APPENDIX 4A
Lessons Learned

Development	Activity Which Led to Lesson	Lesson Learned	Management Result
Giant Mine – NWT Underground stabilization 2015 Non-arsenic and arsenic stopes	Health, Safety & Environment – General Health, Safety & Environment (HSE) activities were carried out under the regulations of the NWT *Mine Health and Safety Act* and supervision of the Care & Maintenance contractor. The key aspects (outside of normal HSE) were medical monitoring, dust control, and water management.	• Stacking tails not necessarily good and does not achieve any efficiencies. This also causes potential challenges for dust control. • A bigger tailings storage facility might be good. • Need to have a blackout period for work on the tailings. • Multiple work fronts were key for continued operations while certain areas were off limits for safe access due to recent paste pours. • In general, HSE was well controlled for underground at night with good reporting and check-ins. • Underground tag board notices worked well. • Physical barriers are needed for underground areas where paste would go. There was a situation of staff entering a “no go” zone that could have been prevented with hard barriers.	The importance of planning is noted, including access restrictions for safety reasons and having multiple work areas available to account for variability in paste set up.
	Health, Safety & Environment – Controls for Working near/in Arsenic Stopes Part of the scope of work involved delivering paste to arsenic-containing stopes and required processes during this activity for worker/environment safety.	• Drilling and backfilling was carried out in arsenic stopes without issues. • Exposure mitigation (e.g., hygiene) is key and should be well explained in future specifications. • Vacuum system worked well. Understanding of underground connections could be better. • Better definition of required PPE needs to be provided.	
	Regulatory Requirements and Interactions Review of the requirements of the regulatory bodies (i.e., Mines Inspector, Lands Inspector and Mine Manager).	• Care & Maintenance contractor helped immensely and made interactions with inspectors go smoothly. • The equipment list should go to Mines Inspector early in the project. • The requirement for design drawings for electrical (contractor site works) was a surprise when requested by the Mines Inspector. • Central site water distribution control could be handled by the Care & Maintenance contractor and not the backfill contractor. This will allow better control of integration of total site water usage. • The North Pond needs to be identified as the main water source, assuming it makes good paste.	
Giant Mine – NWT Underground stabilization 2015 Non-arsenic and arsenic stopes	Ambient Air Monitoring A third party (SLR) controlled the ambient air monitoring program for the Giant Mine and was a requirement for this project.	• A better understanding of the system and how it operates and feeds into the larger program is needed. • SLR could have been on the daily tailgates, and this would provide a better understanding of the daily activities.	There is a need for incorporating the air monitoring into the on-site communication and having a site-wide medical monitoring program. Education of workers around impact of diet and personal hygiene is important.
	Medical Monitoring There was a requirement for medical monitoring of crews for the purpose of understanding the level of arsenic in the body.	• Dietary spikes were a constant concern and challenge. • It would work better if there were a site-wide contractor/consultant managing the medical monitoring program. Then specific contractors could feed into this program. • Orientation packages should include discussions on how diet and other items trigger spikes in arsenic levels.	
	Development of Plans & Water Licence Requirements The consultant (Golder), along with PWGSC and INAC, developed the work plans associated with this project due to schedule constraints.	• Additives and other constituents were not explicit and should be within the tender package. • Baseline plans should be finalized and managed through change management.	
	Mobilization/Demobilization	• Clarity needs to be provided on the close-out process as it relates to the interim acceptance for completion and generation of deficiency lists. • A lessons learned meeting should be included as part of the demobilization activity in the specifications.	

