TROPICAL SUGAR COMPANY LIMITED (TSCL) ENVIRONMENTAL IMPACT ASSESSMENT FOR A NEW SUGAR FACTORY IN LIONEL TOWN, CLARENDON JUNE 2025

ANNEXES



Prepared by:



Environmental & Engineering Managers Ltd.

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ANNEX 1

Letter from NEPA approving the Terms of Reference (TOR) for EIA Terms of Reference for EIA approved by NEPA







ISO 9001: 2015 CERTIFIED

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Ref. #: 2024-13017-EP00360-4

17 March 2025

Mr. Noel McLean Tropical Sugar Company Limited 61 Macaw Drive, Milk River Clarendon

Dear Mr. McLean,

Re: Terms of Reference for Environmental Impact Assessment for Sugar Factory at Monymusk, Clarendon

Reference is made to the captioned.

The Agency has reviewed and accepted the Terms of Reference (TOR) Revision 2, dated March 2025, prepared by Environmental & Engineering Managers Limited.

This accepted TOR is to be appended to the EIA Report. The Report will be assessed against this TOR.

Should there be need for any clarification, please contact the undersigned at Tel# (876) 754-7540 ext. 2101 or by E-mail at gabrielle-jae.watson@nepa.gov.jm.

Sincerely,

National Environment and Planning Agency

Gabrielle-Jae Watson (Ms) Manager, Applications Secretariat Branch for Chief Executive Officer

GW/...

c. Ms. Ianthe Smith – EEM Limited

Mr. Randolph Watson - Manager (Acting), Applications Processing Branch

Mr. Miguel Nelson – Director (Acting), Applications Management Division

Terms of Reference for an Environmental Impact Assessment for a

New Sugar Factory
Tropical Sugar Company Ltd.
Monymusk, Clarendon

Revision 2

MARCH 2025



Environmental & Engineering Managers Ltd.

Unit #7, Phoenix Central, 2 Phoenix Avenue, Kingston 10, Jamaica Tel: (876) 622-4193, (876) 622-4745 Email: eem@environmanagers.com • www.environmanagers.com

Draft Terms of Reference for an Environmental Impact Assessment New Sugar Factory Tropical Sugar Company Ltd. Monymusk, Clarendon

1.0 Introduction

Tropical Sugar Company Ltd. (TSCL) proposes to establish a new sugar factory and associated wastewater treatment plant, power generation plant and water treatment plant at Monymusk, Lionel Town, Clarendon. The project will require the submission of several permit applications regulated under the Natural Resources Conservation (Permits and Licences) (Amendment) Regulations 2015, as well as the Natural Resources Conservation (Wastewater and Sludge) Regulations 2013. Based on the nature of the activities to be undertaken an Environmental Impact Assessment (EIA) will likely need to be prepared. The final decision on the need and scope of the EIA resides the national Environment and Planning Agency (NEPA) and it will be prepared in accordance with NEPA's requirements. NEPA also requires an EIA for wastewater treatment plants and these requirements will be incorporated into the full EIA.

2.0 Scope of EIA

The EIA will include:

- 1. Executive summary
- 2. Description of the project, reasons for the project
 - a. Project Location and Siting
 - b. Project Design Elements and Footprint
 - c. Wastewater Treatment Plant design criteria
- 3. Policy, legal and administrative Framework
- 4. Environmental Description
 - a. Biological Baseline [desktop]
 - i. Flora and fauna
 - ii. Agriculture and Forestry
 - b. Physical Setting [desktop]
 - i. Geology and Hydrostratigraphy
 - ii. Topography and Drainage
 - iii. Soils
 - iv. Hydrology
- 5. Weather, Climate and Natural Hazards
- 6. Social and cultural setting
 - a. Population and demographics
 - b. Community & Utilities
 - c. Geography and environment
 - d. Housing and land
 - e. Income and Employment
 - f. Gender Equality and Empowerment
 - g. Local Government Infrastructure and developments municipal resources
 - h. Sanitation and Environmental Public Health
- 7. Analysis of alternatives including the 'do nothing' alternative

