson County approved a modified application for MLA-02-235, a Mineral Resource Land Overlay (MRL) designation for 690 acres, the Wahl and Meridian Mineral Extraction Areas. This MRL designation formally recognizes the existence of commercially viable deposits of aggregate (sand and gravel); provides for appropriate

notification of adjacent landowners regarding likely future mineral resource activities in this designated area; and allows application for specific excavation permits greater than 10 acres in size under the requirements of the Jefferson County UDC. The MRL designation alone does not authorize specific mining activities within the MRL.

7.0 GEOLOGIC SETTING

Our interpretation of the geologic conditions at the site are based on review of the available geologic literature, our site observations, several hundred test pits and nineteen previous borings in the site area, and the four supplemental borings completed in September 2009. The test pits ranged in depth from approximately 10 feet to 35 feet below the adjacent ground surface. The borings ranged in depth from approximately 35 feet to 420 feet below the adjacent ground surfaces (to Elevations 300 feet to 15 feet MSL). All of the borings were drilled using an air rotary drill rig with a 6-inch steel casing, similar to a water well. Each boring was completed as a groundwater observation well, leaving the steel casing to the approximate depth drilled.

7.1 Regional Geology

The Meridian Extraction Area is located in the western portion of the Puget Trough of the Puget Sound/Georgia Basin ecoregion. This area is referred to as the Toandos Peninsula, and is bounded by Hood Canal on the east and Dabob Bay on the west. The peninsula is also known locally as the Coyle Peninsula. According to measurements taken on the Google Earth website (www.googleearth.com) using the Image 2009 Digital Globe satellite imagery, the Toandos/Coyle Peninsula measures about 6 miles across (Hood Canal to north end of Dabob Bay) and about 14.5 miles long (from Highway 104 south to Hood Canal). Copies of the available geologic maps for the area are included as Figures 4a, 4b and 5. An approximate location of the major outwash channels for area are illustrated on Figure 6.

The Puget Sound topography and stratigraphy is the result of numerous continental glaciations. The most recent glaciation, responsible for most of the current topography of Puget Sound lowland, is known as the Vashon Stade of the Fraser Glaciation. The Vashon Stade occurred approximately 12,000 to 10,000 years ago. As the continental ice mass advanced from the Fraser River area of British Columbia, numerous pro-glacial rivers (outwash channels) emanated from the ice mass carrying coarse to fine aggregate (higher to slower velocity flow areas). These deposits were eventually overridden by the ice mass and are known as Advance Outwash. Scattered lakes in front of the glacier resulted in locally massive silt and clay deposits, known as Glacio-Lacustrine deposits. As the ice mass advanced over the aggregate materials (sand and gravel), a heterogenous mixture of sand, gravel, cobbles, silt and minor clay was deposited and overridden by the advancing ice mass. This deposit is known as Glacial Till (Lodgement Till), and is very dense/compacted when undisturbed. The tills in the Puget Sound area are typically classified as silty sand with gravel, cobbles and occasional boulders. As the glaciers retreated, another network of streams and rivers emanating from the retreating ice mass deposited sand and gravel that was not overridden by the ice mass. These normally consolidated deposits are called recessional outwash. In the Meridian Extraction Area, the recessional outwash soil is thin and discontinuous, resting directly on the sandy till or advance outwash material.

Holocene, or recent, deposits since the last glaciation consist of alluvium, peat, colluvium and locally landslide debris. Alluvium and peat form along stream channels, lakes, and other depressions in the broad glacial upland areas, while the landslide debris and colluvium typically develop along the margins of steeply sloping areas of the glacial uplands, and along the major water bodies.

7.2 Local Geology

The Thorndyke MRL with the Wahl and Meridian Extraction Areas are situated within a Vashon glacial outwash area located west of the Hood Canal Bridge, south of SR 104 and in the northeast portion of the Toandos Peninsula. During the Vashon glacial period, approximately 10,000 to 15,000 years ago, the pre-glacial geomorphic conditions of the site area combined with the advancing and receding glacial ice conditions to deposit thick layers of high quality aggregate material (sand and gravel) within confined geomorphic areas. These aggregate materials were deposited in front of the advancing glacial ice and also as the ice melted and receded. The geomorphology or topography and pre-glacial geology of the area, in conjunction with the high energy of glacial melt waters, resulted in the thick layers of clean sand and gravel material being concentrated in this geographic area.

