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July 22, 2015

Reserve Silica Corporation  
c/o Schwabe Williamson & Wyatt  
US Bank Centre, 1420 5<sup>th</sup> Avenue, Suite 3400  
Seattle, Washington 98101-4010

Attention: Connie Sue Martin

Subject: Preliminary Environmental Conditions Letter Report  
Reserve Silica Corporation  
Ravensdale Quarry  
Tax Parcel Nos. 3622069065, 0121069002, 3522069018  
Ravensdale, Washington  
File No. 06777-002-00

## INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) has prepared this Preliminary Environmental Conditions Letter for the Reserve Silica Corporation's Ravensdale Quarry in Ravensdale, Washington. This letter presents the findings from an environmental review of the information provided by Schwabe Williamson & Wyatt (Reserve Silica Corporation's land use and environmental legal counsel), with regards to potential environmental impacts to the future use of the Subject Property.

The Subject Property is 320 acres, was mined for coal (both surface strip mining and underground) from 1900 to 1967 and then used to mine and process silica sand. We understand that this review includes only the property south of Black Diamond Ravensdale Road, Tax Parcel Nos. 3622069065 and 0121069002 (Subject Property). The property north of Black Diamond Ravensdale Road, Tax Parcel No. 3522069018, where the laboratory, hazardous material storage, equipment storage, and tailing ponds were located, is not included in this environmental assessment.

The purpose of this environmental review is to evaluate the potential for soil, surface water and groundwater contamination from historic sources, and information on the historic coal mine operations that may affect redevelopment at the two Residential Development Areas (about 62 acres of the 320 acre Subject Property, see Figure 1). We understand that Concept Engineering is providing evaluations and opinions regarding zoning, wetlands, steep slopes, critical areas, potential for new access roads, stormwater management and buffer zones. These elements are not part of GeoEngineers' evaluation.

Unless otherwise noted, this summary is based on a subset of information provided by Schwabe Williamson & Wyatt in the documents listed in the reference section. Not all documentation provided to GeoEngineers was reviewed in detail; there were about 130 documents provided to us. We selected pertinent and/or the most current documents in order to form our opinions. Only the sources cited and listed in the Reference section below have been thoroughly reviewed.

## BACKGROUND AND HISTORICAL USE

This environmental review is focused on two proposed Residential Development Areas on the Subject Property; totaling about 62 acres. The northern Development Area consists of approximately 28 acres, and the southern Development Area consists of approximately 34 acres of cleared forest for development and open space. The remaining area outside the Residential Development Areas includes approximately 258 acres of forest, open space, and wetland area.

Historically, areas throughout the Subject Property were used for coal mining from the 1900s to 1930s. The property outside of the Residential Development Areas was used for sand mining from 1967 to 2007 and filling from 2006 to the present.

Beginning in 1900, a subsidiary of Northern Pacific Railroad conducted underground and strip mining on the property. Two coal seams were mined underground (Dale 4 and Dale 7), and later the Dale 4 seam was mined from the surface. This activity area was called the Dale Strip Pit (Shown in Figure 2) and has been backfilled and reclaimed. Burlington Northern, the successor to Northern Pacific, stopped coal mining operations in 1947. Subsequently, the Subject Property experienced no mining activity until 1967 when mining of silica sand from sandstone began (Bennett Consulting, PLLC 2014).

In 1967 the Subject Property was leased by Burlington Northern to allow mining of sandstone containing a high quality silica sand. The property has been leased for sand production by several operators. The current operator, Reserve Silica Corporation, began mining in 1986, purchased the property in 1997, and active mining ended in December 2007. Beginning in 2007, the backfilling and reclamation of the upper pit began in earnest. Since 2007, the operation has consisted of the sale of stockpiled sand, and backfilling of the Lower and Upper Pits (see Figure 2 for pit names and locations) (Bennett Consulting, PLLC 2014).