- 8. Environmental impacts of proposed project (significance, positive, negative, cumulative, residual) associated
 - a. Noise & noise nuisance
 - b. Traffic
 - c. Solid Waste
 - d. Sewage & Trade effluent
 - e. Air emissions
 - f. GHG
 - g. Oil or chemical spills
 - h. Risk of Hazards and Accidents
- 9. Social impacts of proposed project (significance, positive, negative, cumulative, residual)
- 10. Mitigation action to reduce adverse environmental and social impacts
- 11. Environmental Management Plan and Monitoring programme to ensure mitigation measures are implemented and effective
- 12. Maintenance and Operational Plan/Manual (NEPA requirement)
- 13. Septage and Sludge Management Plan (NEPA requirement for Wastewater Treatment Plants)
- 14. Occupational Health and Safety Plans
- 15. Stakeholder and public involvement
- 16. References
- 17. Appendices

Deliverables:

- EIA report with the requisite photographs, maps, etc.
- 1 Digital and 6 hard copies

3.0 Permit and Licence Applications

The following list outlines the permit and lcience applications which need to be submitted to NEPA for the proposed project.

Permit Application Categories

- 1. Construction and operation of agro-processing facilities (including sugarcane)
- 2. Construction and operation of bottling facilities and boxing plants
- 3. Construction and Operation of power generation plants 200kW or above using renewable sources of energy
- 4. Construction and operation of water treatment and storage facilities, including desalination plants and water supply plants
- 5. Construction and operation of facilities for the storage of hazardous materials, toxic chemicals and other similar substances

Licence Application Categories (Trade Effluent)

- 1. Licence to construct treatment plant
- 2. Licence to operate treatment plant for the discharge of trade effluent
- 3. Licence to discharge trade effluent into the environment

Licence Application Categories (Sewage Effluent)

- 1. Licence to construct treatment plant
- 2. Licence to operate treatment plant for the discharge of sewage effluent

3. Licence to discharge sewage effluent into the environment

A licence application will also need to be prepared and submitted to the Water Resources Authority (WRA) for the abstraction of water for the intended water source for the new sugar factory.

4.0 The TOR for the EIA

1. Executive Summary

This section will allow for a clear understanding of the project proposal and summarize the significant results of the EIA study, e.g. positive and negative environmental, social and economic impacts; options considered; reasons for selection of the proposed option and the measures to be implemented to prevent or mitigate negative impacts or capitalise on positive impacts.

2. Description of the project, reasons for the project

The history and background of the project, project objectives and information on the nature, site location/existing setting, timing, duration, frequency, general site layout, pre-construction activities, construction methods, works and duration, and post construction plans will be covered.

All proposed infrastructure will be described including the sugar factory, wastewater treatment plant, power generation plant, water treatment plant, hazardous material storage etc.

This chapter will also provide a comprehensive description of the project in the construction and operational phases. The information provided will cover broader and more in depth details of project activities, with emphasis on those that will be require permits and licences from Regulatory Agencies, including information on the surrounding environment and project infrastructure necessary to identify and assess the environmental impacts of the project.

a. <u>Project Location and Siting</u>

Schematic plans and essential maps, including, map showing project location, project area, including project boundaries, aerial map of project areas, land use map of the study area, site layout plan and an area drainage contour map.

Maps showing the proposed location of the new sugar factory and all supporting infrastructure, will be presented as well as the coordinates of the new facility. The cane fields to supply the factory with raw material will also be presented on a map. The maps will show the location of the proposed factory to other areas of interest such as other industrial facilities, housing, farms, commercial establishments as well as surface and groundwater resources.

b. Project Design Elements and Footprint

All components of the project will be presented on a map and the design details associated with each will be described. A description of raw material inputs and system components, technologies designed for project components and processes to be used as well as

products and by-products generated, will be provided. Additionally an overview of proposed project infrastructure, including structural components of the wind turbines will be described in detail.

c. Wastewater Treatment Plant design criteria

A detailed description of Wastewater Treatment Plant (WWTP) will be provided to include but not be limited to:

- Treatment system and design criteria
- Maintenance and operation plan
- Septage and sludge management plan
- Projected daily flows (average and peak)
- Effluent discharge details (including projected water quality)
- Treatment processes
- WWTP components

Two (2) treatment plants will be constructed. A sewage treatment plant and a wastewater treatment plant to treat trade effluent.