Development	Activity Which Led to Lesson	Lesson Learned	Management Result
Giant Mine – NWT Underground stabilization 2015 Non-arsenic and arsenic stopes	Tailings Excavation, Paste Production/Delivery The contractor (DCN) utilized mainly the Central Tailings Pond for the tailings source for the project. Tailings were processed in the “Super Dome” located at the Central Tailings Pond. Tailings were delivered to the respective stopes via cement trucks and chutes.	• Triple handling of tailings is not ideal. This relates to the requirement to stockpile tailings in fall 2014. • Trafficability will be an issue with the tailings pond. • Variability will increase the more tailings material is extracted from the source. • Delivery via multiple work fronts was key to the success of the process that DCN executed for this project • Underground piping of the same diameter as surface piping would have been beneficial. This would limit the potential for blockages in the pipeline. • Bleed volumes were high and quantities were not well known. There is a need to account for potential bleed water in the volume calculations. • Identify high potential leakage stopes for the contractor to prioritize. • Reporting for quality control is needed to identify leakage more quickly. • Clear expectations are needed around who is responsible to identify that leakage is taking place. • Improvement on the timelines is needed to ensure better flow of information and reviews. • Dealing with stand-down time will be an issue.	Timely reporting of quality assurance results allows prompt response to address issues or concerns such as leakage from stopes. Working in the tailings areas for excavation can be problematic and requires multiple access points to maintain progress. Responsibilities for the various parties need to be well defined and communicated, including control of access and site security.
	Site Access & Interaction with Mine Manager and Others The Giant Mine is a site that has a number of different parties accessing various areas of the site.	• The mine management team did very well to control access and manage inter-action with others. Their active participation in future remedial activities is a necessary requirement for success. • Ground control needs to be with the Care & Maintenance contractor. • Site security could be improved as there were cases of unauthorized people in the DCN work zones. • Security guards were liabilities at times as they did not fully understand the restricted access of certain work zones.	
	Leakage – Identification and Resolution It was known that leakage would happen during the project. There was a leakage plan in place prior to the start of the project, which included a meeting to review and discuss leakage.	• Stope A370 was the main area of concern for leakage • Roles need to be better defined. • Challenges existed when determining leakage vs. not leaking. • Fog was an issue during placement of paste.	
	Volume Verification – Truck Count, Flow Meter, Other Volume verification is critical to both payment and understanding the volume of product placed in each stope. This project used truck count as the method for volume verification.	• Other methods might have been more ideal, but each presented challenges in dealing with the abrasiveness of the tailings product. • Truck counts worked but relied on visual observations. • No specific resolution; different methods could be used under different circumstances.	
Giant Mine – NWT Roaster Complex Stabilization	Waste Assessment Waste assessments were completed in two stages during periods of very cold weather in restricted access buildings. Conditions hampered the assessor’s ability to fully understand issues and constraints, the collection of samples, and the determination of quantities.	• The requirement of significant logistical support during assessments of this nature need to be planned for. • If possible, the overall schedule should be planned to fully utilize the summer season to gather field information. • Investigations were continued during the contracting phase and lighting was increased once it was an identified concern to reduce number of unknowns. • Safety plans need to adequately deal with all risks, including cold weather and lighting.	Work is impacted by weather and benefits from planning the execution during warmer conditions—in particular the site assessment aspects. Waste quantities can vary from estimates and need to include a contingency allowance to account for actual volumes exceeding estimates developed during assessment stage.
	Waste Assessment Previous assessment reports regarding volume of material within sealed structures were found to be very inaccurate. The inability to access the interiors of sealed structures—at the Cottrell especially—resulted in a significant (10×) underestimation of the volume of material to be removed and the scope to complete the work in terms of the condition of material. Blueprints were gathered and compiled during the tender package development. Blueprints were not available at the beginning of the assessment period, which limited initial reviews.	• Field verification should be completed during assessments to the extent possible. Unreachable areas should be treated as hazardous for conservative scheduling/costing. Allowance for uncertainty in waste quantities should be incorporated (contingency). The available drawings were a valuable resource and should be maintained. • Particular attention should be paid to terminology used to describe things (e.g., calling everything "dust" led to a perception by the contractor that material was all very loose and easily vacuumed). • Obtaining building blueprints prior to assessment or reviewing blueprints before tender package would help to better identify potential unknowns. This way, further investigation can be conducted prior to completion of tender package, or the appropriate uncertainty carried in tender package. All available Giant Mine drawings should be scanned and inventoried for future reference. • Unreachable areas should be treated as hazardous for conservative scheduling/costing. Allowance for uncertainty in waste quantities should be incorporated (contingency).	

