

APPENDIX F, 2011 TDS Management Plan Progress Report & Updated Management Plan for NPDES Permit AK-003865-2

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February 28, 2012

Pursuant to Part I.A.7.f of NPDES Permit AK-003865-2 of its NPDES Permit, Teck Alaska, Incorporated (Teck) submitted a TDS Management Plan to EPA and ADEC prior to July 29, 2010. The permit requires Teck to include, by March 1st of each year, a TDS Management Plan progress report as part of the Red Dog Mine NPDES Annual Water Monitoring Summary Report.

This progress report/updated management plan includes information on the actions and investigative efforts undertaken prior to and during 2011 and the actions that are planned for 2012 to provide enhanced treatment for TDS and/or TDS-source control in order to ensure that:

- Red Dog will be able to discharge treated effluent through Outfall 001 in compliance with the 2010 TDS limits (presently awaiting final reinstatement), and;
- Treated effluent of sufficient volume will be discharged to maintain the integrity of the tailings impoundment dam.

Reducing the concentration of TDS in the Red Dog Mine tailings impoundment is a top priority of the mine. In its original TDS Management Plan, Teck identified and selected those actions and/or investigative efforts appropriate for incorporation into the plan. This initial review identified the following actions and/or investigative activities:

1. Source Control (Pre-ARD Generation) – Examine the potential use of co-deposited tailings and waste rock on the stockpiles to inhibit infiltration and oxidation
2. Source Control (Post-ARD Generation) – Examine improved TDS capture through potential construction of a waste stockpile drainage collection system
3. Enhanced Treatment Capacity – Winterization of Water Treatment Plant #3 and improved utilization of Water Treatment Plant #1 and #3
4. Enhanced Treatment Technology Research
 - a. Bioteq Biosulfide® pilot study
 - b. Barium Sulfide pilot study

Results of these activities in 2011 as well as those planned for continuation – or as new – for 2012 are described below.

1. Source Control (Pre-ARD Generation)

Use of co-deposited tailings and waste rock on the stockpiles to inhibit infiltration and oxidation

Acid Rock Drainage (ARD) is largely the action of microbes on sulfide minerals which results in by-production of (sulfuric) acid. The ARD process requires oxygen and water, and generally results in acidic solutions that mobilize metal ions from the host rock. Reducing or eliminating the supply of water and oxygen to a reactive waste rock source is a method to mitigate or prevent ARD generation. Covers are often placed on waste rock stockpiles – or, mine waste stockpiles (MWS's) – to reduce this phenomenon. The use of such cover placement is common in mine reclamation.

Covers usually have a number of components, among them a layer of fine-grained material that acts as a moisture and capillary barrier. Flotation tailings are a locally available source of fine-grained material that was considered for use as a potential barrier material. The objective of this investigation was to evaluate the use of the tailings materials – in different layer-/mixture-configurations – as a moisture and capillary barrier material to mitigate ARD in a reactive waste rock source.

A series of column tests were conducted at the Applied Research and Technology (ART) Laboratory facilities located in Trail, British Columbia, Canada. The tests were carried out using Red Dog waste rock and flotation tailings – also obtained from Red Dog operations. As indicated in the 2010 TDS Management Plan Progress Report, results of this investigation indicated the use of fine tailings did not significantly decrease the generation of ARD.

The next phase in this line of investigation was to examine the use of tailings in conjunction with other potential mitigation strategies. ART worked with Red Dog Operations to investigate ARD mitigation methods based on use of slow-release fertilizer. This option was also investigated in conjunction with the use of tailings although results of this work indicated no significant improvement in ARD mitigation performance.

