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ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO SERVICE CENTER SITE

BUFFALO URBAN REDEVELOPMENT AGENCY WEST SITE
FOURTH AND WEST GENESSEE STREETS
BUFFALO, NEW YORK

FINAL

STATE OF NEW YORK
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1.0 Introduction

This Alternatives Analysis Report has been provided as a basis for the Remedial Work Plan for Operable Units OU-1 and OU-2A (BURA) of the Former Buffalo Service Center (BSC) Site and portions of the Buffalo Urban Redevelopment Agency West property adjacent to the west side of the Former Service Center (BURA West, Figure 1). The background and investigation results are provided in Sections 1.0 and 2.0 of the Remedial Work Plan.

An unrestricted use scenario was considered during the conceptual stages of assembling alternatives for the site. However, the proposed use of the property does not require an unrestricted use scenario as development plans for an office complex and parking garage are underway. The volume of soil requiring excavation to satisfy an unrestricted use scenario would increase significantly (likely to double or triple the restricted use scenario estimates). The costs associated with executing such an alternative would be cost prohibitive to the parties and there would be no opportunity to move forward with the Brownfield Cleanup Program for this site. For these reasons, the unrestricted use scenario was not included in the comparative analysis.

2.0 Remedial Action Objectives and Site-Specific Action Levels

The remedial goal for the Site is for the remedy to be protective of public health and the environment, given the intended use of the Site (New York State Department of Environmental Conservation [NYSDEC] 2002b). HealthNow New York Inc. is proposing to lease this property for an office/headquarters complex from Duke Realty. Furthermore, where an identifiable source of contamination exists, it should be eliminated to the extent feasible. More specifically, the remedial action objectives are to eliminate or reduce to the extent practicable:

- sources of ongoing contamination
- potential for ingestion of groundwater
- impacts to on-site groundwater through removal of source materials
- presence of non-aqueous phase liquid (NAPL) through removal of source material
- potential for direct contact with impacted soil
- long-term threat of exposure to site-related manufactured gas plant (MGP) contaminants

The Site is currently owned by National Fuel Gas Supply Corp. (NFG). As the site has been an industrial/commercial property for over 100 years and neither NFG, Duke Realty, or HealthNow have plans to change that designation, the site-specific action levels (SSALs) are appropriately reflective of current and anticipated future use. Pursuant to the remedial goals, SSALs were previously developed and approved by NYSDEC for use in delineation of areas and media requiring remediation.

The SSALs were defined by historical reports and correspondence prepared by RETEC, specifically the Focused Feasibility Study (RETEC 2002a), Remedial Alternatives Report (RETEC 2004c), and Response to Comment letter (RETEC 2004d). Within the letter correspondence, NYSDEC has knowledged that they routinely approve the use of the following values for industrial/commercial sites in voluntary cleanup programs and that they would be appropriate for the Brownfield Cleanup Plan for this site which will include Institutional Controls and Engineering Controls: Total VOCs = 10 ppm, Individual VOCs = 1 ppm; Total SVOCs = 500 ppm and Individual SVOCs = 50 ppm. Applying this information while considering the site-specific Constituents of Interest (COIs), the SSALs are tabulated as follows:

BSC and BURA West **Surface Soil (12 inches)**	TAGM 4046 levels
Subsurface Soil	10 mg/kg total BTEX 500 mg/kg total PAHs 1 mg/kg (or TAGM value, whichever is greater) individual BTEX compounds 50 mg/kg individual PAHs Presence of NAPL

The eight Resource Conservation and Recovery Act metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver) and cyanide were also evaluated (from the available soil and groundwater data) and found not to be a driver for the Site remediation in the context of an industrial/commercial use. The November 2003 groundwater sampling event found no exceedences in offsite groundwater and few exceedences in onsite groundwater within the OU-1 area. Metals above the Technical and Administrative Guidance Memorandum (TAGM) 4046 values for soil, where seen, are typically within the footprint of the already defined remedial areas, or sporadically located in offsite, subsurface, non-MGP potentially impacted areas.

The presence of NAPL as defined for purposes of remedial action shall be soil containing free product or mobile contamination that is identifiable either visually, through strong odor, or elevated contaminant (SSALs) levels.