During the advance and retreat of the glacial ice, the glacial outwash channels extended through the Thorndyke and Shine areas. Within the outwash channel areas, the glacial till is thin or absent, as a result of non-deposition or subsequent erosion by the scouring melt waters (rivers) from the ice. Where this occurred, recessional sand and gravel deposits were deposited directly over the advance sand and gravel deposits, resulting in a thick section of high quality aggregate material.

Regional deposits of clean high-quality sand and gravel material, like those that occur in the Thorndyke area, are rare. Aggregate resource deposits of this nature and size are rare throughout the Puget Sound and the world. To date, this is the only known deposit identified in the Kitsap or Olympic Peninsula areas. The Meridian Extraction area is a valuable resource that will provide high quality aggregate resource material to the region on a long-term basis.

7.3 Meridian Extraction Area Geology

The geology of the Meridian Extraction Area, consist of (from oldest to youngest): undifferentiated pre-Vashon glacial and interglacial sediments that are overlain by Vashon advance outwash, intermittent glacial till (hardpan) and recessional outwash sediments. Alluvial silts with organic debris occur in isolated valley floor areas near the toe of slopes and in upland lake areas. These silty soils perch surface water creating local wetlands and lakes.

The older glacial and interglacial sediments are exposed along portions of the Hood Canal shoreline bluff located east and south of the subject area, and were encountered in the deepest borings completed in the site area. These soils typically consist of bedded silts or clays, sands and gravels and occasional glacial till deposited by pre-Vashon glaciers and meltwaters. These older sediments are in a very dense or hard condition where undisturbed.

Geologic cross-sections for the Meridian Extraction Area illustrate our interpretation of the geologic or resource units. The locations of the cross-sections are shown on Figure 7. Cross-sections AA', BB', CC', DD' and EE' are included as Figures 8 and 9.

8.0 DEPOSIT TYPE

The aggregate resources of the Thorndyke MRL and Meridian Extraction area are glacially and alluvial deposited. The resources were deposited as advance outwash, sandy glacial till, and recessional outwash during the Vashon glacial period.

9.0 MINERALIZATION

The gravel resources of the Meridian Extraction Area, consist of Vashon advance outwash, and intermittent glacial till (hardpan) and recessional outwash sediments. The resources in the Meridian Extraction area have been subdivided into four resource layers or units for this report, Resources A through D. Resource A is comprised of the recessional outwash sand and gravel. The recessional outwash soils were deposited by the glacial meltwaters as the ice receded from the Puget Sound area. Within the Meridian Extraction area, the recessional sand and gravel is at or near the existing ground surface. The recessional material occurs as a thin, discontinuous layer that overlies Resource B.

Resource B in the Mineral Extraction area consists of a silty sand with gravel, cobbles and occasional boulders unit interpreted to be a sandy glacial till. Resource B varies in thickness at the site, generally from several feet in the north and west to approximately **150 feet** in the southeast. Resource B was deposited at the base of the advancing glacial ice as it extended southward through the Puget Sound area. The Vashon glacial till in the site area, as well as much of the Puget Sound area, has a very high aggregate content. And is a source of a wide variety of aggregate products throughout the area. It is identified as a till based on its depositional environment, rather than lithology.

Resource C consists of the upper, and coarser, portion of the Vashon advance outwash materials. For purposes of this report, Resource C includes the sandy gravel and gravelly sand portions of the Advance sequence. Resource C was deposited by the glacial meltwaters in front of the advancing ice. The coarser materials of Resource C were deposited closer to the ice than the underlying sandy materials, Resource D.

Resource D, below Resource C, grades rapidly into coarse to fine sand with minor to little or no gravel. The sands of Resource D were deposited farther away from the glacial ice by the meltwaters as they meandered in a broad glacial plain, likely criss-crossed by a series of braided streams.