In each case, the detailed design criteria for the proposed wastewater plant to serve the factory for trade and sewage effluent will be presented including the:

- Inputs
- Treatment methodology including details of each component including the justification for the size of the treatment components
- Means of disposal

The description will be supported by diagrams, pictures as required and all relevant assumptions and calculations will be clearly detailed. The accompanying design of the plant will be included.

3. Policy, legal and administrative Framework

An outline and summary of the pertinent regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels will be detailed in this chapter of the EIA.

All applicable legislation, regulations, policies and standards in relation to the construction and operation of the development will be highlighted, including but not limited to the other development permits such as Planning and Building. An examination of the legislation should also include at minimum, legislation such as the NRCA Act and applicable regulations, the Water resources Act, the Public Health Act, the National Solid Waste management Act, the Town and Country Planning Act, and the Wild Life Protection Act as well as any relevant international convention/protocol/treaty where applicable.

4. Environmental Description

A description of the baseline conditions will be done via the collection of <u>only</u> secondary baseline data within the project area. The baseline data will be generated in order to give an overall evaluation of the existing environmental conditions, values and functions of the area, as follows:

- physical environment
- biological environment
- socio-economic and cultural constraints

Secondary data collection will extend within a 10km radius of the project area/boundary. The methodologies employed to obtain baseline and other data will be clearly detailed, with all limitations and assumptions clearly stated. Data gathered will be presented in both written and graphical form. This will be standard throughout the EIA.

a. <u>Biological Baseline</u>

A flora and fauna assessment will be conducted for the proposed site as follows:

	Methodology	
Field work		
Flora	Flora will be examined across the site	
	Lab work will be conducted to assist with the identification of the flora	
Bird Survey	The bird survey will be carried out using the point count method. At each	
	sample area point, there will be 3 points at least 150 m from each other	
	where the point survey method will be carried out.	
	Night and day assessments will be conducted.	
	Lab work will be conducted to assist with the identification	
<mark>Invertebrate</mark>	The foliage will be searched at each sample site. Specimens will be collected	
Survey	from the active search and also by using the sweep. The specimens will be	
	identified at the UWI collection. The study will also involve collecting land	
	snails. A light trap study will be carried out for nocturnal insects.	
	Night and day assessments will be conducted.	
II D	Lab work will be conducted to assist with the identification	
Herps: Day & Survey	At each sample site, the surrounding areas will be actively searched for herps. AudioMoths will be deployed in strategic areas to record the	
& Survey	nocturnal frogs in the area. Species will be identified from seven days of	
	acoustic recordings.	
	Night and day assessments will be conducted.	
	Lab work will be conducted to assist with the identification	
Bat survey:		
Day &	areas where the endemic tree bat roosts. The AudioMoth detectors will be	
<mark>Night</mark>	deployed within the area throughout the project area. They will be left in the	
	field for 7 days; 1 field day of recordings will take 2 days of lab time to	
	analyse. 5 bat acoustic devices will be deployed in the field. The bat survey	
	component will take 3 field days, 2 days to actively search for bats and	
	deploy equipment, the area will be reassessed a week later and the field	
	equipment will also be retrieved. It will take 2 days to analyse data from each device.	
	Night and day assessments will be conducted.	
	Lab work will be conducted to assist with the identification	
1	Lad work will be conducted to assist with the identification	

b. Physical Setting [desktop & field]

A description of the existing **soil, geology, hydrology and hydrostratigraphy** will be provided. The description will focus on the geology of the proposed site, the distribution of soil types in the proposed study areas using appropriate soil survey procedures and the implications of environmental effects on ecosystem sustainability.

Water quality for aquatic environments or surface water features, wells or coastal waters in the vicinity of the development will be included in the scope. Baseline water quality should include study areas and associated environs and control sites for both wet and dry seasons, i.e. monthly water quality monitoring and sampling conducted for a period of no less than six (6) months, with 3 months covering the wet season and 3 months covering the dry season. Samples should include a control. Recent existing data (within the last 2 years), meeting the stated criteria will be used if/where available.