3.0 Development and Evaluation of Technologies

This Alternatives Analysis was prepared to select technologies and develop a set of remedial alternatives that address the MGP-impacted soil and groundwater within the BSC Site and BURA West. The technologies are evaluated by the following criteria:

- overall protection of human health and the environment
- compliance with Standards, Criteria, and Guidance (SCGs) and Remedial Action Objectives (RAOs)
- long-term effectiveness and permanence
- reduction in toxicity, mobility, or volume
- short-term effectiveness
- implementability
- land use

The anticipated future land use was evaluated for all technologies being considered. As the future plans include development of an office complex, all technologies will generally accommodate the anticipated future development. Table 1 includes an evaluation of land use for the recommended alternative while considering the 16 factors provided by DER-10. Moving forward, a relative comparison related to land use of the technologies being considered is not performed. The relative difference based on the anticipated land use is considered insignificant.

The remedial technologies evaluated below are those that will achieve the primary objective of protecting human health and the environment and satisfying the RAOs. The technologies that are being considered for each operable unit include:

- General Response Actions
- Excavation
- *In-situ* Bioremediation/Enhanced Natural Attenuation
- *In-Situ* Solidification
- Vapor Barriers

3.1 General Response Actions

The following General Response Actions are remedial activities that are expected to be common to, and part of, all of the other alternatives discussed.

3.1.1 Groundwater Monitoring

Groundwater monitoring involves collection and analysis of groundwater samples under a long-term monitoring program to determine the evolving concentrations of constituents of interest (COIs) over time. If natural attenuation is determined to be effective, the duration of monitoring may be less than 30 years. The cost for this task would be incurred at approximately $30,000 per year for 30 years, resulting in a Net Present Value (at 2 percent) of approximately $497,000. If used in conjunction with other remedial actions, groundwater monitoring could demonstrate effective remedial action within 4 years at a cost of $120,000.

3.1.2 Institutional Controls

Institutional controls (environmental easements) result in prevention of inadvertent exposure to potentially impacted soil and groundwater at the site. Proposed institutional controls include access restrictions (such as fencing and signage during construction) and deed restrictions.

Institutional controls provide additional protection of human health and the environment and are often used in combination with other soil and groundwater remedial actions. The selection of specific institutional controls would be consistent with future land use considerations, and current zoning and groundwater use ordinances.

3.1.3 Site Management Plan

Due to the industrial nature of the neighborhood and the backfill used in the Wilkeson Slip, there are exceedences of SSALs in portions of the Buffalo Service Center (BSC) and adjacent properties. Soil that is excavated from on- and offsite during remedial activities will be characterized and properly managed in accordance with NYSDEC regulations.

As the HealthNow facility will immediately follow the remedial action, a Site Management Plan (SMP) is not required for the area of the development (to be defined by Duke Realty). If there are areas outside of the development that may be excavated in the future an SMP will be required.

3.1.4 Storm Water Management

Following the completion of the remedial actions, site storm water will be managed onsite in accordance with a defined management plan. The plan will include direction of the storm water to recharge to the subsurface and/or discharge to the Buffalo Sewer Authority (BSA) storm sewer system. The storm water management system will reduce any potential for migration of COIs from the site and will support natural attenuation of residual groundwater impacts. The storm water management plan will end with the redevelopment of the site by Duke Realty for HealthNow.

3.1.5 Surface Treatment Management

Although there are no potential risks associated with current surface soils, the Duke Realty/HealthNow development will ensure proper storm water management and control of contact with subsurface soils. Routine inspection and maintenance requirements will be necessary to protect the integrity of the surface treatment. This requirement is expected to be minimized as the entire site will be covered with a building or newly landscaped grounds.

3.2 Excavation

The use of excavation to achieve the RAOs could involve (1) excavation and characterization of surface soils to allow access to subsurface soils, (2) removal of buried abandoned foundations and utility lines, (3) excavation of soils containing NAPL, and (4) excavation and offsite disposal of surface and subsurface soils exceeding the SSALs.

3.2.1 Description

Excavation of materials from the BSC site can achieve the remedial action objectives for near surface and subsurface soils. This remedial technology involves excavation of impacted soil, and the transportation of the excavated material to an appropriate offsite disposal facility. Excavation removes impacted materials with standard construction equipment such as bulldozers, backhoes, excavators, front-end loaders, and dump trucks. Many of the construction techniques used for excavation are considered standard practice, but would need to be modified for use at the BSC to manage storm water, groundwater, dust and odors, and to segregate and store excavated solids. The areas of excavation would be backfilled with clean offsite borrow or onsite soils that meet the SSALs. The surface treatment could include features such as asphalt pavement, sidewalks, topsoil and vegetation, and fencing.