Development	Activity Which Led to Lesson	Lesson Learned	Management Result
Giant Mine – NWT Roaster Complex Stabilization	Hygiene / Health and Safety The risk of exposure to arsenic (from other sources) by workers in areas outside of buildings was not properly captured in the original health and safety plans and standard operating procedures. This was identified in 2013. Subsequent contractor meetings with the local labour authority resulted in additional measures such as the extension of the exclusion zone, boot wash stations, dedicated coverall laundry and change areas, and wash stations.	• Include details regarding soil contaminant concentrations for overall work areas in specs so the contractor is adequately able to evaluate and mitigate risk to workers. General soil concentrations were provided in supporting documentation (DAR, Parsons soil sampling, reinforced in meetings). • Complete more detailed soil assessments in future work areas. • It needs to be to confirmed whether soil conditions warrant the need to complete medical monitoring for areas of the Giant Mine. • The hygiene program needs to be made more inclusive to consider various contaminant sources and the risk of all work being done at the site. Focus should be placed on good housekeeping and cleanliness. The placement of geotextile was useful in isolating workers from contaminated soils and should be continued in future projects. • Exposure sources were variable, and were often assumed but not conclusively linked to remediation/site. Considerations to worker habits and resulting effect on testing levels should be included (e.g., smokers, diet, personal). Exceedances should be followed up rigorously to pinpoint source of contamination. • Exposure risk was often perceived to be primarily air exposure; however, soil exposure was often more likely. Additional assessments should be done to map contamination concentration of soils (by zones) to better understand and mitigate risks. • The program should not be built around medical monitoring (i.e., not reactionary), but rather actual contaminant levels on site (e.g., soil, air, site). Industrial Hygienist should review soil sampling program. • Soil hot spots need to be reviewed to determine whether any mitigative/remedial action is required.	Contaminant exposures beyond air exposure need to be assessed to develop mitigation plans. Covering work areas with geotextile was an effective means of limiting worker exposure. Education around the risks and importance of hygiene and diet will limit worker risk. Medical monitoring serves as verification of the effectiveness of proactive avoidance measures. Lessons learned will be incorporated into closure activities and/or relevant management plans, where appropriate Housekeeping and site management must be stressed in recognition of the exposure potential. Dust management to control exposure to surface arsenic requires a fine balance between controlling dust but not creating a wet waste.
	Hygiene / Health and Safety The importance of housekeeping in trailers and vehicles and of personal hygiene was not fully appreciated at the start of the project. Even housekeeping staff were not cognizant of how their procedures may be contaminating facilities (e.g., putting chairs or other items that were on the floor onto tables or desks—after they had been cleaned—while mopping floors).	• This needs to be constantly reinforced with workers. Soil contaminant levels surrounding facilities will be part of future specifications to properly inform contractors of risk so that it can be evaluated and mitigated. • Future projects need to emphasize the importance of housekeeping.	
	Hygiene Early on during decontamination work, when actual arsenic abatement work started (vs. asbestos)—at the Baghouse—very high levels of airborne arsenic were recorded (approaching half the Immediately Dangerous to Life or Health Concentrations) which were on the verge of necessitating supplied air from a regulatory perspective.	• It was quickly learned that arsenic dust suppression required more water application than was typically needed for asbestos abatement work. It was also learned, however, that there was a fine balance to use sufficient water to keep airborne levels low but to not have saturated material placed into waste bags that would then cause leaking of free liquid.	
	Hygiene Having to place waste bags into shipping containers in winter conditions resulted in snow being brought into containers, which then created condensation issues and provided liquid for any minor bag leaks to escape the containers.	• Placement of waste bags into containers during snow conditions should be avoided. Remove snow from bags before placing them inside containers.	

Development	Activity Which Led to Lesson	Lesson Learned	Management Result
Giant Mine – NWT Roaster Complex Stabilization	Ambient Air Dust generated from simple vehicle traffic at the site was a concern because of the ambient air monitoring and close data scrutiny, necessitating multiple applications of water throughout the site daily.	• The use of calcium chloride in late 2013 and 2014 significantly lessened dust generation from traffic and lessened the need for water application.	Lessons learned will be incorporated into closure activities and/or relevant management plans, where appropriate. Calcium chloride is an effective dust suppressant and lessens the requirement for watering. Daily air monitoring confirms the effectiveness of health and safety protocols and decontamination procedures. Monitor locations need to recognize the influence of operating equipment, including the potential for false positives.