Obvious **sources of existing pollution** and the extent of contamination affecting the physical environment will be described.

5. Weather, Climate and Natural Hazards

A description of the natural hazards affecting the project area will be described. Meteorological data covering the following will be incorporated in the EIA report.

The meteorological data for at least a 10 year period will be presented from the nearest meteorological station

- Wind speed and direction
- Rainfall
- Relative humidity
- Temperature

Historical databases will be accessed for data on hurricanes, earthquakes and flooding

- History of hurricanes
- History of earthquakes
- History of flooding

6. Social and cultural setting

The section on socio-economic and cultural environment will provide a detailed description of:

- a. Population Demographics: population size, age distribution, gender composition
- b. Community structure: community groups, community programmes and projects
- c. Social infrastructure and facilities: education, health and welfare facilities and infrastructure
 - . Gender Equality and Empowerment
- d. Infrastructure & Utilities: water, electricity, telecommunications
- e. Local Government Infrastructure and developments municipal resources
- f. Sanitation and Environmental Public Health
- g. Economic structure: Employment and income, economic opportunities, programmes and projects
- h. Cultural traditions/customs
- i. All existing resource users (including traditional users) ranging from subsistence utilization of the natural resources to commercial activities

- j. Archaeological features: The historical importance (heritage, archaeological sites and feature) and other material assets of the area will be examined if applicable. (Not applicable based on Site Assessment conducted by Jamaica National Heritage Trust (JNHT)
- k. Land Use: Present and proposed land use (including housing, settlements, commercial, farming and other uses. Details including nature and magnitude, proximity to site etc. will be included.);
- l. Transportation and traffic considerations: transportation of heavy equipment (particularly in the construction phase), planned development activities; issues relating to public health and safety will be covered.
- m. Public Perception: An assessment of public perception of the proposed development will be conducted using appropriate methods and tools such as public meetings and/or questionnaires/surveys.

7. Analysis of alternatives including the 'do nothing' alternative

An examination and evaluation of the project and potential alternative of not proceeding with it will be taken into consideration in the EIA. The evaluation will include:

- An analysis of the alternative means of carrying out the Project, including need for the project, alternative sites, alternate projects and variations to the scope of the project (major components included and excluded) and if any of the alternatives could result in a minimization of adverse impacts. For the project components, a comparison of their environmental and technical performance potential and other relevant variables will be included.
- A discussion on the status of any ongoing analyses, including a discussion of the options not chosen and the rationale for their exclusion.
- Contingency plans if major project components or methods prove infeasible or do not perform as expected; and
- The implications of a delay in proceeding with the Project, or any phase of the Project.
- Examination of the 'do nothing' alternative

8. Environmental impacts of proposed project (significance, positive, negative, cumulative, residual)

A detailed analysis of the various project components will be done in order to examine and identify the major potential environmental, social and public health issues of concern and indicate their relative importance to the development project. The assessment of impacts will include, but will not be limited to the identification of the potential negative and positive environmental impacts of the project at all stages, including an assessment of the magnitude and importance of the impacts.

In assessing the potential impacts related to the proposed project, consideration will be given to the following:

- occupational exposure, health and safety measures and population exposure
- natural hazard risk (hurricanes, earthquakes, flooding potential)
- aesthetics from construction and operations
- loss of and damage to geological and paleontological features
- loss of species and natural features
- habitat loss and/or fragmentation
- biodiversity/ecosystem functions
- water quality from sewage and trade effluent, oil and chemical spills

- air quality from air emissions (to include both point and fugitive emissions)
- socio-economic and cultural issues
- historic landscape, architecture and archaeology of the site
- noise
- solid waste
- traffic including transportation of equipment, including but not limited to blockage of roadways by heavy duty vehicles and equipment
- hazardous waste from operations

The assessment will examine all potential impacts on the physical, biological and social environments. This assessment will be undertaken for each project activity and presented in a matrix for all phases of the project. It will cover:

- i. The types of impact:
 - o Significant positive and negative
 - o Immediate, short and long term
 - o Direct and indirect
 - o Irreversible
 - o Cumulative
- ii. The project phases: Construction, operational and decommissioning phases

The extent and quality of the available data will be characterised, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts.

