TECHNICAL BULLETIN TB-SAL-001

AISCT® Sal™ System

AI-integrated Site Characterization Technology for ion-specific salinity screening, real-time analytics, and laboratory correlation.

Developed by TRIUM EcoSystems **Bulletin** TB-SAL-001 **Revision** 2.0 **Date** August 2026

1. Introduction and Background

The AISCT® Sal™ System — part of TRIUM's Artificial Intelligence Site Characterization Technology platform — is a field screening system for salt-impacted sites. Sal provides an integrated platform for real-time ion-specific salinity screening, data analytics, quality assurance, and laboratory data correlation throughout all phases of soil and water investigation.

Salt contamination — chloride and sodium from produced water and brine releases, road salt applications, and industrial processes — presents a significant environmental and regulatory challenge. Conventional bulk electrical conductivity (EC) meters measure total dissolved ion load without speciation, leaving them susceptible to interference from background minerals, moisture fluctuation, and matrix variability. EC-based field screening therefore misclassifies samples routinely and cannot support defensible regulatory decision-making.

Sal was engineered to overcome those limitations. By employing a precision array of Ion Selective Electrodes targeted specifically to chloride — with sodium capability being introduced — the system isolates the ionic species that regulatory bodies and laboratories actually measure, providing matrix-independent, ion-specific field data with decision accuracy exceeding 90%.

> **PERFORMANCE BENCHMARK**
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> On a recent coarse-sand chloride programme screened against a 3,000 mg/kg criterion, Sal classified 27 of 28 laboratory-paired samples correctly — 96.4% decision accuracy, with 100% sensitivity (zero false negatives) and 96.3% specificity (one conservative over-call). Laboratory R^2 was 0.785, chloride against chloride. The advantage comes from ion-specific ISE measurement and the standardized extraction enforced by the kit and the application, which removes the primary sources of error in bulk conductivity screening.

2. Regulatory and Technical Framework

Sal is designed to support field screening programmes conducted in alignment with established environmental site characterization guidance. Key touchstones include:

- **Alberta Tier 1 Soil and Groundwater Remediation Guidelines — salinity parameters.** Alberta Tier 1 establishes soil and groundwater quality criteria for chloride and sodium relevant to upstream oil and gas and other salt-release scenarios. Sal supports field-based screening against those criteria.
- **CCME Canadian Soil Quality Guidelines (CSQG).** CCME guidelines for the protection of environmental and human health include criteria relevant to chloride and salinity. Sal generates field data interpretable in the context of these national benchmarks.

- **AER Directive 058 — upstream petroleum industry waste and spill requirements.** Requirements for produced water and brine spill reporting and remediation underscore the need for rapid, defensible field characterization of chloride impact. Sal is designed specifically to support this application.
- **CCME Volume 1, Section 3 — Quality Assurance / Quality Control.** Sal incorporates automated QA/QC reporting including calibration records, probe conditioning logs, standard checks, blanks, duplicates, and triplicates.
- **U.S. EPA Triad approach.** Sal is deployed within the Triad framework, in which a field screen supports decisions through known, managed uncertainty verified by an appropriate level of laboratory confirmation — conventionally, fewer than 5% false negatives and fewer than 20% false positives.

Sal supports phased site characterization from initial spill response through delineation and remediation monitoring, building a continuously improving data set at each phase.

3. System Overview

The system consists of three integrated components: the field hardware kit, the mobile and cloud application for data entry and analytics, and the AI reporting engine for automated summary report generation. All three function as an integrated, inseparable system. The sampling procedure must be followed identically for every sample so that results remain defensible, comparable, and statistically meaningful.

3.1 Hardware: the kit

The Sal hardware kit is a precision, AI-integrated ion-specific analysis instrument for field screening of soil and water. It incorporates a specialized Ion Selective Electrode array, a soil extraction station with standardized dry-bath heating, and a laptop-based AI interface. Key hardware characteristics include:

- **Ion Selective Electrode array.** Potentiometric ISE membranes tuned specifically to the chloride ion, with sodium modules being introduced. Unlike bulk EC meters, ISE technology isolates the specific ion of regulatory and environmental significance.
- **Standardized soil extraction station.** A controlled dry bath holds a consistent extraction temperature, enforced at 25 °C for every sample, normalizing extraction across varying field conditions and soil matrices.
- **Ionic strength adjustment.** The proprietary AISCT® I.S.E. Solution, supplied by TRIUM, provides matrix independence by suppressing background electrolyte interference, so the electrode responds only to the target ion.
- **AI-assisted signal processing.** The interface processes raw electrochemical signals against a database of correlated laboratory data, reporting salinity in both mg/kg and mg/L, with water samples measured directly.
- **Integrated calibration and QA/QC logging.** Daily calibration with certified solutions and probe conditioning procedures ensure measurement traceability throughout field deployment.