From 1979-1989, Ideal Cement Company (Ideal Cement) used cement kiln dust (CKD) to backfill the lower disposal area (LDA) and the Dale Strip Pit (DSP) (see Figure 2) (Bennett Consulting, PLLC 2014). The LDA had an authorized volume of 250,000 cubic yards and was closed in 1985, the DSP had an authorized volume of 250,000 cubic yards and was closed in 2003 (Seattle King County Department of Public Health 2014). In total these two areas encompass less than 15 acres in the center of the Subject Property, outside of the proposed development areas (Bennett Consulting, PLLC 2014). This closure activity was conducted under Seattle King County Public Health Department solid waste disposal permits (only two permits identified during this review dated 1983 and 1987), and a Washington State Department of Ecology (Ecology) exemption under Washington Administrative Code (WAC) 173-303-910(3) (State of Washington Department of Ecology 1987)—related to exempting the CKD waste as being designated a dangerous waste). Both of these areas have been capped, and according to an interview conducted as part of the Phase I Environmental Site Assessment (ESA), and figures from the Interim Reclamation Plan, 13 groundwater monitoring wells exist on the Subject Property, and two exist adjacent to the western property line (shown in Figures 2 and 5). The groundwater monitoring wells were monitored by ARCADIS

from 2005 through the second quarter of 2009, Golder Associates, Inc. from the second quarter of 2009 through the first quarter of 2014, GeoEngineers between the first quarter of 2014 through the third quarter of 2014, and Golder Associates, Inc. from the third quarter of 2014 to the current monitoring period at the time of this environmental review, on behalf of Holcim US Inc. (Holcim) (Bennett Consulting, PLLC 2014) (Farallon Consulting 2014) (GeoEngineers 2014). Holcim, the successor to Ideal Cement, is responsible for fulfilling the Ecology Closure Order for these two areas (Bennett Consulting, PLLC 2014). The Closure Order reference number requires a public disclosure request through Ecology which was not made due to scope and schedule constraints of this environmental review.

The primary environmental hazards associated with the Subject Property are located in the vicinity of former surface and subsurface mining and mine filling locations. The two proposed clustered development areas, are strategically located outside of the former mining zones as shown in figures 1 and 3.

## ENVIRONMENTAL HAZARDS

Several potential environmental hazards were identified, however, no documented hazards appear to directly affect future use of the two proposed Residential Development Areas.

### Hazardous Substance Storage

The Phase I ESA Report completed in 2014 identified several hazardous storage containers including above ground storage tanks (ASTs), a possible underground storage tank (UST), 55-gallon drums, and numerous small containers (Farallon Consulting 2014). However, this material discovered during the Phase I ESA appears to have been stored in areas north of the Subject Property, and with surface water and the shallow aquifer flowing north and west, away from the two proposed development areas, it is unlikely that the Residential Development Areas would be impacted.

### Former Mining Activity

Based on the historic maps, and The Coal Fields of King County publication (Attachment A and B), it appears underground Breast and Pillar, and Chute and Block, and surface strip mining methods were used in the Ravensdale area. The approximate locations of former underground coal mining in relation to the Subject Property and proposed development areas are shown in Figure 3.

The primary hazards associated with underground coal mines are open adits or portals, sinkholes, and ground surface settlement. The King County Zoning Code recognizes the variety of hazards that are present from past mining activities, but only addresses the foundation materials beneath proposed structures and the likelihood of the collapse of underground workings (CAO Users Manual). The collapse of underground void spaces can create significant ground surface settlement, and if the collapse propagates to the surface, it can generate small to very large sinkholes. Settlement associated with coal mine collapse can occur gradually through time or may occur suddenly many years after the coal mines have been abandoned. These settlements are often difficult to predict in timing or area impacted, and can have a significant effect on surface structures.

Open adits or portals are historic surface access to the underground mine. The presence of historic adits or portals presents a potential environmental hazard. Records indicate that at least one "portal of the mine is located...some 2,000 feet northwest of the Dale Strip Pit." and "The entire Dale No. 1 mine was