Residual Impacts: Identify any residual negative impacts for which no solution for mitigation has been proposed.

9. Air Emissions Inventory

An Air Emissions Inventory (AEI) will be prepared for the sugar factory operations, primary among which the proposed bagasse fired power generation plant will be a potential significant source of air emissions. The AEI will determine the category within which the facility falls, that is, major, significant or neither and if an air pollutant discharge licence application will need to be submitted to NEPA. Note that the Air Dispersion Model and Licence application will be conducted as a separate exercise if it is confirmed to e require.

10. Social impacts of proposed project (significance, positive, negative, cumulative, residual)

Objective and Scope of Work

The objective of the social impact assessment is to conduct a socially inclusive and gender-responsive social impact assessment of the proposed vertically integrated sugar cane cultivation and sugar production factory. The results of the social impact assessment will help to support the identification, assessment, evaluation and reporting of the potential socio-economic effects of the proposed project, improve the design and operations of the factory, and guide the resolution of potentially adverse impacts identified.

The scope of work for the social impact assessment will include a description of the social environment and will involve the provision of data on the socio-economic landscape of communities within the delineated study area. This will include relevant information on

demography, labour force, housing, municipal services and facilities, cultural and historical sites and land use. Specifically, the works to be undertaken include:

- 1. Description of the Social Baseline- Describe the baseline social characteristics of the project area, including but not limited to a baseline of the social and cultural environment, including present and projected, where appropriate (i.e., population, employment and labour market, economic activities, land use, planned development activities, community social structure, cultural and historical sites, vulnerable groups; etc.) The boundaries of the study area for the assessment, as well as any adjacent areas that should be considered with respect to the Project should be specified.
- 2. Assessment of Impacts-Description of the project's potential social and gender impacts (positive, negative, long term, short term and cumulative impacts), during the construction and operations phases.
- 3. Description of Mitigation Measures: Based on the findings of the SIA, identify feasible and cost-effective mitigation measures to reduce potential direct and indirect negative social/gender adverse impacts and risks identified for both the construction and operational phases of the Project and enhance positive impacts where identified. Development, where required, the relevant social plans to monitor the implementation of the mitigation measures and impacts of the project. To the extent possible, mitigation measures should emphasize the use of nature-based solutions.

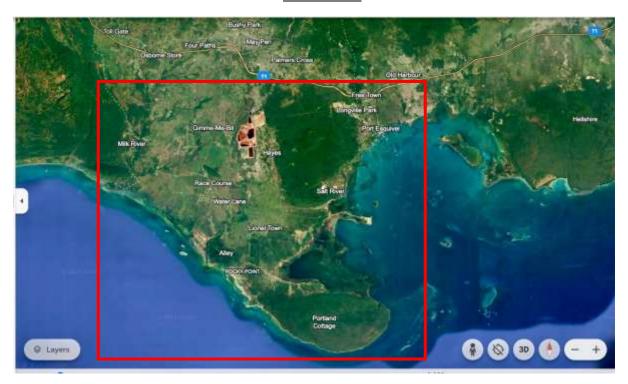
Methodology

This study will be conducted using a mixed-method approach, with differential participatory and consultative methodologies used in engaging various stakeholders and institutional actors. The main objective of the approach is to assess, from the perspective of the beneficiaries the potential benefits and opportunities to be derived from the operation of a vertically integrated sugar cane cultivation and sugar production factory, and ascertain the ways in which the proposed project can improve and/or may affect the population of the communities surrounding the proposed project site. Although the operation in the initial stages will include the production of sugar, when fully operational and equipped, the factory will also undertake the manufacturing and distribution of locally and export intended downstream products inclusive of molasses, cane liquor, water for retail consumption and pharmaceutical products, among others.