Soil within the areas to be addressed with this technology would be excavated to remove COI in concentrations above the SSALs. The work would begin by removing and/or relocating utilities, abandoned foundations, and other obstructions from the excavation area. If this technology were applied to subsurface soils at depths greater than 8 feet below ground surface, dewatering and braced sheet pile or other structural support would be required near the property lines, for the façade, and adjacent structures. The presence of bedrock at 22 feet bgs (on average) will limit practical conventional excavation to depths of 14 feet or less at the toe of the piling, near the perimeter of the site or near the Façade. Other areas of the site could be excavated at deeper depths. Groundwater would be removed to the extent practicable, treated (if necessary) onsite to meet the pretreatment criteria of the BSA publicly owned treatment works (POTW), and discharged to the sanitary sewer system under a temporary permit.

Site controls, such as temporary barriers, would be installed to isolate the work area from the adjacent streets, parking lots, and pedestrians. To control odor and vapor migration associated with excavation, limited areas of excavation, Biosolve™, vapor suppression foam, or a temporary structure (with an appropriate vapor recovery and treatment system) would be utilized.

Excavated materials would be pre-tested according to the requirements of the SSALs and receiving facilities. If necessary, the excavated soil would be treated onsite as needed to meet the acceptance criteria and approved waste profile for offsite shipment and the pre-approved disposal facility. Offsite disposal would be primarily at non-hazardous waste landfills in the western New York area. Thermal desorption, in lieu of disposal at an approved landfill, is not applicable to the materials at this site because the majority of the soils above the SSALs are fully saturated with groundwater, large debris is prevalent, and an excavation is ultimately required for construction of the new HealthNow facility.

Excavated overburden soils that meet the subsurface SSALs would be reused as backfill. Clean backfill meeting TAGM 4046 values would be imported as necessary to establish a finished design grade (Note: the design grade will be established by Duke Realty for the new facility, it will not be the current ground surface.). After final site compaction and grading, the surfaces would be completed. Within OU-1 and OU-2A (BURA) the surface would be completed to support HealthNow construction activities which are expected to be initiated during the remedial program.

3.2.2 Overall Protection of Public Health and the Environment

There are currently no complete exposure pathways associated with the COIs which result in unacceptable risk to human health and the environment. Because of the invasive nature of excavation, there is risk of short-term exposure to noise, vibration, and airborne constituents of concern by the public during implementation. The excavated materials will have to be transported to the landfill on public roadways. The risk of exposure during transportation is far higher than currently exists.

3.2.2.1 Conclusion

While overall protection of human health is diminished by implementing excavation and offsite disposal in the short term, the facilitation of the HealthNow building construction makes this approach feasible.

3.2.3 Compliance with SCGs and RAOs

The removal of contaminated soils could meet the RAOs in the majority of the site(where accessible and practicable). Because of the location of roadways, utilities and impacts from historical offsite uses of the neighboring properties, NYSDEC SCGs for soil and groundwater may not be fully met, even with excavation and offsite disposal along the Fourth Street Site boundary and within the soils supporting the onsite façade. However, excavation would remove a much larger quantity of COI mass and satisfy SCGs to a greater extent than other alternatives being considered.

3.2.3.1 Conclusion

Limitations in excavating all soils and fill exceeding SSALs, as well as regional issues, prevent achieving full compliance with SCGs at the site. Therefore, excavation may not fully achieve SCGs, but is expected to comply more fully than the other alternatives.

3.2.4 Long-Term Effectiveness and Permanence

There is no complete exposure pathway by which the public can be exposed to soils or groundwater at the site. This alternative would effectively limit direct exposure of site utility installation and future construction workers (should future excavation or foundation work be conducted) by removing impacted soil. These potential future exposures, however, could never exceed the short-term level of exposure resulting from excavation and removal activities. However, excavation will be permanent as there are no reversible components, and will provide the highest level of long-term effectiveness. Over time, the concentration of site related COIs in groundwater would decrease since the onsite source is being removed. Long-term groundwater monitoring must be limited to site-related conditions as there are regional groundwater issues that are not the responsibility of NFG. Groundwater controls will be installed as necessary to prevent re-impact to the clean fill placed in OU-1 and OU-2 following the excavation. These groundwater controls could be incorporated into any future development and may include drainage systems and waterproofing systems. Benefits with respect to ecological receptors are better supported by the reduction in mobility criterion.