constructed as a self-draining mine, that is, with the portal the lowest point in the mine. Groundwater which was encountered, was allowed to drain by gravity from the working[s] through the tunnel and out the portal." (Metropolitan Engineers, Consulting Engineers 1972) Letters between Industrial Mineral Products, Inc. and the Seattle-King County Department of Public Health in 1982 reference the "The drainage from the coal mine outlet has been pouring out onto the swamp area adjacent to the county road since the early 1900s." (McLucas 1982). This portal is shown just north of the LDA, and east of the main haul road (Ecology and Environment, Inc. 1986) (GeoEngineers 2014). Surface water monitoring of the Portal discharge has generally occurred on a quarterly schedule since March 2002 (Golder Associates Inc. 2013). The pH of the water exiting the Portal is generally neutral. This neutral water is mixed with the very basic CKD leachate before entering the infiltration ponds (Ecology and Environment, Inc. 1986). In addition to this documented Portal, reference was made in the March 2012 Reserve Silica Project Land Use Classification Evaluation to "open mines and test mine pits...in the forested areas" (Bennett Consulting, PLLC 2014). The specific location of these features were not identified. A subsidence investigation and assessment within the development areas would enable development planning and design to eliminate these potential risks.

Specific mine characteristics such as adits, water levels, coal transport methods, etc. are not apparent from Figure 3, or the historic maps included in Attachment A. The chambers, pits, and tunnels shown may have been closed or filled, but remaining uncompacted fill material and subsurface void space continues to present a subsidence risk. A Coal Mine Hazard Investigation or Assessment was not provided for this environmental review, but is recommended to mitigate these subsidence risks prior to development.

Coal mining practices in the early 1900s typically included mechanical equipment. The operation and maintenance of this equipment likely required petroleum products and potentially hazardous substances. The storage and use of these substances creates the potential for historic leaks, spills or releases that are considered a potential environmental concern. No reference or documentation of historic releases were provided during this environmental review that indicates this may be a potential concern for future development.

Coal mining practices in the early 1900s also exposed mined coal to erosion and transport mechanisms such as surface water flow and wind, and included refinement processes such as on-site wash plants before transport (Evans 1912). This exposure to water and wind creates a potential environmental concern for contamination of soil, surface water, and groundwater on, and adjacent to the Subject Property. It is not likely that coal washing was conducted in the Residential Development Areas, due to its hillside location and distance from the rail line, but residual coal dust and coal products may be present. No reference or documentation of coal stockpiling or processing being specifically conducted on the Subject Property was provided as part of this environmental review.

The northern most point of the property, outside of the proposed Residential Development Areas, contains approximately 10 acres reported by Reserve Silica to contain extensive volumes of coal tailings from the early subsurface coal mines found beneath the property (Figure 4) (International Forestry Consultants, Inc. 2012). These tailings may result in contamination by heavy metals, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), and other associated contaminants depending on the makeup of the tailings material. Surface water and groundwater flow through this material presents a potential environmental concern to soil, surface water, and groundwater on and adjacent to the Subject Property. Also, the mine fill, overburden, and waste soil materials most likely included in the tailings, may reduce the structural capacity of this soil for future development. This former tailings pile is outside of the proposed development areas

and is currently covered with soil and supporting low value timber growth, therefore exposure pathways are limited and can likely be further managed after residential development using institutional controls such as signage and fencing.

The possible generation of methane gas or other organic vapors from organic materials that might be present in significant quantities in the former mine network and fill, and the possible migration of these gasses on the Subject Property is considered a potential environmental concern. This risk is very minimal due to the location of proposed residential development being concentrated in areas outside of the former subsurface mining locations.

Beginning in the late 1960s, the Washington State Department of Natural Resources (DNR) has been responsible for regulating silica sand source material extraction and reclamation through Permit No. 10346. Potential environmental concerns from the surface sand mine extraction is limited to leaks and spills of mechanical equipment used on site, and is not likely to impact future development of the site.

#### **Cement Kiln Dust Disposal**

"CKD is the primary by-product of cement manufacturing. In brief, CKD is a very fine material emitted from the...heating process used to make cement from various raw materials including limestone and other calcareous materials...The cement dust produced is a very fine dust, or flue 'ash'...The cement dust is usually very alkaline (pH 10.5 to 12), and often contains metals that represent the content of the clinker source materials used in the cement manufacture...All cement kilns generate CKD; the quantities and characteristics of the CKD depend on operational factors and the characteristics of the input material." (Leidos 2015).

The primary environmental hazard associated with the presence of CKD is its impact to pH, and potential concentrations of toxic constituents. The US Environmental Protection Agency's (EPA's) analysis of CKD dust solids and leachate chemistry identified CKD as potentially contributing concentrations of arsenic, thallium, antimony, lead, chromium, total-2,3,7,8-substituted dioxins, and total hexachlorodibenzodioxin. When CKD comes into contact with water, the leachate is often characterized as Resource Conservation and Recovery Act (RCRA) corrosive waste (see 40 CFR 261.22), with pH levels commonly in excess of 12.5 standard units (Leidos 2015).