A combination of qualitative and quantitative data collection methods and tools will be used in conducting the social impact assessment. Qualitative methods will include a desk review, focus group discussions, and key informant and institutional actor interviews. The quantitative method will involve the completion of a socio-economic and beneficiary perception and experience survey. The methodology, which is designed around a participatory approach, is in line with the general requirements of the World Bank Environmental and Social Framework and standards for conducting environmental/IFC performance Standards on Environmental and Social Sustainability and social impact assessments and the International Association of Impact Assessment (IAIA).

Preliminary Study Area

The pre-scoping delineated study area extends from the communities east of Milk River to the communities west of Salt River Bay and includes communities within the Vere Plains and lower Rio Minho watershed.



Scoping

The first step in executing the assessment of the potential impacts of the proposed integrated sugar cane cultivation and sugar production factory is determining the nature and scope of the problem to be addressed. This concretises the issue and provides a framework within which actions and scenarios can be contemplated and impacts assessed. Hence, the nature and scope of the issue will influence the focus of the assessment's mitigation measures and the intended stakeholders, actors and audiences that will be the target of such measures.

Comprehensive desk-based review of existing literature of key social aspects (geographical, social, cultural and economic), site/field visits, and the hosting of consultations with key stakeholders will be the main methodological approach used in the scoping phase of the SIA. The stakeholder consultation will include a stakeholder identification and mapping process to identify all relevant stakeholders. Stakeholder engagement activities will be geared towards garnering feedback from identified stakeholders on the proposed project and scope of the SIA. Desk review and site visits will be used, where necessary, to gather and present baseline information on the various social components.

Document Review

The Document Review will provide secondary data on the demographic, socio-economic, cultural and community landscape of communities within the final defined study area. The main objective of the documentary review is to provide an in-depth understanding of local communities, which will include the social and economic environment and overall baseline description of key socio-economic variables within the project areas. The baseline will include a description of

- demographic factors (population-sex, age, population density, etc.)
- socio-economic factors (economic activities, sources of income etc.,)
- social organisations (civil society organisations, non-governmental organisations,)
- municipal and community institutions (health, education, etc.)
- environmental factors (natural resources, protected areas

- cultural, historical and community factors
- vulnerable and marginalized groups (persons with disabilities, elderly, children, women, fishers etc.)

Documents to be reviewed will include:

- National Sustainable Development Plan 2020-2035
- Population and housing census
- Labour force survey reports
- Poverty assessment reports
- Survey of Living Conditions
- National Accounts Report
- National Budget
- Voluntary National Review Report
- Medium Term Action Plan (2022-2024)

The social baseline derived from the document review encourages identification of gender-specific risks and vulnerabilities and exploration around key social, economic and environmental issues impacting women and men in the project areas. The information gathered will be integrated into the design of the primary data collection instruments including identification of specific actions to address existing and potential issues

Quantitative

The quantitative data collection will consist of the administration of a socio-economic and beneficiary perception and experience survey. The Survey will be executed in three phases (see below):

- a. Design and Development of instrument and data collection procedures, including recruitment and training of interviewers.
- b. Data collection and Processing
- c. Analysis of data

Figure 1: Phases of Survey Implementation



The questionnaire will consist of a standard set of questions that cover the following thematic areas, among others:

- Socio-demographics, including current family composition
- Level of education
- Housing and Land characteristics
- Employment and income characteristics, including livelihood characteristics
- · Community and municipal services and infrastructure
- Cultural, archaeological and heritage characteristics
- Hazard Risks and Vulnerabilities
- Social and community challenges

• Project awareness and perception

The questionnaire will also cover respondents' perceptions of the proposed flood and coastal rehabilitation intervention measures, including concerns and benefits. A Likert scale will be used for some perception questions, asking respondents to rate their experiences on a scale of 1-5. Questions will be presented on a Likert scale.

Sampling Methodology And Design

To achieve the objectives of the study, the socio-economic and beneficiary perception survey will assess the responses of respondents who are 18 years and older who are usual residents of the communities identified in the final defined SIA study area and are living in private dwelling units at the time of the survey. The sampling frame for the survey will be the 2011 Population and Housing Census or the most recent demographic data, if available.

The data will be collected using a convenience-based sampling technique, as the sample is indicative, and not representative of the population of communities within the pre-scoped project boundary.