2. Source Control (Post-ARD Generation)

Improved TDS Capture through a Waste Stockpile Drainage Collection System

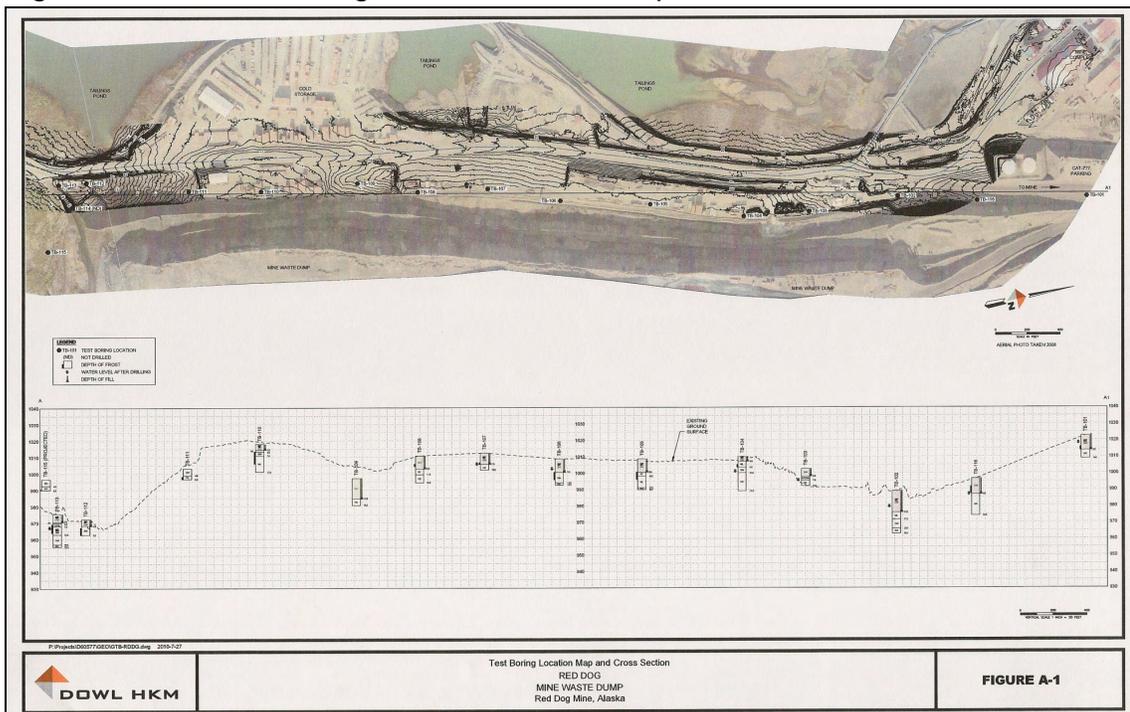
A geotechnical evaluation to determine the water flow paths emanating from the MWS was completed in 2010. This was a two phase program.

Phase I had four objectives

- ✓ Determine nature and material properties of the overburden
- ✓ Determine depth and nature of weathered/fresh bedrock
- ✓ Determine depth to groundwater
- ✓ Locate discrete low resistivity (high conductivity) 2D and 3D pathways that could reflect metal rich water migrating from the MWS to the tailings impoundment.

The data required to meet the first three objectives was obtained by drilling a series of 15 holes along the base of the waste stockpile using a hollow stem auger. In each of the holes the overburden material was logged, and the condition of the bedrock was determined. In the eight holes that encountered groundwater, the groundwater elevation was measured.

Figure1: DOWL HKM Auger Hole Location Map



To gather the data needed to meet the fourth objective, two different electromagnetic (EM) surveys were conducted. A RESOLVE Airborne EM Survey was conducted to locate discrete low resistivity (high conductivity) 3D pathways of metals rich water flowing/draining into the tailings impoundment. The airborne survey was followed up by a ground based Dipole-Dipole Array and Wenner Array survey. The results of the surveys are presented in the figures below.

Figure 2: RESOLVE Airborne EM Survey – Differential Resistivity (320 MASL)