	Occupational Air Monitoring Hydrogen cyanide / arsine monitors are sensitive to carbon monoxide and other similar gases and will trigger false positive alarms when placed around operating equipment (e.g., power washers, skid steer). Daily arsenic air monitoring data were indicative of the effectiveness of decontamination procedures and wetting methods.	• Procedures were established and implemented to allow for the use of this equipment and maintain the protection that these monitors provide (e.g., monitor calibration and equipment venting). • Air data were used to develop a greater understanding of airborne arsenic concentrations in relation to decontamination work activities and the development of mitigative measures to reduce dust releases. • Lessons learned has to be continuously implemented as familiarity with instruments and potential causes of alarms increased. Moved potential sources of carbon monoxide, carbon dioxide, water vapour, etc. away from meters.	
	Ambient Monitoring Sensitivities of real-time monitors.	• Real-time monitors were sensitive to relative humidity, cold temperatures, forest fire smoke and fog. Procedures were developed for properly documenting alarms and sensitivity issues.	Any issues that arose were addressed immediately. Air monitoring team members worked well together to prepare meaningful standard operating procedures and documentation to support the program.
	Medical Monitoring Change in acceptable levels of arsenic in urine. Employee hygiene throughout the project. Non-occupational interference.	• The Workers' Safety and Compensation Commission (WSCC) changed the acceptable level of arsenic in urine during first field season. Greater involvement by WSCC is recommended to determine acceptable working criteria before onset of project field season. • It was a constant daily challenge to get employees to take personal hygiene seriously. Consistently coached, mentored, and discussed with employees the importance of increased personal hygiene. • It was discovered that some non-occupational sources such as diet could affect arsenic levels in urine. Consistently coached and mentored employees on importance of diet during the life of the project.	Lessons learned will be incorporated into closure activities and/or relevant management plans, where appropriate. Worker education is critical in combination with a medical monitoring program to improve the effectiveness and reliability of results.
	Spills/Releases Spills generally occurred as a result of equipment failure, waste bag failure, or water treatment plant failure. Failure to report a reportable spill to NT Spill Report Line in timely manner.	• Equipment failure: Crews were reminded to complete all pre-use inspections and follow proper fuelling procedures. • Waste meter bags were to be inspected on a regular basis and only those rated and accepted through quality assurance procedures should be used. Bags should also not be filled with over wet material or filled beyond their weight capacity. Regular inspection of these areas was required to be completed. • Water treatment plant failure: Increase number of inspections on water treatment plant components to confirm that they are in good working order. Also inspect tank levels on a daily basis to be sure they are not reaching capacity. • All project team members should be familiar with spill contingency plans and their associated reporting procedures in order to minimize the possibility of a spill being reported outside the acceptable time limits.	Lessons learned will be incorporated into closure activities and/or relevant management plans, where appropriate. Equipment maintenance is to be stressed to reduce the potential for spills on site. Responsibilities for reporting and responding to spills need to be well communicated.
Giant Mine – NWT Baker Creek Reach 4 realignment	Frozen material was encountered during excavation and proceeded to melt upon exposure, particularly to the sun, which caused thermal settlement in channel.	• Bridge foundation design was impacted and may require future adjustment to grades on approach fills. • Presence of frozen material in the creek channel necessitated excavation below design grade, impacting volume of fill material required. • Thermal settlement in channel was encountered.	Exposure of ice or frozen ground to sun is to be managed to either facilitate or avoid melting, depending on activity. Adjustment of designs will be required during construction.
	Arsenic contamination was encountered during excavation and backfilling.	• Unexpected contamination was encountered with in situ material. • Unexpected contamination was encountered in borrow material.	Adaptation is required to excavate unexpected contaminated soil and for sourcing of uncontaminated borrow material. Adaptation measures may include health and safety actions, additional soil analysis and waste disposal actions.