According to the Phase I ESA, in the early 1980s CKD was accepted from Ideal Cement and Holcim for use as backfill in two locations outside of the proposed Residential Development Areas (Lower Disposal Area and Dale Strip Pit shown in Figure 2). The areas have been capped since the 1990s, but surface and groundwater with heavy metal concentrations and a pH as high as 12 flows from these areas, within and outside of the designed leachate conveyance system (Public Health - Seattle & King County 2014) (GeoEngineers 2014). Holcim, the successor to Ideal Cement, maintains environmental responsibility for both the Lower Disposal Area and Dale Strip Pit areas (Farallon Consulting 2014).

The Residential Development Areas are located outside of the CKD fill areas and upgradient of surface and groundwater flow, therefore, CKD fill is not expected to directly impact the Residential Development Areas. Also, institutional controls such as fencing and signage can reduce general human exposure on the Subject Property.

### Groundwater and Surface Water

The Phase I ESA identified 15 groundwater monitoring wells installed on, and directly adjacent to the northwest corner of the Subject Property (Figures 2 and 5). These groundwater monitoring wells have been monitored by ARCADIS from 2005 through the second quarter of 2009, Golder Associates, Inc. from the second quarter of 2009 through the first quarter of 2014, GeoEngineers between the first quarter of 2014 through the third quarter of 2014, and Golder Associates, Inc. from the third quarter of 2014 to the current monitoring period at the time of this environmental review on behalf of Holcim (Bennett Consulting, PLLC 2014) (Farallon Consulting 2014) (GeoEngineers 2014). The groundwater and surface water monitoring points were selected to monitor and assess the groundwater and surface water conditions with respect to potential impact from the CKD fill. The sampling results from these wells only represent the groundwater and surface water conditions in the vicinity of the LDA and DSP areas.

The most recent groundwater and surface water monitoring report provided for this environmental review was completed by GeoEngineers in 2014 (see Attachment D), and includes summary tables of historic sampling data, and a figure showing sampling locations. Surface water sampling has been conducted from the south pond, still well, weir, and infiltration pond 1 as defined in the groundwater monitoring reports and shown in Appendix A and Figure 2 of the GeoEngineers third quarter 2014 report included in Attachment D (GeoEngineers 2014). The monthly and quarterly monitoring measured flow directions, heavy metal concentrations, and TDS, conductivity, and pH water quality parameters in the surface, shallow, and deep aquifers in the vicinity of the LDA and DSP. "Groundwater flow in the shallow groundwater system is toward the northwest and in the bedrock system is north to northwest" (Golder Associates 2014). A full analysis of groundwater and surface water data was not completed as part of this environmental review, but the monitoring results were reviewed and the following bullets summarize the general impacts.

- **Surface Water sampling** indicated high pH (greater than 12 at the Still Well and South Pond sampling points), conductivity and total dissolved solids, as well as concentrations of iron, lead, and manganese exceeding preliminary standard thresholds as defined in the quarterly Groundwater Monitoring Reports (GeoEngineers 2014) (Golder Associates 2014). A preliminary standard for dissolved arsenic and potassium has not been determined for the Subject Property, but arsenic concentrations exceeding the Model Toxics Control Act (MTCA) Method A cleanup levels and upgradient surface water concentrations, have been reported in quarterly monitoring reports (ARCADIS 2006) (GeoEngineers 2014).
- **Shallow/Alluvial Groundwater sampling** indicated slightly elevated pH relative to upgradient groundwater wells, high conductivity and total dissolved solids, as well as concentrations of iron and manganese occasionally exceeding preliminary standard thresholds as defined in the quarterly Groundwater Monitoring Reports (GeoEngineers 2014) (Golder Associates 2014). A preliminary standard for dissolved arsenic and potassium has not been established for the Subject Property, but arsenic concentrations exceeding MTCA Method A cleanup levels and upgradient shallow/alluvial groundwater monitoring well (MW-4A) sample concentrations, have been reported in quarterly monitoring reports (ARCADIS 2006) (GeoEngineers 2014).
- **Bedrock Groundwater sampling** indicated elevated total dissolved solids, as well as concentrations of iron, manganese, and lead exceeding preliminary standard thresholds as defined in the quarterly Groundwater Monitoring Reports (GeoEngineers 2014) (Golder Associates 2014). A preliminary standard for dissolved arsenic has not been determined for the Subject Property, but arsenic concentrations exceeding MTCA Method A cleanup levels were reported in quarterly monitoring reports (ARCADIS 2006) (GeoEngineers 2014).