Area of Administration (Perception Survey)

The perception and experience survey will be administered in communities within the immediate vicinity of the factory.

Table 2: Total Combined Population of Communities located in pre-scoping project boundary based on 2011 Census

Community Name	Enumeration District	Population	
Alley	SE 102	2011	2023*
Amity Hall	SW 77	331	347
Chesterfield (Lionel Town)	SE 100	375	393
Cook's Gate (Parnassus)	SW 42	643	674
Gimme-me- Bit	SW 54-56	883	925
Hayes	SE 71-76, 78-90	10,639	11,148
Hunter's Village	SE 117	736	771
Kemp's Hill	SW 57, 58	573	600
Lionel Town	SW 79-82, SE 91, 97-99	3,044	3,190
Longwood	SE 103	509	533
Milkspring	SW 51	282	295
Mitchell Town	SE 92-95	1,452	1,521
Monymusk (Lionel Town)	SW 78	Factory	Factory
Morelands (Mitchell Town)	SE 92	404	423
New Yarmouth	SW 59	230	241
Parnassus, Rhymesbury	SW 34, 43	1,581	1,657
Perrins (Lionel Town)	SW 83	191	200
Portland Cottage	SE 118-121	2,040	2,138
Pusey Hall (Alley)	SE 101	655	686
Race Course	SW 60, 61, 68-73	2,949	3,090

Community Name	Enumeration District	Population	
Rocky Point	SE 110-116	2,473	2,591
Salt Savanna	SE 108, 109	598	627
Sedgepond	SW 63	480	503
Springfield (Milk River)	SW 66	137	144
Vere	SW 64, 65	833	873
York Town	SW 37-41	1,623	1701
		33,661	35,271
	*Note- estimated using 2011 intercensal growth rate		
	of 0.36%		

Data Collection And Processing

Data for the socio-economic surveys will be primarily collected electronically by trained interviewers using computer-assisted personal interviewing (CAPI) with the use of tablet computers. It is proposed that respondents be offered a small incentive for participation (see financial proposal). Interviewers will be recruited and undergo a short training on questionnaire administration, interview techniques and strategies, and the administration of the socio-economic and beneficiaries experience and perception survey (SBEP).

Qualitative Approach

The qualitative approach in data collection will comprise Focus Group Discussions and Key Informant and Institutional Actor Interviews. The Focus Group Discussions and Key Informant Interviews will provide most of the in-depth primary qualitative data for this study.

Focus Group Discussions

The focus group discussions (FGDs) will provide primary data on community members experiences with the operation of manufacturing plants and sugar factories within their communities. This will provide in-depth data on any socio-economic and environmental impacts and barriers community members may have experienced as result of these environmental factors and provide insights into any differentials that may exist between women and men. These FGDs are also intended to provide data and information on the gender dimensions of the perceived potential benefits and opportunities and concerns that community members may experience as a result of proposed activities associated with the construction and operation of the sugar factory.

For this study, the target population will be disaggregated by sex, to adequately capture any differentials in beneficiaries' perceptions of the proposed project. One (1) focus group session will be held with members of the communities within the designated study area as agreed with the client. A purposive sampling technique will be adopted for selection of participants to the FGD's. The proposed preliminary breakdown of the FGDs is provided in Table 2. The final categories and number of FGDs will be undertaken following the scoping activities and desktop review.

Table 2: Focus Group Discussions By Category

Respondent/Participant	Number of	Number of participants
category	groups	
Community members, Farmers and	1	8-12
Business Operators (including		
MSMEs), Vulnerable stakeholders		
(Persons with Disabilities, elderly,		
women)		
Total	1	12

A FGD guide will be designed for use, in consultation with the client, and will be refined after preliminary discussions with key informants and institutional actors to help more clearly identify the pertinent issues associated with the operation of the factory. Preliminary design concepts will also be presented to participants in the FGD sessions to garner their feedback on proposed interventions and perceived impacts. The groups will be convened either face-to-face and/or virtually as is feasible and agreed with the client.

Target Area

Participants will be sought from the communities where cane lands are situated and those closest to the factory.