	Haulage trucks could not safely drive on silt- or clay-based roads during or after rain	The roadbed material for most of the project was composed of varying combinations of silt and clay, both of which readily become slippery and soft when wetted by rain. Continued travel could have resulted in: • Making tire ruts in completed areas which would then require re-work. • Equipment damage or stuck from sinking into soft areas. • Loss of control of equipment on slippery areas, particularly hill.	Work could continue at times when rain was light or travel routes had no hills. Rain generally resulted in a project work delay. Allowances for occasional weather delays need to be included in schedule.
	Construction work sometimes proceeded without the guidance of construction drawings.	Construction drawings were not always available when required for several reasons: • Design drawings changed as bulk excavation proceeded and subsurface conditions became apparent. • Drawings changed to accommodate the availabilities of borrow materials as they were identified, assessed and added to inventory.	Channel design evolved into a collection of typical sections, which were applied to suit field conditions encountered during the course of construction.

Development	Activity Which Led to Lesson	Lesson Learned	Management Result
Giant Mine – NWT Baker Creek Reach 4 realignment	Poor survival rate of vegetation post realignment.	Dry weather following the realignment of Baker Creek led to the death of planted vegetation due to lack of water.	Contingency of watering is required during dry weather to increase survival rates of planted vegetation during establishment as well as realistic planning for locations where vegetation can grow.
Giant Mine – NWT A-Shaft Complex, Curling Rink and Assay Lab Deconstruction	Some building structures were identified as structurally unsound.	Ongoing vigilance required in deconstruction activities, particularly as it pertains to health and safety.	Repair required prior to removal of hazardous substances to ensure worker safety.
	During the course of work, a large number of additional items were identified by the contractor as needing sampling because of suspected hazardous materials.	Hazardous material may not be completely identified during initial inspections.	Samples were collected and analyzed as required to confirm material classification.
	INAC had requested that porous, structural non-hazardous waste, which was identified to be stored on site, be fully tested to confirm that the waste can be classified as non-hazardous waste for potential disposal in the City of Yellowknife landfill.	Flexibility in terms of the sampling and analysis regime required in order to classify waste appropriately.	A large number of wood waste samples (and one concrete sample) were analyzed for toxicity characteristic leaching procedure (TCLP) analysis to support the request to dispose of the structural waste at the City of Yellowknife landfill.
Giant Mine – NWT C-Shaft Headframe Structures Deconstruction	In some cases, it was not possible or safe to remove identified hazardous waste prior to deconstruction (for example asbestos tar paper located in between additions or wedge behind supporting beams).	Flexibility required in the timing and sequence of hazardous waste removal and disposal during deconstruction activities.	The wastes were noted and isolated in order to not become a risk during r deconstruction activities. Specifications need to be flexible to allow alternative abatement methods to be utilized.
	During the deconstruction of the wooden portion of the headframe, rotten structural members were encountered.	Crews would inspect the integrity of support beams prior to entering locations to perform work.	To safely perform the work, temporary support structures, such as wooden cross braces, were constructed in identified problem areas prior to crane deconstruction.
	An incident occurred where, due to contractor communication error, asbestos containing wood waste was accidentally converted into wood chips	Clear communication required for all waste disposal streams.	The asbestos containing woodchips were treated as asbestos containing hazardous waste and disposed of off site.
Giant Mine – NWT Structural Assessments, Baker Creek Assessments, and UBC Bridge Repair Works	The loss of permafrost within the Giant Mine site has been observed and the structural integrity of a number of structures has been compromised.	Identification of permafrost and regular monitoring of permafrost where it is a key foundational support is required in order to mitigate against infrastructure damage.	Project assessments and siting studies seek to determine the location of permafrost and design avoids these areas, or implements appropriate controls such as founding structures on bedrock. Monitoring of structure stability and permafrost has been included in the Geotechnical Management and Monitoring Plan.
Ekati Diamond Mine – NWT	Infrastructure development in caribou migration paths	The potential for caribou passage to be impeded or for caribou to be injured/killed by infrastructure exists.	Wildlife access ramps were provided on haul roads;
Con – NWT	Establishment of vegetative islands	There were difficulties in acquiring the growth media required to support plant growth from the Yellowknife region.	Choice of closure options and scheduling of these options need to consider difficulties that may be encountered in procurement of required supplies to support option.