These impacts may be limited to the vicinity around the LDA and DSP surface, subsurface and downgradient areas including the infiltration pond, seep, and treatment slope areas (Figure 5), (Golder Associates, Inc. 2007) but an investigation or conclusion around impacted groundwater limits, was not identified during this environmental review, which is a potential environmental concern.

Human exposure to the impacted surface and groundwater is limited due to the CKD source location being west and downgradient of the proposed development areas. Exposure pathways outside of the development areas are limited and can be managed after residential development using institutional controls such as signage, fencing, and groundwater access restrictions.

#### Fill Material

Fill has been placed as part of the mine reclamation project since the 1970s (Bennett Consulting, PLLC 2014). Fill placed in the old strip mine areas has been regulated by the King County Department of Permitting and Environmental Review since 1971 through its Grading Permit L7061122. In 2010 King County requested and DNR agreed to transfer fill regulatory responsibility for reclamation from the State to King County. Fill is currently being regulated by the King County Health Department (Bennett Consulting, PLLC 2014). In 2012 the King County Health Department approved an inert waste disposal permit to allow Reserve Silica to receive inert waste materials specified in Chapter 173-350-410 WAC and certain other inert wastes approved in advance by the King County Health Department (Clean Soil/Inert Waste Acceptance Agreement n.d.).

After 2012, the Inert Waste Disposal Permit specified that acceptable soil material is "free of any contaminants which do not contain radioactive wastes, dangerous or extremely hazardous wastes (as defined by WAC 173-301) hazardous substances (as defined by WAC 173-340), petroleum or its by-products, soil removed as part of any cleanup action, or any other solid waste, included but not limited to rubbish, ashes, or material not meeting the definition of and criteria for inert waste (WAC 173-350-10Q; WAC 173-350-990)." (Clean Soil/Inert Waste Acceptance Agreement n.d.). Therefore, it is reasonable to assume waste with contamination concentrations up to the MTCA thresholds may have been used as fill. Soil accepted from the Highway 99 tunneling project, and other development sites in downtown Seattle represent this type of fill material that may contain contaminant concentrations up to the MTCA reporting limits.

The cumulative result of using fill impacted by contamination concentrations less than MTCA reporting limits is a potential environmental concern due to soil exposure and groundwater impacts and potentially additional end use costs if this soil is excavated for redevelopment purposes.

The Interim Reclamation Plan also references pre-screening and approval from Public Health for "disposal of material such as Hardi-Board, controlled density fill, shotcrete, polymer spoils and limestone..." (Bennett Consulting, PLLC 2014). In a letter from Seattle King County Public Health Department to Reserve Silica Corporation, LLC in 2014, reference was made to "the non-sloped area north of the Lower Pit and east of the haul road (i.e. the area subject to previous placement of Hardy Board waste)" (Lasby 2014). The use of this type of fill on the Subject Property, creates the potential for significant differential settlement due to underground voids and limited compaction, and may become a future hazard.

Filling currently continues in the Upper Pit, Lower Pit, and North Pit areas (Farallon Consulting 2014).

The fill material does not appear to impact the Residential Development Areas and exposure pathways on the Subject Property can be managed using institutional controls such as signage and fencing.

### Other Documented Contamination

According to the Environmental Data Resources (EDR) report included in the Phase I ESA, the Ecology records show the Subject Property was "listed as a landfill until December 1999; has suspected groundwater, soil, and surface water contamination by metals and corrosive waste; and had an industrial wastewater discharge permit as of September 1994. Seven violations were recorded for the Subject Property in 2002, four in 2004, eight in 2005, and one in 2006. All of the violations were listed as 'Closed,' and the mine status was listed as 'Abandoned' as of October 2010. The Subject Property status is currently listed as 'Awaiting Cleanup.'" (Farallon Consulting 2014). Documentation regarding the specific violations and their remedies were not provided for this environmental review.