3.2 Application: data entry, logging, and QA/QC

The application serves as the central data hub for all field and laboratory information. Users enter site details, sample metadata, field observations — soil type, depth interval, temperature, moisture — and every screening result in real time. The application enforces the standardized sampling procedure on every entry, ensuring that all data in the system was collected under the same conditions and is therefore statistically comparable across samples, locations, depths, and dates.

3.3 Analytics engine: real-time data interpretation

As the data set builds, the analytics engine provides continuous, real-time interpretation of screening results. Because the instrument reports a concentration in the same units as the criterion, no population-derived threshold is developed: the user selects and enters the applicable screening criteria for the parameter at each sample location, and every result is classified against those criteria as it is recorded — with a probability of exceedance attached, so borderline samples are visible as borderline while the crew is still on site.

Spatial summary	Real-time breakdown of chloride screening results by depth interval and sample location, enabling rapid identification of spatial trends and anomalies.
Criteria entry	The user selects and enters the applicable screening criterion for the parameter at each sample location. Results are classified against that criterion directly, in the same units, at the moment of reading.
Probability of exceedance	Field duplicate readings capture the natural heterogeneity of the soil and are expressed as a probability that the sample sits above criteria — turning scatter into usable triage information.
Depth profiling	Vertical chloride profiles by location, supporting conceptual site model development and delineation decisions.
Laboratory confirmation	Sal reports a concentration directly against the criterion, so no correlation model is required to interpret a result. Confirmation samples serve the regulatory record and provide ongoing verification of decision performance — sensitivity, specificity and overall accuracy are computed per programme from the laboratory-paired subset and reported alongside the data.

3.4 Laboratory confirmation and decision-performance verification

This system reports a concentration directly, in the same units as the applicable criterion, so no site-specific correlation model is required before a field result can be used. The comparison against the criterion is available at the instrument, on the first sample of the programme. Laboratory confirmation therefore serves a different purpose than it does for a response-based screen:

- **The regulatory record** — accredited analysis of the samples the field data identified as the highest-consequence decision points, documenting decisions already made rather than unlocking them.
- **Decision-performance verification** — every laboratory-paired sample is classified against the criterion to build a confusion matrix for the programme, from which sensitivity, specificity and overall accuracy are computed and reported with the data.
- **Heterogeneity quantification** — duplicate splits and re-reads measure how variable the soil actually is at each location, and that measured spread is what the probability-of-exceedance output is built from.

Parameters compared against laboratory results are:

- Chloride (Cl^-) — reported as both mg/kg and mg/L
- Sodium (Na^+) — mg/kg or mg/L (module being introduced)

Because the field result is already expressed against the criterion, changing the criterion does not require a model to be re-derived. The threshold is set in the application and every probability of exceedance is recalculated against it. This allows practitioners to reduce laboratory submissions substantially without deferring the field decision, and to document decision performance for the programme rather than asserting it.

4. Field Performance

On a recent third-party chloride remediation programme in coarse sand, screened against a 3,000 mg/kg criterion, 28 Sal readings carry a paired laboratory chloride result. Sal classified 27 of those 28 correctly against the criterion — 96.4% decision accuracy. The confusion matrix contains one true positive, 26 true negatives, one false positive and **no false negatives**: 100% sensitivity, with no exceedance passed as clean, and 96.3% specificity. The single disagreement was a conservative over-call on a sample the laboratory returned just under the criterion. Laboratory R^2 across the paired set was 0.785, chloride against chloride. Duplicate splits on the same programme spread by 5–20%, and that measured heterogeneity is what the probability-of-exceedance output is built from. Client, consultant and location are withheld.

5. AI-Assisted Report Generation

The system includes an integrated AI reporting function that automates the generation of professional site screening summary reports. Users define reporting parameters — date ranges, sample subsets, locations of interest, regulatory criteria — and the engine produces:

- Executive summary of screening programme scope and objectives
- Summary table of all samples collected within the defined parameters
- Identification and narrative description of elevated locations and depth intervals
- Classification of every result against the entered criteria, with probability of exceedance
- QA/QC summary including calibration records and field quality control performance
- Laboratory confirmation summary and programme decision-performance statistics
- Recommendations for further investigation, delineation sampling, or remediation

The AI report function reduces post-processing time from days or weeks to minutes, while producing a technically defensible, consistently formatted output that can be incorporated directly into site investigation reports or provided to clients and regulatory bodies. Users retain responsibility for review, professional sign-off, and any final regulatory submissions.

6. Application Throughout the Investigation Lifecycle

The system is most effective when deployed at the earliest possible stage of a site investigation and maintained consistently throughout the project lifecycle, providing progressively increasing analytical value as the data set grows.