3.2.4.1 Conclusion

Excavation and offsite disposal is a construction method that is capable of removing a targeted mass of COI from the site within limitations and these actions will create conditions that render permanance to the remedial action. It is an effective remedial technology for this site, despite the short-term risks associated with the excavation which are greater than the current environmental risks.

3.2.5 Reduction of Toxicity, Mobility, or Volume

The toxicity of the constituents is not altered with the excavation alternative. The mobility of the compounds is significantly increased during the excavation program as they are exposed, transported over public roadways, and placed in a landfill. After the receiving landfill is closed, the mobility should decrease as the compounds will move to the leachate collection system, be treated, and be discharged to the local POTW or under a National Pollutant Discharge Elimination System permit. Excavation removes impacted material and relocates a targeted mass of constituents of concern to an off-site landfill. As a result, the site would realize a significant net decrease in toxicity, mobility and volume relative to the other alternatives being considered.

3.2.5.1 Conclusion

The toxicity, mobility, and volume of the constituents of concern are not significantly altered between the existing condition and the final condition due to excavation and offsite disposal. However, the site will realize a significant reduction relative to the other alternatives being considered.

3.2.6 Short-Term Effectiveness

The principal advantages of excavation and offsite disposal are the reliability of effectiveness in the long-term. During the remedial action the potential exposure is higher than under current conditions and under any hypothetical future use condition. There is a short-term reduction in onsite COI mass as it is transferred to the landfill. A primary disadvantage associated with this remedy is the disruption of commercial and residential activities that can result from noise, construction activities, increase in truck traffic, and air emissions such as dust, odor, and, potentially constituents of concern.

It is anticipated that the onsite work would take approximately 3 months for OU-1 and 2 months for OU-2 and BURA West, although these would not be sequential and some activities will overlap. During the implementation of this remedial alternative, measures would be taken to protect the community by monitoring and reducing the potential for air emissions resulting from the excavation and transportation of materials. Dump trucks covered with tarpaulins would be used to transport materials offsite. Excavation would be performed within limited areas, using vapor suppression foams, and other controls. Air monitoring at the perimeter of the site would be performed to ensure air quality standards are met. Vibration and noise would be minimized to the extent practicable. Nonetheless, the potential for exposure, in the short-term only, is significantly greater than exists today.

Direct contact by workers with impacted material during this process is anticipated to be minor since the impacted material is primarily handled by heavy equipment. Exposures would be further controlled by adherence to a detailed work plan and compliance with a site specific Health and Safety Plan (HASP).

3.2.6.1 Conclusion

The short-term effectiveness of the remedial action is an unavoidable increase in the potential risk followed by a reduction in the volume of impacted soil. However, the relatively immediate removal of mass provides for a significant short-term effectiveness to the environment as compared to other alternatives.

3.2.7 Implementability

The implementation of this remedial action would require control of groundwater, air emissions, and traffic; decontamination of trucks and other construction equipment; proper management of decontamination waters; a soil management plan; health and safety protocols; closing the adjacent public parking lot; and transporting the excavated materials on public roads. Noise, vibration, odors, and traffic will impact the public and the adjacent Waterfront School, unless approval and implementation can be accomplished during the 2005/2006 school years when the building is closed for renovation.

Although excavation of shallow soil and debris is common at MGP sites, dewatering and excavation below the water table is much less common. Impacted soil lies up to 15-feet below the water table and water handling will be especially difficult. Braced excavation supports are extremely difficult to install when the excavation approaches the top of rock. Due to the depth of excavation that will be necessary, there is no opportunity to advance sheet piles to the depths required for toe stability. Thus, some soil will not be excavated near the toe of the sheet piling.

3.2.7.1 Conclusion

Excavation below the water table in an area where sheet piles cannot be driven a minimum of 15 feet below the base of the excavation is dangerous. Excavation of areas OU-1 and OU-2A (BURA) to depths in excess of 8 feet are difficult, and below 14 feet are impracticable immediately adjacent to the sheeting (e.g., near the façade)

3.2.8 Cost

The estimated cost for implementing this alternative is $12.8 million for OU-1, $0.4 million for OU-2A (BURA), and $0.7 million for BURA West.

3.3 Bioremediation

Bioremediation coupled with Monitored Natural Attenuation is an effective means to address the mobile fractions of the benzene, toluene, ethylbenzene, and xylenes (BTEX) and polycyclic aromatic hydrocarbons (PAHs) at the site. This technology provides a means to reduce or eliminate migration of COIs in groundwater and reduce the mass of COIs at the site. This technology is not expected to address NAPL or areas of the site containing significantly elevated concentrations of PAHs.