Three recent inspections were completed by the King County Public Health department in 2013 and 2014 (see records in Attachment C). These inspections cited leachate with pH 11 to 12, "escaping/exiting the hillside north and downslope of the installed leachate catch basin. The volume of leachate appears significant and is not entering the system installed for conveying leachate to the downslope infiltration ponds." (Public Health - Seattle & King County 2014). Also noted by Holcim in an email to Seattle King County Public Health "The pipeline is prone to plugging due to the small diameter of the pipe." (Bolduc 2014) Numerous corrective and maintenance actions have been completed to improve the function of the leachate drainage system.

These documented sources of contamination may present an environmental risk to future use of the property, outside of the Residential Development Areas, due to impacted soil, surface water, and groundwater in localized areas. It is likely that the forested areas in the Residential Development Areas were not significantly impacted by these documented occurrences based on the forest age in the development areas indicating minimal disturbance for the past 20 to 30 years (American Forest Management, Inc. 2015).

### DATA GAPS

#### Previous Investigations

There may be additional information available at Ecology that was not provided for this environmental review. A State Environmental Policy Act (SEPA) review and approval was completed by King County Department of Development and Environmental Services (DDES) in 2006, which included a hydrogeologic analysis, storm water management plan, geotechnical report as well as wetland and wildlife habitat analyses (Bennett Consulting, PLLC 2014). These reports were not made available for this environmental review. Previous investigations not included in the referenced files of this letter present a significant data gap in identifying environmental impacts on future land use.

#### Hazardous Waste Storage

According to the Phase I ESA, Seattle and King County Public Health was contacted by Farallon Consulting on October 21, 2014 to "...inquire whether notices of violations or reported hazardous spills at the Subject Property were on file. An application comment noted that a permit was submitted to re-line a 10,000-gallon diesel UST with an epoxy coating in April 24, 1991." (Farallon Consulting 2014). It is unclear if the 10,000-gallon diesel UST referenced in the Seattle and King County Public Health is the same UST Reserve Silica indicated in the vicinity of the silica sand dryers north of the Subject Property. The existence and location of USTs on the Subject Property remains a data gap with potential impacts to future land use, although not within the Residential Development Areas.



### Former Mining Activity

At the time of this environmental review, GeoEngineers was not provided with a coal mine hazard investigation, assessment, or related information for the Subject Property.

With this limited information, specific environmental hazards due to coal mining operation outside of the Residential Development Areas, associated practices, and remaining wastes remains an important data gap. Additional investigation prior to future use would be prudent to evaluate hazards from former mining activity.

### Fill Materials

Without reasonable estimates of the volumes, locations, and makeup of strip mine backfill accepted prior to the 2012 Inert Waste Disposal Permit, the significance and extent of this contamination remains a data gap in evaluating impacts to the Subject Property.

The Inert Waste Disposal Permit reduces the risk of contaminated material being deposited on the Subject Property by limiting acceptable material, however, the fill material may still become a source of contamination due to the significant volume of fill potentially impacted up to MTCA thresholds (Clean Soil/Inert Waste Acceptance Agreement n.d.). The lack of chemical analytical lab data representative of the fill material placed or accepted, surface water infiltrated, or groundwater beneath the Subject Property, remains a data gap. The fill material does not appear to impact the Residential Development Areas and exposure pathways on the Subject Property can be managed using institutional controls such as signage and fencing.

### Groundwater and Surface Water

Monthly and quarterly groundwater and surface water monitoring of the surface, and shallow and deep aquifers in the vicinity of the LDA and DSP areas have been conducted since 2005, and indicate surface and groundwater contamination in the shallow and deep aquifers that may be of concern to human health and the environment. Although surface and groundwater quality has been monitored in the LDA and DSP areas, for CKD related contaminants, the limits of these impacted waters, and potential contaminant sources other than CKD, have not been investigated based on the information provided for this environmental review, and remains a data gap. Based on this review, the groundwater and surface water impacts observed in the vicinity of the LDA and DSP do not appear to impact the Residential Development Areas, and exposure pathways on the Subject Property can likely be managed using institutional controls such as signage and fencing.