Initial response — spill characterization	Deploy immediately on discovery of a produced water, brine or road salt release. Establish baseline chloride data, identify the extent of impact, and generate QA/QC-compliant records. Submit targeted samples to initiate correlation.
Phase II ESA — systematic investigation	Screen all soil and water samples collected. Enter the applicable criteria and use spatial and depth summaries to identify areas of elevated concern and direct targeted delineation sampling.
Phase III ESA — delineation	Classify every screened sample against the entered criteria as it is read, and use the probability of exceedance to target confirmation sampling where it changes a decision.
Remediation monitoring and closure	Track remediation performance in real time against site criteria, and carry a complete QA/QC-documented screening record into final regulatory submissions.

The value of the data set compounds over time. Sites where the system has been used from the beginning of investigation have the richest and most defensible data records, the most accurately calibrated thresholds, and the greatest ability to leverage predictive analytics.

7. Technical Specifications Summary

Primary analyte	Chloride (Cl^-)
Expanding parameters	Sodium (Na^+) module being introduced
Measurement principle	Potentiometric Ion Selective Electrode (ISE) array — ion-specific, not bulk EC
Sample extraction	Standardized dry-bath extraction, temperature enforced at 25 °C for every sample
Matrix control	Proprietary AISCT® I.S.E. Solution (TRIUM-supplied ionic strength adjuster)
Decision accuracy	96.4% correct classification on the reference programme (n = 28 lab-paired)
Throughput	Up to 40 samples per hour
Data output	Concentration vs. criterion, with probability of exceedance per sample
Reporting floor	N.D. below 50 mg/kg
Sample matrix and units	Soil and water — reports both mg/kg and mg/L
QA/QC outputs	Calibration records, probe conditioning logs, standard checks, step-downs, blanks, duplicates, triplicates
Reporting parameters	User-defined: date range, location, sample subset, regulatory criteria
Operating temperature	Above 0 °C — units must not be exposed to freezing conditions
Probe maintenance	Weekly and daily usage-determined probe maintenance and preparation cycles
Regulatory alignment	Alberta Tier 1 salinity parameters; CCME CSQG; AER Directive 058; CCME Vol. 1 Section 3
Required protocol	AISCT® Sal Standard Operating Procedure (SAL-SOP-001) — mandatory for every sample
Data ownership	All system logs, diagnostics and firmware data owned by TRIUM

8. Limitations and Important Requirements

8.1 PROTOCOL COMPLIANCE

SAL-SOP-001 must be followed exactly for every sample. Any deviation — non-approved consumables, non-standard extraction volumes, alternative ISE conditioning — invalidates the comparability of results and the reliability of analytics outputs.

8.2 ISE PROBE CARE

ISE probes are sensitive instruments requiring proper conditioning. Maintenance and preparation cycles are determined by weekly and daily usage and are prompted by the application. Failure to maintain conditioning may cause drift, degraded performance or probe damage. All consumables and calibration solutions must be sourced through TRIUM.

8.3 EXCLUSIVITY OF THE KIT

The analytics platform, criteria evaluation, probability modelling and laboratory confirmation functions are calibrated to the measurement characteristics of the Sal hardware and the proprietary ionic strength adjuster. The reported decision accuracy is achievable only with the Sal kit under the Sal SOP with TRIUM-supplied consumables.

8.4 PROFESSIONAL RESPONSIBILITY

Sal is a decision-support tool. All professional judgments regarding site characterization, risk assessment, remediation design and regulatory submissions remain the responsibility of the qualified environmental professional.

IMPORTANT NOTICE

AISCT® Sal™ provides field screening information only. Results are not accredited laboratory data and must not be used as a substitute for accredited laboratory analysis for regulatory compliance purposes. Results should be interpreted by qualified environmental professionals.

The system can only be used with the AISCT® Sal™ hardware kit. Data from any other instrument or alternative screening method is not compatible with the AISCT® analytics platform, and the standardized sampling procedure must be followed identically for every sample.

TRIUM is not responsible for any decisions, interpretations, actions, or project outcomes arising from the use of AISCT® data. The user bears full responsibility for professional judgment, regulatory compliance, and all field and reporting decisions.

9. References

- Alberta Environment and Protected Areas (AEPA). Current. *Alberta Tier 1 Soil and Groundwater Remediation Guidelines.* Government of Alberta.
- Canadian Council of Ministers of the Environment (CCME). 2011. *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health.* PN 1129.
- Alberta Energy Regulator (AER). *Directive 058.*
- U.S. Environmental Protection Agency. *Triad Approach to Streamlined Site Characterization and Cleanup.*
- TRIUM. 2026. *AISCT® Sal Standard Operating Procedure (SAL-SOP-001).* Internal document.
- TRIUM. 2026. *AISCT® Sal System — Performance Validation Report.* Internal document.

DOCUMENT CONTROL

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