3.3.1 Description

Bioremediation is being considered for use in OU-1, OU-2A (BURA), and BURA West to prevent groundwater carrying MGP hydrocarbon constituents from potentially impacted submerged soils offsite. This alternative would enhance the ongoing and naturally occurring biodegradation process at the site using injection, through wells or driven points, of biostimulants (oxygen and nutrients) and continued monitoring of the BTEX and PAH compounds.

Long-term operation and maintenance of the bioremediation and monitoring systems are routine for these compounds. The mobile fractions would be addressed as they migrate through a zone of enhanced biological activity. Moderately impacted sources of groundwater contamination would be degraded *in-situ*.

Additional studies would be required to evaluate site conditions with respect to aerobic biodegradation before this technology can be recommended as a viable remedial component. Relative to other alternatives being considered, Bioremediation provides for the least protection to public health and the environment.

3.3.2 Overall Protection of Public Health and the Environment

The General Response Actions address all exposure pathways for groundwater. The improvements that this technology provides reduce the time required for natural reductions in the mass of constituents to occur.

3.3.2.1 Conclusion

There is no current risk associated with groundwater. The use of bioremediation accelerates the reduction of the mass of mobile MGP hydrocarbons and reduces or eliminates future potential risks associated with this medium.

3.3.3 Compliance with SCGs and RAOs

Subsurface soils that do not meet the SSALs for BTEX and PAH compounds can be addressed using bioremediation to the extent there is no NAPL present. SCG's and RAOs can be met using this technology for subsurface soils that do not contain NAPL.

3.3.3.1 Conclusion

Although there is no current risk related to groundwater, the stimulation of biological activity will accelerate the ongoing mass reduction in the mobile fraction. This acceleration will reduce the time required for the site to achieve a steady state condition closer to the site boundary. The current extent of COIs in groundwater is limited, but the implementation of this technology can further reduce their extent. The performance of this technology is limited in satisfying SCGs/RAOs relative to others being considered, especially while considering NAPL.

3.3.4 Long-Term Effectiveness and Permanence

Bioremediation and monitored natural attenuation convert the MGP hydrocarbons to harmless naturally occurring compounds, such as carbon dioxide and water. Once transformed, the compounds cannot revert to the BTEX and PAH compounds that were remedied. The available groundwater data show that BTEX and PAHs may already be declining naturally at the site, although additional data collection would be required to confirm.

3.3.4.1 Conclusion

Although there is no current risk from groundwater, the elimination of the mobile fraction of the compounds and ongoing bioremediation that will occur will reduce the mobile fraction of BTEX and PAHs at, and from, the site. This solution will operate for a long-term period and will then be permanent. However, the NAPL areas and relatively high PAH concentrations would not be actively addressed with technology.

3.3.5 Reduction of Toxicity, Mobility, or Volume

Bioremediation and monitored natural attenuation directly reduce the mobility, toxicity, and volume of the COIs mass at the site. The available groundwater data show that BTEX and PAHs may already be declining naturally at the site. Based on the elevated concentrations of COIs and presence of NAPL at the site, the performance of solidification and excavation are expected to provide a greater reduction of toxicity, mobility, and volume

3.3.5.1 Conclusion

Bioremediation is the most effective technology available to reduce the mobility, toxicity, and volume of the COI at the BSC site. Bioremediation provides significant reduction in all three categories of this criterion because complete irreversible destruction takes place. However, the presence of NAPL and high concentrations of COIs limit the performance of bioremediation. The technology will increase the rate of naturally occurring biological decay of the BTEX and PAH compounds and the process will continue as long as the compounds exist in sufficient concentration to support the biologic population. As the compounds decrease in concentration so will the bacterial populations NAPL will not be addressed with this technology.

3.3.6 Short-Term Effectiveness

There is no current risk from groundwater, so the bioremediation cannot provide any net short-term benefit. The system can be installed quickly as the biostimulants can be introduced in wells, a trench, or temporary driven points. The bacterial population will grow quickly and the benefits can be measured within months. Comparatively, bioremediation is expected to provide for a slow realization of performance relative to other technologies being considered.

3.3.6.1 Conclusion

Bioremediation can be initiated quickly and the benefits can be monitored within months of the initiation of the process. NAPL will not be addressed with this technology.

