



CIVIL DESIGN CRITERIA



Project Name:	GREAT ATLANTIC SALT FEASIBILITY STUDY
Project No.:	H21261-01
Client Name:	ATLAS SALT INC.
Document Title:	CIVIL DESIGN CRITERIA
Document No.:	H21261-0000-C-DC-0001

Rev:	Date:	Issued For:	Prepared by:	Checked by:	Approved by:	Client Approval:
A	8-May-2023	Internal Review	HF	AD	AOM	-
B	12-May-2023	Client Review	HF	AD	AOM	-
0	30-May-2023	Final	HF	AD	AOM	-

TABLE OF CONTENTS

1	INTRODUCTION.....	1
2	GENERAL.....	1
	2.1 Scope.....	1
	2.2 Design Life.....	1
	2.3 Units of Measurement.....	1
3	CODES, STANDARDS, AND SPECIFICATIONS	2
	3.1 General	2
	3.2 Precedence, Deviations, and Conflict.....	2
	3.3 Project Design Criteria	2
	3.4 Discipline Standards.....	2
4	HEALTH, SAFETY, AND ENVIRONMENT	3
	4.1 General	3
5	Site Conditions.....	4
6	DESIGN RESPONSIBILITIES.....	4
	6.1 General	4
	6.2 Construction Type.....	5
7	EARTHWORKS	5
	7.1 Site Preparation	5
	7.2 Bulk Earthworks.....	5
8	ROADWORKS.....	6
	8.1 General	6
	8.2 Traffic Loading.....	6
	8.2.1 Operational Traffic	6
	8.2.2 Construction Traffic	6
	8.3 Geometric Design of Roads.....	7
	8.4 Vehicle Vertical Clearance	7
	8.5 Earth Safety Barriers	7
9	STORMWATER DRAINAGE.....	8
	9.1 Design Basis for Plant Site and Access Road Drainage.....	8
	9.2 Rainfall Intensity	8
	9.3 Open Channel Drains.....	8
	9.4 Culverts.....	9
	9.5 Provision for Maintenance	10
	9.6 Scour.....	10
10	SEDIMENT CONTROL.....	10
11	SITE SERVICES.....	10
	11.1 Fire Water	10
	11.2 Portable Water	10
	11.3 Sanitary Sewers.....	11

1 INTRODUCTION

Atlas Salt and SLR have retained Halyard to progress the Feasibility Study (FS) phase for mine and surface infrastructure for the Great Atlantic Salt Project (the “Project”).

The Deposit is located approximately 30 km south of the Town of Stephenville, Newfoundland –in the community of St. Georges’. The coastal areas in St. George’s Bay are accessible by all-weather paved roads. The salt deposit is located close by to the Trans-Canada Highway, high voltage power grid, and an extensive network of roads. Run of mine material will be transported via belt conveyors to Turf Point Port, located approximately 5-6 km from the mine.

2 GENERAL

2.1 Scope

This document establishes the design criteria to be applied to the Civil design of the facilities and infrastructure associated with the Great Atlantic Salt. This design criteria, in conjunction with other project design criteria, design standards, and engineering practice describes the minimum engineering standards, practices and requirements that will be taken into consideration during the civil design.

2.2 Design Life

The Project considers a 30-year life of mine (LOM).

2.3 Units of Measurement

Units used for the project will be metric as per standard practice for use of the International System of Units (SI)

Abbreviation	Meaning
UNO	Unless noted otherwise
%	percent
°C	degree Celsius
kg	kilogram
km	kilometre
km/h	kilometre per hour
m	meter
m ²	squared meter
m ³	cubic meter
mm	Millimetre
kPa	kilopascal

3 CODES, STANDARDS, AND SPECIFICATIONS

3.1 General

All designs shall be prepared in accordance with Project Specifications; other Project disciplines design criteria, latest Canadian Standards and Codes including addendums or approved equivalent standards, and standard practices. Any new standards to be used under special circumstances in design shall be approved by the Engineering Discipline Lead.