	Groundwater monitoring	Changes in surface water and groundwater management may cause some monitoring wells to become dry.	Flexibility may be required in groundwater monitoring program.
	Management of arsenic impacted soil	The contaminated soil was excavated and disposed of on-site in approved hazardous waste disposal area (former calcine storage area).	The area impacted by contaminated soil was minimized through consolidation of contaminated soil.
	Management of arsenic sludge	Arsenic sludge was removed and treated: excavated to bedrock, high pressure washed, backfilled with clean country rock, and capped.	Contaminated sediment was removed from area.
	Tailings containment areas	Reclamation of consolidated tailings was carried out through establishment of self-sustaining native vegetative cover.	Tailings were isolated from contact by humans and wildlife.
	Tailings containment areas – recently active	Tailings were capped and then covered with material to support vegetation growth.	
	Surface water management	Contouring and installation of armored drainage channels was carried out to direct contact water towards the TCA for treatment (if required) prior to discharge. Additional surface water was prevented from entering the site.	Surface water is managed on site
	Surface structures	Site infrastructure may have value to the local community. The City of Yellowknife requested the warehouse/shop/ administrative area for future use as a public works building. The City also expressed interest in maintaining the Robertson Shaft headframe as a heritage site.	A Memorandum of Understanding was developed between Miramar Northern Mining Ltd. and the City of Yellowknife for the retainment certain buildings on site.
	Post-closure monitoring and maintenance of site	Monitoring was initially estimated to be required for at least 50 years, but may be required for longer.	Regulators are aware of potential ongoing post-closure monitoring requirements; communication is pivotal and reasons for delays must be outlined

Development	Activity Which Led to Lesson	Lesson Learned	Management Result
Tundra – NWT	Site structures: Building demolition and disposal Buildings burnt in place or demolished using and excavator	Burning of waste results in undesirable air emissions.	Burning of waste is now discouraged due to air emissions.
	Closure of mine openings. Competent rock assumed to be present at all shaft openings to allow concrete cap to be doweled into it	Competent rock was not present at all openings, necessitating modification of mine seals.	Modification of mine seal allowed sealing of all openings.
	Asbestos abatement Additional materials identified as being impacted by asbestos during pre-demolition inspections beyond those originally identified.	Disposal of additional asbestos-containing material was required.	Asbestos containing material was disposed of via approved methods at on-site landfill
	Lead paint abatement Unable to dispose of in on-site landfill due to potential for toxic leachate.	Lead paint was used extensively throughout structures. Various methods of disposal used: • paint stripping and disposal of sludge at off-site facility • wood material packed into containers for disposal at off-site facility Remainder of paint had low enough concentration to be disposed of in on-site waste disposal facility.	Lead paint was disposed of via approved methods.
	Petroleum and sludge abatement Significantly more product on site than initially estimated.	Additional empty fuel drums were salvaged to contain petroleum product from above ground storage tanks. The produce was disposed of off-site.	Petroleum and sludge were removed from site.
	Implementation and administration of licence conditions. Contractors generally do not understand how Water Licences are applied.	In the future, some type of explanatory note is to be provided by the Crown explaining who is responsible for which activities under the terms and conditions of the Water Licence and what are the training issues.	Clearer communication of responsibilities pertaining to the Water Licence.
	As part of the Tundra Phase IIB remediation design, a borrow area was regraded to expose the bedrock in high elevation areas. The bedrock dipped more in certain areas than what was assumed, and therefore the overburden was excavated deeper than required resulting in more volume.	It was agreed that a “depth-to-rock” geophysics survey should have been conducted during the design phase to mitigate the over-excavation. This survey information would have been invaluable prior to quarrying, to avoid uncovering previously buried debris.	A ‘depth-to-bedrock’ geophysics survey was conducted and assisted with the remaining excavation work. The geophysics survey was utilized to determine the presence of buried metal debris in the airstrip area, which was partly uncovered during quarrying efforts.