3.3.7 Implementability

Bioremediation can be implemented easily. The system can be installed in a manner that allows application of nutrients and oxygen supplying compounds without unduly impacting the site.

3.3.7.1 Conclusion

Bioremediation is easily implemented, measured, and maintained.

3.3.8 Cost

The estimated cost for implementing a bioremediation program in moderately impacted soils and groundwater is approximately $180,000 for OU-1 and $600,000 for OU-2A (BURA) and BURA West. This would involve injection of a nutrient and oxygen source along the downgradient edge of the impacted materials. A bioremediation program is not applicable to areas of the site containing NAPL.

3.4 *In-Situ* Solidification

In-situ solidification (ISS) is a commercially available technology used to immobilize contaminants and reduce the permeability of the soil matrix. This technology has been successfully implemented at several MGP sites. At this site, two options exist for application of this technology:

- solidification of the zones where NAPL has been identified
- solidification of all soils exceeding the SSALs in each targeted OU

3.4.1 Description

Solidification is achieved by injecting and mixing a cement-based slurry through an auger into the soil mixing zone. Soil mixing is accomplished below the ground surface by repeated upward and downward movements of a rotating paddle auger as the solidification agents are added. The addition of slurry, and its subsequent hydration, can increase the total volume of the treated soil by 10 to 30 percent and reduce the permeability to 10^{-5} centimeters per second (cm/sec) or less. Overlapping columns of stabilized materials creates a wall or solidified mass.

The RAOs would be met by meeting a series of specific objectives; creating a solid *in-situ* soil/cement matrix that had a permeability of 1×10^{-5} cm/sec or less; an unconfined compressive strength of 50 to 100 pounds per square inch; and elimination of visible NAPL. A treatability study of different mix ratios and additives (primarily Portland cement) has been performed to determine the type and amount of additive that would be needed to achieve the objectives (RETEC 2004a). Augered solidification could be conducted around or in OU-1 and OU-2A (BURA).

The ISS activities would begin by removing and/or relocating utilities and other surface and subsurface obstructions from the area to be stabilized. Site controls, such as temporary barriers, would be installed to isolate the work area from the adjacent streets, parking lots, and the public.

Overburden soil within the remedial areas would be excavated to allow for the expansion of the solidified mass. Assuming a 25 percent expansion, and a solidification zone of 4 to 20 feet below original ground surface, an average of 4 feet (0.1 foot above average water table) would be pre-excavated from OU-1 and 6.3 feet (3.0 feet below water table) from OU-2A (BURA). The resulting top of the ISS mass would then be approximately 1.5 feet below finished grade at OU-1 and 4 feet below grade at OU-2A (BURA). The soils from these excavations, following testing and compliance with SSALs, would be used as fill on the BSC property.

Additionally, subsurface MGP structures and the surface of OU-1 outside of the remedial area (except the façade) would also be pre-excavated as necessary to allow for placement of a clean soil or asphalt cover.

Following pre-excavation, the footprint of the remedial areas would be augered and mixed *in-situ* with the pre-designed Portland cement slurry to produce overlapping columns of monolithically solidified soil to a depth below the impacted soil, or to bedrock. The fill, soils and debris removed during pre-excavation would be stockpiled adjacent to the excavation and the debris would be segregated for offsite disposal. The excavated soils that do not meet SSALs would be returned to the excavation for ISS or stabilized for onsite use in temporary berms.

Onsite quality control would involve monitoring the depth and thoroughness of ISS mixing. The solidifying fluids would be monitored for viscosity, density, and filtrate loss. A sampling program would be required to verify that the solidified material does not fail TCLP testing.

Depending on the approach, actual onsite process time would be approximately 1 to 3 months for OU-1 and 1 to 2 months for OU-2A (BURA) and BURA West.

After final site compaction and grading, the entire remedial area would be covered with fill meeting the SSALs and restored. O&M costs would be limited to groundwater monitoring and annual inspections. The solidification process may alter groundwater flow near the site and quarterly monitoring would be required for 2 years following remediation (at a minimum). Controls to prevent groundwater mounding may be required as part of the design phase.

3.4.2 Overall Protection of Public Health and the Environment

As there are currently no complete exposure pathways associated with the impacts at the site, ISS will marginally increase protection of human health. ISS will decrease the permeability of the soils and fill in the treatment zone. Groundwater from upgradient sources could accumulate behind the mass and rise closer to the surface (increasing the potential for exposure), though ISS designs are based in part on groundwater modeling to avoid adverse groundwater elevation changes. ISS would reduce the potential mobility of the MGP COIs in the environment. The ISS action would be conducted in a manner that allows a future developer to use the property. The new development must be designed in a manner that is consistent with the ISS.