3.2 Precedence, Deviations, and Conflict

The following order of precedence shall apply when conflict in the requirements arises between these design criteria and other documents such as:

- Project Drawings & General Notes.
- Engineering Specifications.
- Local Regulations or Statutory Requirements.
- Newfoundland and Labrador Regulations.
- National Codes and Standards.
- Other referenced codes and specifications.

3.3 Project Design Criteria

Document Number	Document Title
Project Design Criteria - Atlas Salt - GAS 2.5 Mtpa FS	Project Design Criteria
H21261-0000-M-DC-0001	Mechanical Design Criteria
H21261-0000-M-DC-0002	Fire Protection Design Criteria
H21261-0000-S-DC-0001	Structural Design Criteria
H21261-0000-E-DC-0001	Electrical Design Criteria
H21261-0000-J-DC-0001	Instrumentation Design Criteria

3.4 Discipline Standards

General Standards:

Document Number	Document Title
AASHTO	American Associations of State Highway and Transportation Officials
TAC	Transportation Association of Canada
ACI	American Concrete Institutes
MSHA	Mine Safety and Health Administration
OSHA	Occupational Safety and Health Administration
CSA-A23.3:19	CSA Design of Concrete Structures

Earthworks Standards:

Document Number	Document Title
ASTM D2487-17	Standard Practice for Classification of Soil for Engineering Purposes (Unified Soil Classification System)
ASTM D2488-17e	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

Roads and Paving Standards:

Document Number	Document Title
AASHTO- 7th Ed. (2018)	A Policy on Geometric Design of Highways and Streets
AASHTO- 4th Ed. (1993/98)	Guide for the Design of Pavement Structures

Site Drainage, Pipe Installation, Appurtenances Standards:

Document Number	Document Title
ASTM C33-18	Standard Specification for Concrete Aggregates
ASTM C76-22a	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipes
ASTM C90-22	Standard Specification for Load Bearing Concrete Masonry Units
ASTM C139-22	Standard Specifications for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C150-22	Standard Specification for Portland Cement
ASTM C270-19	Standard Specifications for Mortar for Unit Masonry

Under no circumstances does this specification replace or supersede the requirements contained in any national standard or regulation that may be applicable.

4 HEALTH, SAFETY, AND ENVIRONMENT

4.1 General

The project shall be designed to:

- Prevent injury or illness to employees, contractors, customers, and the public.
- Identify access and control the environmental aspects during the project execution.
- Deliver plant and facilities which will permit to achieve outstanding HS&E performance.
- Be generally in accordance with the Environmental Impact Statement (EIS) and consent documents. It shall be noted where the project design exceeds these requirements.

5 Site Conditions

The Great Atlantic Salt Mine Site is a highly corrosive environment resulting from the rock salt being mined and produced and the environmental conditions of its locations.

The design data for Stephenville, Newfoundland based on the NBC 2020 is summarized in the table below:

Parameter	Value
Elevation (m)	2 ¹ -60
Minimum Design temperature (January)	
2.5% (°C)	-16
1% (°C)	-18
Maximum Design temperature (July)	
2.5% dry (°C)	24
2.5% wet (°C)	19
Degree days below 18°C	4,850
15 Min Rainfall (mm)	14
One-Day Rainfall, 1/50 (mm)	102
Annual Rainfall (mm)	1,000
Moist Index	1.2
Driving Rain Wind Pressures (Pa, 1/5)	350

6 DESIGN RESPONSIBILITIES

6.1 General

The design engineer shall familiarize themselves with the functions and operating conditions of the plant such as the movement of materials and liquids, rotating masses, out of balance forces, temperature changes, impact forces, spillage loads, build-up of scale, and relevant environmental loads.