10.0 EXPLORATIONS

Explorations in the general Thorndyke area consisted of several hundred trackhoe test pits and a total of twenty borings. The trackhoe test pits were excavated between 1997 and 2002, and ranged in depth from about 8 feet to 35 feet below the adjacent ground surfaces. Select soil samples were collected from the test pits and selectively evaluated for grain size distribution and/or fines (minus US No. 200 Sieve). Subsequently, the owner, Pope Resources, began drilling the Thorndyke area to explore the depth of the gravel resources in the area.

Between **2000 and 2002**, nineteen borings with observation wells were completed and established the area as an extensive aggregate resource area. The borings extended in depth from approximately 40 feet to 420 feet below the existing ground surface.

The recent four borings, OB-20 to OB-23, were completed as part of this evaluation and to confirm the previously identified gravel resources in the Meridian Extraction area.

11.0 DRILLING

The recent borings were completed by using a truck mounted direct air-rotary drill rig. Air rotary drilling is ideal for extremely difficult subsurface conditions such as large cobbles, boulders, as encountered at the Thorndyke site. In direct air rotary drilling, high pressure air is pumped down the between the inner and out casing, exiting the drill bit in small holes. As the bit is "hammered" into the soil or rock, it grinds the cuttings into smaller pieces and advances the casing. The sand, gravel and cuttings are then lifted back up to the surface through the center of the casing, and are discharged onto the ground through a "cyclone" or energy dissipater.

12.0 SAMPLE METHODOLOGY AND APPROACH

The cuttings for each 20-foot interval were separated into a pile at the base of the cyclone. The soil from the 20-foot interval was blended and mixed and a composite sample was obtained. This method simulates how the excavation from a working face of an active mine isn't from discrete layer or horizon, but rather from a thicker section. The sample was logged in the field and placed in large 50-pound sample bag. The bag was labeled and tied.

13.0 SAMPLE PREPARTION AND ANALYSES

The collected samples were returned to GeoResources' office and separated into the boring it was obtained from and placed in order according to depth. A total of ___ samples were selected for various index testing including grain size, fractured face, and durability. In some instances, two 20-foot samples were combined to get a representative result over a broader interval. When samples were combined, the original was split using a Gilson sample splitter. Half of the sample was returned to the original sample bag, while the other half of the sample was blended with half of the sample from the adjacent sample interval. Grain size and durability testing was performed by Mayes Testing, whose laboratory is in full conformance with ASTM E-329 "Recommended Practice for Independent Testing & Inspection Agencies, " and approved by the American

Association for Laboratory Accreditation (A2LA), Washington State Department of Transportation (WSDOT), and the US Army Corps of Engineers.

- Grain Size Analysis: Grain size testing was completed in accordance with ASTM:D-422. A grain size analysis indicates the range of soil particle diameters included in a particular sample. A sample of dry aggregate of known weight is separated through a series of sieves with progressively smaller openings. Once separated, by a repeated shaking motion, the weight of particles retained on each sieve is measured and compared to the total sample weight. Particle size distribution is then expressed as a percent retained by weight on each sieve size. The results of these tests, in both tabular and graphical format, are presented on the enclosed grain-size distribution graphs and were used in soil classifications shown on the boring logs. Results of our grain size analysis are attached in Appendix __.
- Toughness/Abrasion: The toughness or abrasion of a material can be evaluated by the Los Angeles (L.A.) abrasion test. The L.A. abrasion test (ASTM C 131) is used to characterize toughness and abrasion resistance of a material. The test uses the portion of an aggregate sample retained on the 1.70 mm (No. 12) sieve. The material is placed in a large rotating drum that contains a shelf plate attached to the outer wall. A specified number of steel balls or spheres are placed in the machine and the drum is rotated for 500 revolutions at a speed of 30 - 33 revolutions per minute (RPM). The material is then extracted and separated into material passing the 1.70 mm (No. 12) sieve and material retained on the 1.70 mm (No. 12) sieve. The retained material (larger particles) is then weighed and compared to the original sample weight. The difference in weight is reported as a percent of the original weight and called the "percent loss".
- Fractured Face: Particle shape and surface texture can be evaluated by use of the Fracture Face Test (ASTM D: 5821). This test determines the percent of fractured particles in coarse aggregate. The portion of the sample retained on the 4.75 mm (No. 4) sieve is collected and the number of particles with fractured faces is compared to the number of particles without fractured faces. A fractured face is defined as an "angular, rough, or broken surface of an aggregate particle created by crushing, by other artificial means, or by nature" (ASTM, 2000). In order for a face to be considered fractured it must constitute at least 25 percent of the maximum cross-sectional area of the rock particle.