	With the size of the Tundra mine remediation site, it was difficult for the contractor to achieve ‘final completion’ in all areas, especially with the cold weather and snow covered areas at the end of the construction season.	It would have been helpful to develop an area completion checklist prior to the construction commencing.	Final completion achieved
Colomac – NWT	The ongoing additional assessment by other consultants during design phase created delays in the design process.	All assessments by other consultants should have been completed by the time of detailed design.	The completion of detailed investigations prior to the commencement of detailed design minimizes the amount of time spent in the detailed design phase and also minimizes re-work.
	Information provided prior to design, such as the leach tank contents, was found to no longer be accurate at the start of construction.	Old information provided for design needs to be confirmed ("ground-truthed") prior to inclusion in design.	The availability of more reliable/complete information enables better planning to be carried out.
	Some historic/pre-development history and ESA reports did not appear to have been reviewed.	Comprehensive historical document review requirement needs to be set out in Terms of Reference.	Allows a more complete conceptual image of the site to be formed prior to any on-site work.
	Expectations, roles, and responsibilities for each team were not clear on the project. Lack of clarity on which parties should be involved during contract negotiations.	Holding a partnering session at the start of the construction work would help to clearly identify roles, expectations, and foster a team dynamic. Roles & responsibilities of all Project Management Team members needs to be clearly defined and understood.	

Development	Activity Which Led to Lesson	Lesson Learned	Management Result
Northern Remediation - DEW Line clean up 2013 - 2015	Non-hazardous debris stockpiled on permafrost	At a DEW line remediation, non-hazardous debris was piled near the beach on a portion of flat ground. Granular borrow at this site was very limited and a pad was not built for the temporary storage area (TSA). The debris pile was initiated in the summer of 2013 and was removed in the summer of 2015. When the pile was removed, it was evident that during the freeze-thaw cycles of the past two years and the weight of the pile, some of the debris had sunk into the permafrost and was now frozen. The contractor will have to return in 2016 to remove remaining debris and metals contaminated soil associated with the debris.	In the specifications, require that the contractor submit a waste management plan, so AECOM can review the planned TSA construction in advance of going to site include in spec or management plan, that waste must be stored in a location and manner to prevent waste from impeding drainage and becoming mixed with underlying soils, taking into account freeze-thaw cycles, and being dispersed by wind, precipitation or gravity. In the event that borrow is poor or unavailable, encourage contractor to use geotextile or similar to prevent debris from pushing into the ground surface
Halliburton - Bonnyville and Lloydminster - Assessment and Remediation	Acting as a Prime Contractor, Near Miss (underground utilities) and out of scope work	AECOM was acting as the prime contractor for site assessment and soil remediation work at 3 sites in Bonnyville and Lloydminster. The scope of work for these projects grew significantly during the remediation stage, expanding from simple surface stain removal program to substantial excavation. Additional challenges included: health and safety responsibilities, inappropriate excavation equipment, damaged underground utilities in work area, long work hours, and landfill/deep well waste acceptance.	Keep in constant contact with PM (and client) with respect to sample exceedances and surprising site observations to properly approach work that is out of the initial contract scope Follow underground utility locating and daylighting procedures (including allowable work proximity) Line up landfill and deep well disposal facilities (inform them of the waste type, and make sure you correct generator number.)
Northern Remediation - DEW Line clean up 2013 - 2015	Unknown PHC contaminated soils and treatment	At a DEW Line remediation, several thousand m^3 of PHC impacted soil was identified late in the project, resulting in the work taking an extra season. The largest excavation was located a 45 min journey from the land farm. To minimize the time spent on site, a soil disposal area was constructed near the excavation to dispose of soil exceeding near shore criteria but not far shore criteria, to allow handling of contaminated soil in an efficient manner while meeting the requirements of the guiding remediation documents (AMSRP, RAP).	Additional sampling should be conducted as early as possible in the project timeline to identify additional contaminated soils. Look for alternate solutions to problems

NWT = Northwest Territories; HSE = Health, Safety & Environment; PWGSC = Public Works and Government Services Canada; INAC = Indigenous and Northern Affairs Canada; DAR = Developer's Assessment Report; WSCC = Workers' Safety and Compensation Commission; TCA = Tailings Containment Area; TSA = Temporary Storage Area; PHC = Petroleum Hydrocarbon

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