### FUTURE LAND USE OPINION

Based on the information provided for this environmental review, GeoEngineers' opinion on the primary potential environmental impacts outside of the Residential Development Areas, include the following items:

- **Residual Mine Hazards**

The primary residual mine hazards are open adits, sinkholes, and regional ground surface subsidence due to collapsing underground mine workings. The resulting subsidence or sinkholes can significantly affect land surface features and structures while sinkholes, vent shafts, and adits

present acute hazards to human health. The unpredictable nature and result of these occurrences and hazards present challenges to future land use. With thorough geotechnical analysis, King County may permit varying degrees of development within Mine Hazard Areas depending on the classified hazard level (King County 2014).

Based on a review of publicly available coal mining maps and documentation in the Ravensdale area (see Attachment A and B), the underground mine networks shown in Figure 3 appear consistent with what we have learned through interviews. However, it is not uncommon for historic underground mining activities (and maps) to be inaccurate or outdated. Validation of these locations are not within the scope of this environmental review, but are critical to evaluating future development hazards.

Residual mine tailings may reduce the structural capacity of soils for foundational support, and impact soil and groundwater quality.

The release of methane gas or other organic vapors generated within former underground mine networks could potentially be a hazard to human health.

#### ■ **Groundwater and Surface Water**

Groundwater and surface water could be impacted from former mining activity, processes and waste, CKD and landfill material leachate, potentially contaminated fill material, historic releases of hazardous substances, leaking USTs, and unknown adjacent property use. The potential for the documented CKD-impacted groundwater in the vicinity of the development areas may be minimal based on the location of the 15 groundwater wells and 4 surface water monitoring points on the Subject Property, but without identifying the impacted limits, surface and groundwater quality remain a potential environmental concern. In addition, other potential sources of surface and groundwater contamination on the Subject Property, other than CKD fill, may exist. Due to the limited sampling locations and analysis included in the current water quality monitoring program, other potential sources and/or recognized environmental conditions have not been evaluated. Therefore, it is possible that surface and groundwater quality may present a risk to human health and the environment, which may dictate opportunities for future use of the property.

#### ■ **Leachate**

Although the LDA and Dale Strip Pit have been capped and a legal agreement with Holcim is in place for continued liability, leachate from the LDA and Dale Strip Pits continue to present an environmental concern for impacts to groundwater, soil, and the exposure to leachate. Leachate (in the form of surface water) is seeping out of the west side of the LDA, and west of the LDA into collection ditches, which fall outside of the conveyance infrastructure in the marsh areas, the south pond area, and in the infiltration ponds (Public Health - Seattle & King County 2014). Although the conveyance and infiltration facilities are in place, the capture of leachate within collection ditching and inlet infrastructure has not been reliable. The uncontrolled nature of the leachate and impacted surface waters result in exposure pathways impacting human health and the environment that could be an ongoing concern depending on future land use type. Although Holcim carries liability for the CKD filled pits, they have not provided complete control of the contamination impacts.

It is our option that these potential environmental impacts on the Subject Property likely do not impact the development and use of the Residential Development Areas. Furthermore, human exposure to these risks outside of the Residential Development Areas on the Subject Property, can be reduced or eliminated through appropriate planning, design, and institutional controls,

## LIMITATIONS

This report has been prepared for use by Schwabe Williamson & Wyatt and Reserve Silica Corporation. GeoEngineers has performed this environmental review in general accordance with the scope and limitations of our proposal. This environmental review is not inclusive of all potential environmental hazards. All content within this letter report regarding current or historic conditions on site are based on documents and reports provided by Schwabe Williamson & Wyatt, and referenced below.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with the generally accepted environmental and geologic engineering sciences practices. No warranty or other conditions, express or implied, should be understood. Please refer to Appendix B titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

## REFERENCES

Approximately 130 documents were provided for this environmental review generally consisting of water quality testing, regulatory correspondence and inspections, landfill closure and disposal practices and improvements, forest management assessments, environmental reviews, and former coal mining practices. The following list includes the current and most pertinent documents reviewed, and used throughout this report to form the discussion and opinions presented.