The design engineer shall ascertain, in conjunction with the lead engineer and in consultation with the process, mechanical, piping, structural, electrical and Instrument engineers, the loads created by plant, equipment, operational conditions, and stacked materials during construction and ongoing operations for each facility.

All design input shall be authorised by the lead engineer prior to application.

Safe constructability and access for maintenance shall be considered.

Standard drawings have been produced for the project and these standards, where appropriate, shall be referred to and used in preference to other, non-standard details. The design engineer shall be aware that these standards may be used by default and shall review the details and clauses therein for adequacy for the actual design requirements.

¹ From sea level at the port, to 60 masl of the site.

6.2 Construction Type

The method of construction and the materials of construction shall be agreed with the lead engineer.

7 EARTHWORKS

7.1 Site Preparation

The surface infrastructure areas shall be cleared and grubbed of trees and scrub brush, topsoil removed, rough graded, and ditched prior to construction.

Perimeter ditches / diversion canals shall be constructed to divert uncontaminated storm-water drainage external to the facilities around the plant site to the existing stream. Internal drainage ditches / sewers / swales shall direct runoff to the sedimentation pond(s) for sediment removal, as needed. Uncontaminated water from the pond(s) shall overflow to the existing stream via the outlet structure.

Lined containment pond(s) shall be constructed for the storage of potentially contaminated water.

Topsoil shall be stockpiled in designated areas with appropriate erosion protection and sedimentation control. The topsoil shall be used for reclamation purposes.

7.2 Bulk Earthworks

The slope parameters shown in Table 1 shall be used for design of bulk earthworks within the general site area, unless specified otherwise in site Geotechnical Reports (TBD), or determined by further geotechnical investigation and testing of specific materials proposed for use, or particular to specific site areas.

Table 1 - General Earthworks Design Parameters

Parameter	Value
Permanent cut batter slopes in residual sandy or gravelly clay and clayey sand and gravel soils up to 5 m height	1 V: 2 H
Temporary cut batter slopes up to 5 m height in excavated sandy or gravelly clay up to 5 m height	1 V: 1.5 H
Permanent fill batter slopes constructed in compacted lifts from site excavated sandy or gravelly clay up to 5 m height	1 V: 2 H
Permanent cut slope in bedrock	1 V: 0.75 H
Cut or fill batters exceeding 5 m in height	To be determined
Maximum vertical spacing between benches in cut batters	6 m
Minimum width of batter benches	3 m
Cross-fall for batter benches	5% inward
Minimum longitudinal gradient for batter benches	2%
Minimum finished surface grade for temporary or permanent earthworks	1%

Steeper batter slopes may be acceptable but shall be subject to slope materials investigation and slope stability analysis.

Catch drains designed to intercept and divert surface runoff from above the batter shall be provided along the crests of all permanent cut and fill slopes.

Toe drainage swales or ditches designed to intercept seepage and runoff from slope surfaces and convey it away from roads, plant site platforms and facility areas shall be provided at the base of all permanent cut batters.

Batter slopes and drainage features likely to be subject to erosion or scour shall be protected with rip rap or other suitable material.

Existing drainage features or springs and seeps to be buried under fill embankments shall be covered with a drainage blanket which daylight to a free draining face. The drainage blanket shall be constructed using open graded hard durable angular rock material, with particle sizes in the range of 10 mm to 100 mm, placed to nominal 0.5 m thickness along the fall line, topped with a separation geo-textile filter fabric, prior to commencement of fill placement.

Foundation areas shall be graded and sloped to prevent surface run-on or ponding. Run-off from roofs, gutters, and downspouts shall be directed away from foundation areas.

8 ROADWORKS

8.1 General

The design of plant site roads shall conform to the AASHTO standards and the TAC standards.

Plant site roads shall be designed as one-lane each-way, two-way roads. All plant site roads shall be gravel surfaced, uniformly graded, free draining, and compacted to meet the requirements of AASHTO T180.