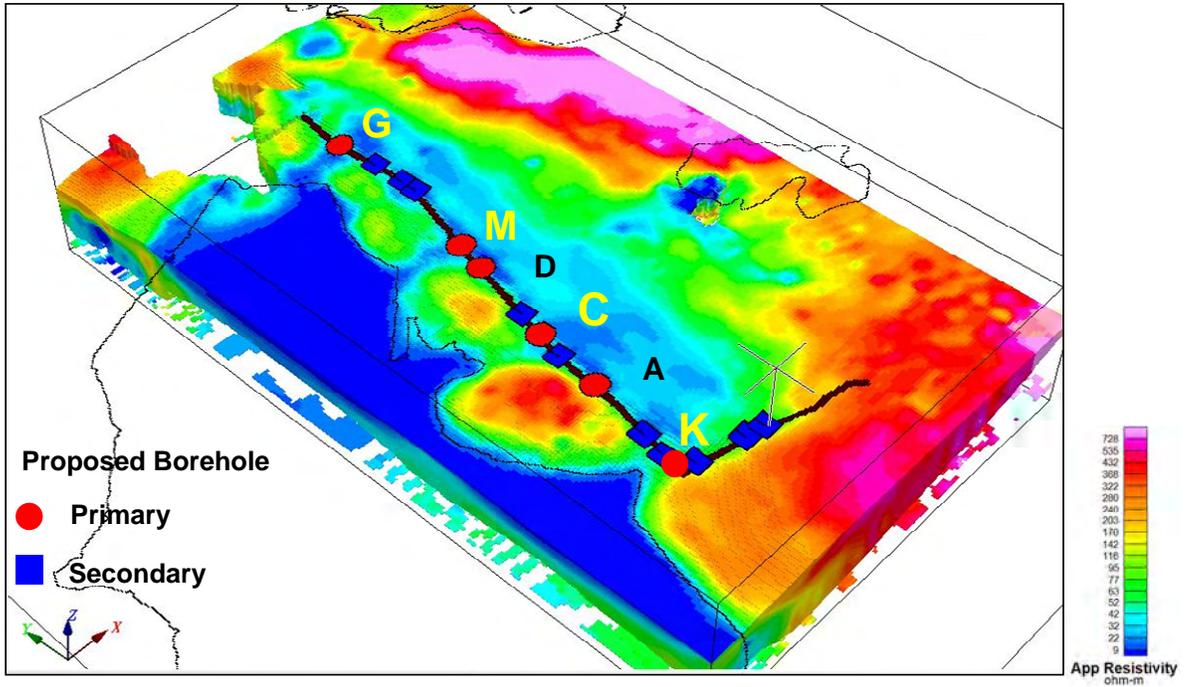
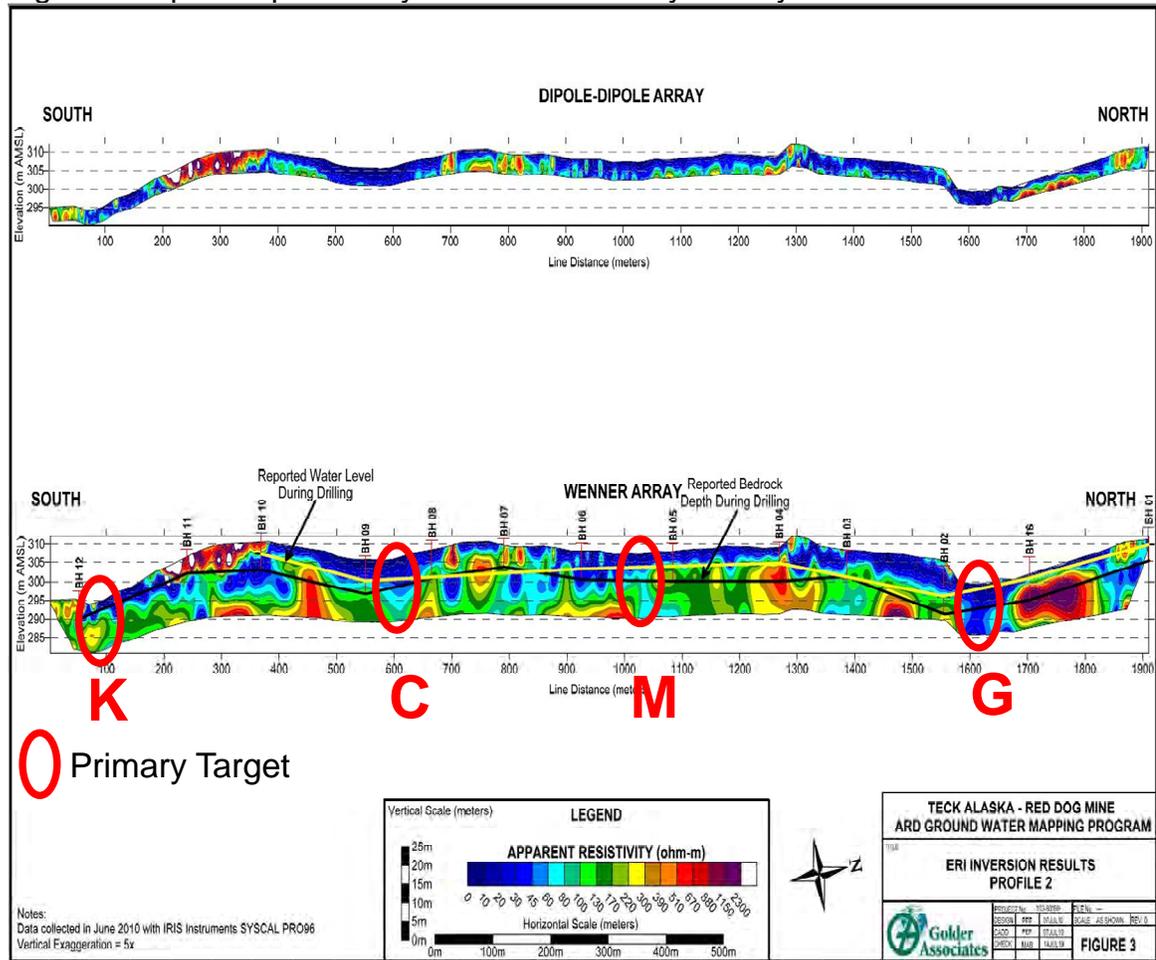