American Forest Management, Inc. 2015. "Forest Management Plan Reserve Silica Property." Ravensdale.

Bennett Consulting, PLLC. 2014. "Interim Reclamation Plan for the Ravensdale Quarry."

Bolduc, Joel. 2014. *Reserve Silica Closed Landfill*. June 6.

n.d. "Clean Soil/Inert Waste Acceptance Agreement."

Concept Engineering, Inc. 2014. *Reserve Silica Reclamation Forest Management Plan*.

Concept Engineering, Inc. 1999. *Reserve Silica Reclamation 72-Lot Exhibit*.

Ecology and Environment, Inc. 1986. "Recommendations L-Bar Products." Memorandum.

Evans, George Watkin. 1912. "The Coal Fields of King County." Olympia.

Farallon Consulting. 2014. "Phase I Environmental Site Assessment Report."

GeoEngineers. 2014. "Quarterly Monitoring Report." Technical Report.

George Bennett, M.Sc., P.G., interview by John Peters. 2015. *Geologist and Owner of Bennett Consulting, PLLC* (June 24).

- Golder Associates. 2014. "Groundwater and Surface Water Statistical Characterization. Arsenic Background Level Evaluation." Technical Memorandum.
- Golder Associates Inc. 2013. "Quarterly Monitoring Report First Quarter 2013 Ravensdale Quarry." Technical Report.
- Golder Associates, Inc. 2007. "Reserve Silica Site CKD Disposal Area Cover Design Easement and Buffer Areas." Figure.
- Gordon Bradley, Gregory J. Ettl, Ashley Lunde. 2012. "Reserve Silica Project Land Use Classification Evaluation."
2002. "Holcim/Reserve Silica Easement Agreement."
- International Forestry Consultants, Inc. 2012. "Reserve Silica Ravensdale Property Roest Analysis."
- King County. 2014. "Department of Permitting and Environmental Review." *Critical Areas, Stormwater, and Clearing and Graing Ordinances (CAO)*. April 18. Accessed June 22, 2015. <http://your.kingcounty.gov/ddes/cao/Manual/EntireManual.pdf>.
- Lasby, Bill. 2014. "Measurements for pH on February 18, 2014." Letter.
- Leidos. 2015. "Cement Kiln Dust: Summary of Existing Information." Technical Report, Bothell.
- McLucas, Glenda. 1982. "Responce to Solid Waste Disposal Site Permit Application at the Ravensdale Silica Sand Mine." Letter.
- Metropolitan Engineers, Consulting Engineers. 1972. "Final Report Geologic and Hydrologic Conditions Sludge Disposal Site Near Ravensdale, Washington." Technical Report, Seattle Washington.
- Public Health - Seattle & King County. 2014. "Routine INspection/Field Review of a Closed Landfill." Inspection, Ravensdale.
- Seattle King County Department of Public Health. 2014. "Reserve Silica Limited Purpos Landfill (Post-Closure) Annual Permit." Permit.
- State of Washington Department of Ecology. 1987. "Exemption Under WAC 173-303-910(3)." Letter.
- Washington State Department of Ecology. 2015. "Cleanup Site Details." June 22. Accessed June 22, 2015.

We appreciate the opportunity to be of service to Schwabe Williamson & Wyatt. Please call if you require more information or have questions regarding this report.

Sincerely,  
GeoEngineers, Inc.



John Peters, PE, ENV SP  
Environmental Engineer



David A. Cook, LG, CPG  
Principal

JP:DAC:leh

Attachments:

- Figure 1. Proposed Development Areas (produced by Concept Engineering Inc.)
- Figure 2. Mining Pit Areas (produced by Bennett Consulting, PLLC)
- Figure 3. Former Underground Mineworks with Proposed Development Overlay (produced by Concept Engineering, Inc.)
- Figure 4. Forest Assessment Areas (produced by International Forestry Consultants, Inc.)
- Figure 5. Sheet EAS-1 (produced by Golder Associates, Inc.)
- Attachment A. Historic Mine Maps
- Attachment B. Coal Fields of King County Report
- Attachment C. Public Health Seattle and King County— Routine Inspection/Field Review
- Attachment D. Quarterly Monitoring Report, Third Quarter 2014, Ravensdale Site, 28131 Ravensdale-Black Diamond Road

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