Plant low speed minor access roads shall be designed one-lane roadways.

8.2 Traffic Loading

8.2.1 Operational Traffic

Operational traffic loads for design of pavement and drainage structures shall refer to project's Structural Design Criteria.

8.2.2 Construction Traffic

Construction traffic loads for design of pavement and drainage structures shall use actual construction traffic loads if available.

In the absence of actual construction loads, for design purposes the anticipated maximum traffic loading during construction shall be as per Table 4.

Table 2 – Construction Traffic Loading

Heavy Load Platform - Parameter		Value
Maximum heavy load platform axle loading (6 axles)		69 tonne
Heavy load platform dimensions:	740 GC Articulated truck overall width	3.8 m
Limit state load factor		Refer to Section 3.5 of the Canadian Highway Bridge Design Code CAN/CSA S6-06

Heavy Load Platform - Parameter	Value
Dynamic load allowance	Refer to Section 3.8.4.5 of the Canadian Highway Bridge Design Code CAN/CSA S6-06

Note: (1) Heavy load platform dimensions will be confirmed after logistic studies.

8.3 Geometric Design of Roads

Geometric design of site access roads- may include public roads, in-plant roads and minor access roads shall be based on the values shown in Table 5.

Table 3 – Road Geometric Design Parameters

Feature	Haul Road (surface)	In-Plant Roads	Minor Access Roads
Design speed	50 km/h	40 km/h	40 km/h
Travel width	13.3 m (2-way)	8.5 m (2-way)	5 m (1-way)
Safety berm (m)	1.0h-3.0 base	0.75h-1.5 base	0.75h-1.5 base
Cross-fall for gravel pavement	2%	2%	2%
Maximum grade	8%	8%	10%
Maximum super-elevation on curves	4%	6%	6%
Minimum horizontal curve radius	100 m	30 m	30 m
Minimum Stopping Sight Distance	100 m	40 m	40 m

Roadside table drains shall be trapezoidal or swale shaped dependent on traffic requirements and drainage design.

8.4 Vehicle Vertical Clearance

Roads shall be designed to provide vertical height clearances as shown in Table 4.

Table 4 – Vertical Height Clearances

Parameter	Value
Over mine haul road crossings	9,000 mm
Over main road crossings	6,100 mm
Over secondary road crossings	4,500 mm

8.5 Earth Safety Barriers

Earth safety barriers shall be provided where deemed necessary to prevent vehicles leaving the roadway, generally where steep drop-offs greater than 1.0 m in height are located adjacent to the roadway.

Earth safety barriers shall be constructed from selected suitable material excavated on the site. The berms shall be formed and shaped to a pyramid shape in accordance with Table 3 to at least as high two third height of the largest wheel.

9 STORMWATER DRAINAGE

Surface runoff from the site areas is considered to be potentially contaminated and shall be collected by an open ditch system and discharged into storm water pond (See 10556.002_Hydrology Baseline Report).

9.1 Design Basis for Plant Site and Access Road Drainage

Rational Method shall be used as the primary method. Drainage of process plant includes open ditches designed for 10 years storm event. Runoff coefficients are listed in Table 5.

Table 5 Runoff Coefficients

Description of Area	Run-off Coefficient
Undisturbed Area	0.30
Stripped Ground	0.60
Gravel roads and yard areas	0.60
Concrete and roof areas	0.90

9.2 Rainfall Intensity

See Document 10556.002_Hydrology Baseline Report.

9.3 Open Channel Drains

Open channel drains shall be designed to limit design storm flow velocities to the values shown in Table 6.

Table 6 – Channel Maximum Design Flow Velocity

Channel Lining	Max. Flow Velocity (m/s)
Unlined bare erodible earth	1.0
Unlined bare erosion-resistant earth	1.5
Well grassed	2.5
Rip Rap	2.5
Reno mattress	4
Stone-pitching	5
Reinforced concrete	6

Dimensions of unlined trapezoidal ditch shall be as per Table 7.