Figure 3: Dipole-Dipole Array and Wenner Array Survey at the Toe of the MWS



The objective of Phase II was to determine the target locations for intercept wells based on the results of the geophysical surveys. Wells were installed at locations G, M, C, and K. Pumps were installed in wells at locations G and M. Initial test work resulted in a non-sustained water draw. A system design evaluation is currently ongoing to re-assess well size diameter, recharge rates and optimal pumping capacity. Additional testing was undertaken during the 2011 field season.

Ongoing and/or planned ARD management measurements

In Q1 2012, mining in the main pit will be completed, back-filling of the pit with waste rock will start and the pit will begin to fill with mining-impacted water to 840’ above mean sea level (AMSL) at which time the water will be pumped to the treatment system. A significant opportunity has been identified to accelerate TDS reduction in the TSF, by pumping ARD in excess of what can be treated into the North Main pit. Under the proposed scenario, in 2012 up to 50 million gallons of

ARD would be sent to the North Main pit, thus reducing the TDS load in the TSF significantly.

An element of TSF TDS reduction is the result of the impact of spring freshet and summer precipitation flowing into the TSF. This impact is increased as the TSF water volume is decreased, and to maximize this, consideration is being given to placing additional treated water in the South Main pit. Under the proposed scenario, up to 900 million gallons of treated water would be sent to the South Main pit depending on precipitation and the receiving capacity of Red Dog Creek. This would reduce the TSF water level to 950' AMSL and ensure Red Dog does not encroach into the TSF dam freeboard limit. Additional benefit would be the reduction of ARD in the pit due to placing a water cover over ARD generating rock.

It is estimated that placing ARD and excess discharge in the pit would reduce the time to flood the main pit from the currently anticipated 4 years to 3 years.

Source Control (Post-ARD Generation)

Red Dog is committed to increasing the capture of Acid Rock Drainage (ARD) from the main waste stockpile before it enters the Tailings Storage Facility (TSF). Capturing and separately treating this water has been demonstrated to be the most cost effective method to reduce the TDS load in the TSF. It also provides process benefits as a lower TDS recycle water will reduce pipe scaling, thus improving availability and grade/recovery performance.

It is estimated that treatment modifications may require a capital investment of \$10-25 million, however additional data is required to design the revised system. The largest issue is that the volume, quality, and seasonality of the flows changes dramatically, and more data is required to appropriately size an ARD capture and treatment system. To this end, Golder Engineering was engaged in 2011 to design and size an ARD collection system and a series of additional wells, French drains and piezometers were constructed.

The intent is to monitor the volume and composition of the ARD over the seasons so that a treatment system can be appropriately sized and designed. However, as ARD generation exceeds current treatment capacity, ARD would continue to flow into the TSF for the next 2-4 years.

Improved TDS Capture through the Waste Stockpile Drainage Collection System
ARD is currently collected through a series of 5 intercept wells that flow ARD to a main collection tank for pumping to WTP3 for treatment. Based on geotechnical information gathered in 2011, 4 new wells and a series of French drains were installed to increase collection of the ARD. Plans are being developed to install

pumps and piping to send water from the new wells to the main collection tank for treatment in WTP3 or to the pit.