Because of the invasive nature of ISS, there is risk of short-term exposure to noise, vibration, airborne Portland cement, and airborne COIs by the public during implementation. The risk of exposures would be minimized through the use of engineering controls, such as dust suppression and vapor controls. Due to the fact that the majority of the process is *in-situ*, the exposure risk would be less than that of excavation except for those soils that must be removed to allow for expansion.

3.4.2.1 Conclusion

There will be limited improvement of the protection of public health, as there is no complete exposure pathway before or after ISS. There is a potential that the alteration of the groundwater system could create a situation whereby exposure to groundwater COIs would be greater than under the current conditions. There would be a large reduction in the mobility of COIs.

3.4.3 Compliance with SCGs and RAOs

In-situ treatment of contaminated soils using the ISS method would reduce the mobility of COIs in the soil and reduce the potential for continued leaching to groundwater. Compliance with NYSDEC SCGs would not be achieved within the solidified soil mass, but reductions in

COIs would be achieved over time in the surrounding groundwater (although contributions from upgradient groundwater sources cannot be controlled).

3.4.3.1 Conclusion

Compliance with NYSDEC SCGs would not be achieved in the solidified soil, per se, but reductions in COIs would be achieved over time in the surrounding groundwater. ISS would achieve compliance with site RAOs.

3.4.4 Long-Term Effectiveness and Permanence

The long-term effectiveness of ISS is related to the ability to retain the BTEX compounds in the solidified mass. This alternative would provide long-term reliability for reducing direct exposure of the public to impacted surface and subsurface soil. Solidification of contaminated soils would decrease the potential for migration of impacts to groundwater and surface water.

ISS has been shown to be effective in immobilizing DNAPL, metals, and other COIs within a low-permeability solidified soil matrix, thereby preventing (or severely restricting) future migration into groundwater. The permeability of the resulting solidified mass would be such that groundwater would be unable to penetrate it, thus the MGP constituents would be unavailable to leach into the groundwater or volatilize into soil gas. Since the MGP constituents could not migrate from the solidified mass, they would not be available to affect human health or the environment. Consequently, impacted groundwater would continue to naturally attenuate over time. Overlapping of the ISS action into areas that satisfy the SSALs or other controls should be evaluated to address any potential leaching of contaminants into the groundwater from the outer surface of the solidified mass.

ISS would be compatible with most future site development plans, because the solidified soil would have improved structural integrity but would not have a hardness incompatible with future building or utility construction on the site.

3.4.4.1 Conclusion

ISS would be a long-term solution. Solidification of contaminated soils would decrease the potential for migration of impacts to groundwater and surface water. The long-term effectiveness of this technology lies in the ability of the solidified mass to resist groundwater migration. Once the cement/water/soil mixture “sets up” and satisfies the required compressive strength and corresponding permeability much lower than the surrounding groundwater zone, the long-term effectiveness is achieved.

3.4.5 Reduction of Toxicity, Mobility, or Volume

ISS has been demonstrated to be effective in immobilizing hydrocarbons and metals within a low-permeability solidified soil matrix, preventing future migration. However, there would be no reduction in toxicity or volume of constituents within the soil matrix.

3.4.5.1 Conclusion

ISS can limit mobility of NAPL by enclosing these materials within a solid matrix. The toxicity and volume of the COIs will remain, so the same limitations on excavation and materials management exist after ISS as they do today.

3.4.6 Short-Term Effectiveness

During the implementation of this remedial alternative, measures would be taken to protect the community by monitoring and reducing the potential for air emissions by the use of a vapor recovery/treatment hood (fitted over the soil auger) and foam suppressants. Sealed bed dump trucks covered with tarpaulins would be used to transport materials offsite. Air monitoring at the perimeter of the site would be performed to ensure air quality standards are met. Vibration and noise would be minimized to the extent practicable. Due to the *in-situ* nature of this remedy, the exposure risk would be less than that of excavation.

Direct contact by workers with impacted material during ISS is anticipated to be minor since the impacted material is primarily below the water table. Exposures would be further controlled by adherence to the site HASP.