Table 7– Minimum Open Channel Dimensions

Parameter	Value
Minimum bottom width	300 mm
Trafficable side slope	1 V: 5 H
Maximum side slope for un-lined drains	1 V: 2 H
Maximum side slope for lined drains	1 V: 1 H
Minimum longitudinal grade for concrete lined drains	0.2%
Minimum longitudinal grade for natural, gravel or stone paved drains	0.5%

Manning’s roughness coefficients for design of open channels shall be as shown in Table 8.

Table 8– Common Manning’s Roughness Coefficient

Channel Lining	Minimum	Normal	Maximum
EXCAVATED OR DREDGED CHANNELS			
Earth, straight, and uniform clean, recently completed.	0.016	0.018	0.02
Clean, after weathering	0.018	0.022	0.025
gravel, uniform section, clean	0.022	0.025	0.03
with short grass, few weeds	0.022	0.027	0.033
no vegetation	0.023	0.025	0.03
Rock cuts: jagged and irregular	0.035	0.04	0.05
Rock cuts: smooth and uniform	0.025	0.035	0.04
MAIN CHANNELS			
clean, straight, full stage, no rifts, or deep pools	0.025	0.03	0.033
same as above, but more stones and weeds	0.03	0.035	0.04

If the channel in question is not one of the above listed, please consult the Engineer to provide proper Manning’s Coefficients.

9.4 Culverts

Where culverts are constructed on natural drainage lines, the alignment should follow the existing streamline and culvert inverts should match existing levels where practical.

Culvert material types shall be corrugate steel pipe. Design parameters for culverts shall be as per Table 9.

Table 9– Culvert Design Parameters

Parameter	Value
Minimum diameter for pipe culverts	450 mm
Minimum cover to pipe culverts under light vehicle traffic	600 mm
Minimum grade for culverts - CSP Material	0.50%
Minimum depth of cut-off wall at the upstream edge of inlet aprons	500 mm
Maximum ratio of headwater/pipe diameter under design storm flow	1.50

Pipes under roadways if any shall be designed for AASHTO HS20 or mine haul truck if required, plus load impact, with the loading applied to the top of the subgrade.

Where the layout requires a curved alignment, the minimum radius of curvature shall be in accordance with the pipe manufacturer's recommendations.

Where available cover is less than the minimum required for pipe culverts, reinforced concrete box culverts (RCBC) shall be used. RCBCs may be either precast or cast in situ.

9.5 Provision for Maintenance

Drainage system elements, including pits, culverts, and sub-surface drain outlets shall be readily accessible for cleaning and unblocking. The whole drainage system shall be designed so as to minimise maintenance.

9.6 Scour

Ground surfaces upstream and downstream of drainage structures, culverts, and sedimentation basins, shall be protected from scour. Appropriate measures shall be in place to prevent scour at flows of not less than the design drainage flow.

Measures shall include, but not be limited to beaching, provision of rip rap, erosion matting, lining, and flow velocity control as appropriate.

10 SEDIMENT CONTROL

Sediment control fence shall be placed to protect surface runoff.

11 SITE SERVICES

11.1 Fire Water

Fire Water distribution piping shall be either carbon steel above ground pipe with freeze protection or HDPE pipe buried with a minimum of 1.6 metre soil cover or equivalent.

11.2 Potable Water

The design consumption rate shall be 200 liters per person per day and buildings fixture units.

Potable water distribution piping shall be HDPE pipe with freeze protection or buried with a 1.6 m minimum cover.

11.3 Sanitary Sewers

Sewage to be connected to the town sewer system.

All sewage shall be conveyed by gravity through buried PVC piping, buried with a minimum cover of 1.5 m. Sewers shall be at least 150 mm diameter. Minimum velocity shall be 0.6 m/s flowing half full and maximum velocity 2.6 m/s.