A design review will be undertaken after the additional data is gathered to determine if the existing systems are capable of handling the increased volume of ARD. Modifications will be engineered and constructed as required.

It should be noted that beginning in the fall of 2011, flow-rates from the ARD recovery system – as it existed at that time – were insufficient to allow for continuous operation under hard-freezing conditions. The design and modification improvements discussed in the preceding paragraphs are anticipated to resolve this condition.

ARD Diversion to the North Main Pit

In Q1 2012, mining in the main pit will be completed, back-filling of the pit with waste rock will start, the pit pumping systems will be shut down, and the pit will fill with mining-impacted water to 840' AMSL at which time the water will be pumped into the treatment system. Current models indicate it will take until 2016 for the pit to fill to 840' AMSL.

A significant opportunity has been identified to accelerate TDS reduction in the TSF, by pumping ARD in excess of that which can be treated into the soon-to-be completely mined and empty North Main pit. This provides multiple benefits, including reduction of in-pit ARD generation by placing waste rock below water sooner rather than later, and also, this is where ARD will ultimately be sent as already described in the reclamation plan.

Treatment of the ARD in WTP3 is limited by lime mixing ability during the spring and early summer. Lime demand is high during spring melt period as lime is used to treat reclaimed TSF water for discharge purposes. Hence all of the collected ARD cannot be treated. Any ARD that cannot be treated in WTP3 overflows to the TSF, thus increasing its TDS load.

Plans are being developed to pump ARD that isn't currently treated to the North Main pit. It is anticipated that, in 2012, up to 50 million gallons of ARD would be sent to the North Main pit reducing the TDS load in the TSF significantly.

Under the proposed scenario, TSF TDS may be reduced to saturation levels, at which time data would be available to design and construct additional facilities, thus eliminating the need to place ARD in the pit until closer to closure (as this is already part of the final reclamation plan).

TSF Water Level/Volume Reduction

Treated Water in the South Main Pit

A significant element of TSF TDS reduction is the result of the impact of spring freshet flowing into the TSF. This impact is increased as the TSF water volume is decreased. To maximize this, consideration is being given to placing additional treated water in the empty main pit. To reduce the TSF water level to an elevation of 950' AMSL, up to 900 million gallons of treated water would be sent to the South Main pit depending on precipitation and the receiving capacity of Red Dog Creek. A plan will be developed to pump the treated water to the pit in a safe manner from July through September.

Reducing the TSF water level will also ensure Red Dog does not encroach into the TSF dam freeboard limit. Again there is an added benefit of reducing ARD production in the pit, by getting ARD generating rock below water sooner rather than later. It is estimated that placing ARD and excess discharge in the pit would reduce the time to flood the main pit from the currently anticipated 4 years to 3 years.

3. Enhanced Treatment Capacity

Enhanced Utilization of Water Treatment Plant #1 and #3 (WTP1 and WTP3) and Winterization of Water Treatment Plan #3.

Based upon findings of the second-quarter 2010 hydrologic and geophysical field testing and surveying efforts along the base of the MWS, Teck drilled four MWS runoff/seepage (MWS-stream) recovery wells along the toe of the stockpile. The wells are located at sites considered best for capturing the MWS runoff and/or subsurface seepage throughout the year based on the information obtained through the Airborne EM and ground based Dipole-Dipole Array surveys. Two of the wells have already been equipped to pump MWS-stream to either WTP1 or WTP3.

Currently, winter conditions are affecting the performance of the MWS-stream recovery system and certain operational issues remain to be resolved. However, lime-HDS treatment of the MWS-stream in WTP1 has proven successful in dramatically lowering the high TDS concentrations of this source.

Improvements are required for the MWS-stream recovery/treatment system to allow reliable winter operation. Upon completion of these improvements, the volume of MWS-stream available for recovery and treatment will be quantified.

System diagnostic study and improvements – including commissioning of the two remaining MWS-stream recovery wells – will continue throughout 2012.