3.4.6.1 Conclusion

ISS could have an overall positive effect on the environment because the process reduces the mobility of COIs in the subsurface. A modified groundwater flow pattern may develop such that flow would be around rather than through the ISS material, reducing the flow of groundwater into and through the media containing the COIs. The use of supplemental technologies around the monolith will be evaluated in the final design to ensure that final conditions do not pose a risk.

3.4.7 Implementability

The implementation of this technology would require control of air emissions and traffic, decontamination of trucks and construction equipment, and proper management of decontamination waters. It should be noted though that odor and volatile emissions from ISS are significantly less than that of excavation because the work is occurring primarily below the water table. Likewise, truck traffic for transport of material to or from the site would be far less. Noise from the drill rig would, however, be similar to a major construction project. Noise, vibration, odors, and traffic would all be monitored, and appropriate corrective action taken, as necessary.

3.4.7.1 Conclusion

ISS at OU-1 and OU-2A (BURA) would be complex due to the presence of subsurface concrete, structures, piping, and debris. Pre-excavation and removal of MGP structures would be required.

3.4.8 Cost

The estimated cost for implementing this alternative is $4.5 million for OU-1 and $2.1 million for OU-2A (BURA), and $0.7 million for BURA West.

4.0 Proposed Site Remedy

In this Alternatives Analysis, ESC Engineering of New York has evaluated appropriate technologies that address impacted soil and groundwater at the Buffalo Service Center site (OU-1, OU-2A [BURA], and BURA West) with respect to the evaluation criteria and proposed use for an office building/headquarters complex. The remedial technologies evaluated include:

- General Response Actions, including
  - Groundwater Monitoring
  - Institutional Controls (environmental easements)
  - Site Management Plan
  - Storm Water Management
  - Surface Treatment Management
- Excavation
- Bioremediation
- Solidification

General Response Actions provide a means to protect against future actions that could create exposure pathways, and monitor conditions to ensure that there is no increased risk in the future.

The use of ISS further reduces the potential for compounds to partition from NAPL impacted soils into groundwater. NFG's ISS treatability study has shown that solidification will, predictably and cost effectively, meet the remedial action objectives in those areas with NAPL and will allow rapid site re-development and re-use.

The addition of *in-situ* bioremediation downgradient of the stabilized masses accelerates the natural remediation of COIs in the lesser impacted soils and those that are moving within the groundwater system.

In-situ chemical oxidation was eliminated from consideration at this time because the treatability studies conducted for the BSC indicated that the cost would be high and complete treatment would be difficult to attain.

Excavation of impacted soil, other than the first few feet of overburden, is only considered cost-effective in light of the proposed development. The short-term level of exposure resulting from excavation, handling, and transport activities will unavoidably exceed the potential for future exposures were the material not removed. Excavation is disruptive of commercial and residential activities due to increased truck traffic and air emissions. The high groundwater table (2 to 8 feet bgs) coupled with the shallow bedrock (20 feet bgs) does not allow sheetpile support walls to be tied to the subsurface. Excavation of areas OU-1 and OU-2A (BURA) in excess of 8 feet would be dangerous and difficult and below 14 feet would be impracticable along the sheet pile barriers.

There is currently no unacceptable level of risk to NFG employees working at the site, employees or patrons of the adjacent parking facility, or the students or faculty at the Waterfront School.

Based on the proposed site development, site investigations to date, and the evaluations presented in this Alternatives Analysis Report, ESC Engineering of New York, PC recommends the following as the proposed remedy for the BSC (Figure 1):

- General Response Actions for OU-1 and OU-2A
- Excavation of Soils exceeding the SSALs in OU-1, OU-2A(BURA), and BURA West
- Groundwater monitoring of the site perimeter for 2 years (at a minimum)

The proposed remedy encompasses all exceedences of the SSALs.

The Proposed Remedy provides the most effective short-term and long-term overall protection of human health and the environment in light of the proposed HealthNow building. Excavation of soils with COIs in excess of the SSALs eliminates the partitioning that can contribute to groundwater migration of COIs. Groundwater monitoring for 2 years at locations defined by the results of analysis of extracted groundwater.

The proposed remedy will be permanent as there are no reversible components, and will provide the highest level of long-term effectiveness.

The proposed remedy addresses all current and future potential risks and relies on technologies proven to be effective and permanent for reduction of toxicity, mobility, and/or volume of COIs at MGP sites.

The proposed remedy can be implemented within a single construction season, thereby rapidly returning the site to beneficial use.

The estimated cost of the proposed remedy is $ 14 million.

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Figure

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