14.0 DATA VERIFICATION

15.0 ADJACENT PROPERTIES

16.0 AGGREGATE PROCESSING AND TESTING

17.0 MINERAL RESOURCES AND RESERVE ESTIMATES

The mineral reserves within the Meridian Extraction area were evaluated by three differing methods; Polygonal, Grid and Composite methods. Each reserve calculation method utilized a maximum mining depth of Elevation 130 feet. Portions of each of the resource units extend to or below Elevation 130 within the Meridian Extraction area. Resources A & B were calculated together using the existing ground surface and the lower boundary with Resource. Resource C was calculated using the upper limit and the boundary between Resource C and Resource D (dry). The reserve volumes for Resource A and B, C and D (dry) are considered **proven probable**. The volume of Resource D (dry) is provided as a possible resource to Elevation 130 for this preliminary analysis.

The Polygonal method utilizes lateral boundaries that form polygons as defined by the known data points in conjunction with the upper and lower limits of the defined resource. The average resource thickness within each bounded area (polygon) is mathematically calculated and used to determine the volume (cubic yards) within the area. The volumes of the individual polygons are summed for the mine area to provide a total reserve volume for each resource unit.

The Grid method calculates the reserve volumes using a grid overlaid on the two resource surfaces (i.e. top and bottom). The method breaks the site into a series of grid cells in rows and columns and then samples the top and bottom elevations at the corners of each grid cell for each identified resource unit. AutoCAD then breaks the resulting face into two triangular prisms. The cells are split into individual prismatic objects. This method calculates the volumes by using the prismatic volume of all grid areas for each resource unit.

The Composite method calculates re-triangulated surface areas based on the known data points and the identified top and bottom surfaces in each. The triangulated points from the top and bottom surfaces, as well as any location where the triangle edges between the two surfaces are used to calculate the new composite surface elevations. (This method is typically considered the most accurate).

Table 3 summarizes the results of the three reserve estimate methods.

17.1 Previous Studies

Several geologic publications cover the Meridian Extraction and surrounding area. In addition, several regional and site specific geologic and hydrogeologic evaluations have been conducted for the Thorndyke and Shine areas since 1998. These are listed in the attached bibliography.

17.2 Quality Parameters

Based on our site observations throughout the region, excavation of the trackhoe test pits, and completion of the borings, the sand and gravel deposits located within the TMR consist of high quality commercial sand and gravel with cobbles and occasional boulders. The fines content (material passing the US. No. 200 Sieve) varies, but is typically less than 5 percent. This aggregate material is suitable to produce high quality commercial pit run and a variety of select commercial aggregate products. The sand and gravel resources in this area are unusual because of the low fines content, thereby having very little reject or unsuitable soil material. Any reject soil material that cannot be exported from the site will be utilized for reclamation of the site in accordance with DNR (Washington Department of Natural Resources) regulations.

Adequate coarse gravel, cobbles and boulders occur in the aggregate material observed/encountered to produce commercial crushed products. Sufficient fine to medium sand occurs as lenses and at depth to provide for material binder and select concrete and commercial specialty sand products.

Recent grain size analysis and other index testing are described above in sections 13 and 14.

17.3 Aggregate Quantity

Based on the results of our subsurface explorations and data review, the aggregate resource quantity within the TRM is that of a regional area resource, capable of supplying a variety of quality commercial aggregate products to local intra-state and inter-state regions on a long-term basis. There are no other known aggregate resources of this quality and quantity in the Olympic and Kitsap Peninsula areas.

18.0 OTHER RELEVANT DATA AND INFORMATION

19.0 INTERPRETATIONS AND CONCLUSIONS

20.0 RECOMMENDATIONS

21.0 REFERENCES

The following documents, including reports, maps, and other published literature, were used in the preparation of this report:

- United States Department of Agriculture, Soil Conservation Service, *Soil Survey of Jefferson County Area, Washington, 1975.*

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