During summer 2010, piping and other required modifications were completed in order to allow Water Treatment Plant 1 (WTP1) to treat the MWS-stream. Subsequently, WTP1 was successfully utilized to treat the MWS-stream for a short period of time. Upon onset of winter conditions, WTP1 was isolated and upgraded to allow for winter operation. These modifications included the addition of heat-trace and insulation and the incorporation of other measures necessary to allow the system to treat the MWS-stream during winter months. Currently, the WTP1 system is equipped to treat the MWS-stream throughout the year and requires no further modification.

The scoping-level engineering work for winterization of WTP3 was not completed in 2011. In light of the successful conversion of WTP1 to a facility capable of year-round MWS-stream treatment and because of delays in optimization of the MWS-stream recovery system (i.e., the MWS-stream recovery wells) as previously discussed, the potential need for winterization of WTP3 will be re-evaluated in 2012.

4. Enhanced Treatment Technology Research

a. Bioteq Biosulfide® Pilot study

As discussed in its 2010 TDS Management Plan Progress Report, Red Dog mine conducted a BioteQ Biosulfide® - High Density Sludge (HDS) pilot study between September 8th and October 27th, 2010. The objective of this study was to prove or disprove the BioteQ Biosulfide® (BioteQ) process' capability to produce lower TDS-concentration water than is possible through the currently utilized lime-HDS treatment process. The goal of the pilot study was to reduce TDS concentrations in the final effluent to 3500 mg/L or less through use of the BioteQ process.

The pilot plant was configured with a chemical-sulfide circuit for zinc removal followed by a lime-HDS treatment stage for pH adjustment, removal of remaining dissolved metals, and gypsum (calcium-sulfate) precipitation.

The pilot plant proved successful at removing dissolved zinc from reclaimed Tailings Impoundment water (reclaim) as zinc-sulfide. However, it was not successful at reducing final effluent TDS concentrations below those achieved through the currently utilized lime-HDS treatment process. Final effluent from the pilot plant remained generally constant at about 4700 mg/L throughout the

testing process. This was well above the targeted 3500 mg/L and its effluent contained mostly dissolved gypsum – the primary byproduct of the current lime-HDS treatment technology.

A final report from BioteQ on the pilot testing results has been received. The report addresses potential causes of the plant's failure to meet targeted TDS-reduction goals and also provides recommendations for future test work. A thorough evaluation of the report and BioteQ's conclusions has been made and Teck does not currently consider this technology to be a viable treatment alternative.

b. Barium Sulfide bench study

Red Dog mine conducted two barium-sulfide treatment pilot studies in 2010; Phase I in August and Phase II in November/December. The barium-sulfide technology was tested in order to determine its potential applicability in: 1) treatment of reclaim for use in onsite industrial-processes, and; 2) the "overtreatment" process (i.e., returning treated, reduced-TDS reclaim water back to the Tailings Impoundment as one potential means of ultimately reducing the TDS concentration of the impoundment water). Results of whole effluent toxicity (WET) testing indicated this technology – as evaluated – is not suitable for potential discharge through NPDES Outfall 001.

The Phase I pilot test was operated in order to determine if barium-sulfide treatment could be used to effectively treat reclaim water for removal of dissolved metals, and to reduce reclaim water TDS concentrations to below those achieved with the current lime-HDS treatment technology. The Phase II pilot study was conducted to prove/disprove findings of the first phase pilot test results, determine important process design parameters for potential large scale application, and to determine the treated effluent's effects on the mill flotation process.

Results of both studies indicated the barium-sulfide technology did remove dissolved metals from reclaim and also reduced final effluent TDS to ~3700 mg/L. Preliminary indications are that this technology may be more effective in TDS reduction than the currently utilized lime-HDS technology. Due to the inability of the pilot plant's effluent to meet Teck's NPDES Permit WET limits, the process is considered potentially viable only for the internal year round treatment of the reclaim water to reduce TDS in the tailings pond and is not considered a viable treatment option for discharge through Outfall 001. There are significant uncertainties related to the up-scaling of the bench test to a full size plant and Teck's ability to obtain a sufficient supply of barium sulfide.

Phase II study results were mixed and therefore inconclusive regarding configuration for potential large scale operation. Although dry reagent addition – necessary for large scale operation – may be possible, key operational parameters and system-configuration requirements were not definitively identified in this study phase.

A Phase III pilot plant study was conducted in 2011 in order to test the more promising of the two initial pilot plant configurations. Results of the most recent testing were encouraging and future plans are being developed based upon them.