Key Informant Interviews

Qualitative in-depth interviews are an ideal method for detailed discussion and understanding of the phenomenon being investigated. Key informant interviews will be conducted with institutional actors and key stakeholders, including community and municipal leaders and representatives and leadership in the ministries, department and agencies agreed with the client, if required. These interviews will be conducted virtually and/or in-person using an approved interview schedule.

Where permitted, key informant, individual interviews and FGDs will be audio recorded, and supplementary notes taken during the engagement exercises. For the socio-economic survey, data analysis will be done using Excel. Data gathered from the surveys will be coded to arrive at clusters to tabulate percentage responses. The data will be analysed primarily through frequency tables and cross-tabulations to filter the required information and key demographic variables for the analyses such as sex, age, education etc.

Impact Identification And Assessment

Based on the findings of the baseline assessments, an impact analysis will be undertaken to identify and assess various social aspects and impacts associated with the proposed project. The impact analysis will be done through the application of an impact matrix, with significance ratings divided into four categories: negligible, minor, moderate and major/high.

Mitigation And Monitoring

For the construction and operational phases of the project social mitigation and monitoring measures will be identified and where necessary, relevant management plans to guide the implementation mitigation and monitoring measures will be developed. The Mitigation Hierarchy will be used as the framework for identifying, prioritizing and quantifying mitigation measures.

The four-step process- avoid, minimize, restore and provide offsets for unavoidable impacts, will be used to guide mitigation planning and the identification and development of appropriate mitigation measures.

11. Mitigation action to reduce adverse environmental and social impacts

This section will outline the details of the mitigation methods proposed to reduce adverse effects of the project, best environmental practices and conservation of natural resources.

Mitigation and abatement measures will be formulated for each potential negative impact identified. This will also include recommendations for the maximization and enhancement of beneficial impacts, energy conservation and the use of green building technology.

12. Environmental Management Plan and Monitoring programme to ensure mitigation measures are implemented and effective

This section will outline and include details for an environmental monitoring programme. An environmental management and monitoring plan to monitor the effectiveness of the mitigation measures for the construction, operation and decommissioning phases will be developed. For the long-term operations of the site the monitoring plan will include:

- an EHS Management Plan
- a Historic Preservation Plan (if necessary) for the management of the natural, historical and archaeological environments of the project (Not applicable based on Site Assessment conducted by Jamaica National Heritage Trust (JNHT)

At the minimum the monitoring programme and report will include:

- An introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit and/or licence(s) granted.
- The activity being monitored and the parameters chosen to effectively carry out the exercise, including avifaunal mortality
- The methodology to be employed and the frequency of monitoring.
- The sites being monitored.
- The systems to be instituted to ensure that corrective measures are employed (when necessary) based on results obtained through monitoring
- Frequency of reporting to NEPA

13. Maintenance and Operational Plan/Manual (NEPA requirement for Wastewater Treatment Plants)

The plan will outline the recommended maintenance activities and a schedule for the conduct of same to ensure optimal operation of the plant.

14. Septage and Sludge Management Plan (NEPA requirement for Wastewater Treatment Plants)

A septage and sludge management plan will be developed giving consideration to environmental, occupational health and safety standards. Where there are opportunities for reuse or recycling, these will be included.

15. Occupational Health and Safety Plans

This section will outline the considerations for an occupational health and safety programme for the construction, operation and decommissioning phases.

16. Stakeholder and public involvement

There will be consultation with stakeholders throughout the EIA including a perception survey and a focus group meeting conducted in the communities immediately surrounding the site of the proposed project.

A description of the public participation methods, timing, and information provided to the public and stakeholder target groups will be included in this section of the EIA. Public input that has been incorporated into the proposed project design and environmental management programmes will be presented.

a. Public Consultation Meeting

A public meeting will be held, **if required by NEPA**, to present the findings of the EIA after submission of the draft EIA report to the Agency. The objective is to inform stakeholders and solicit and discuss comments from the public on the proposed development. Verbatim notes of the proceedings will be documented. This will be a separate submission from the EIA report.

The EIA report will be updated based on feedback from the Public Consultation Meeting if necessary and the final EIA will be submitted to NEPA.

17. Conclusion and Recommendations

The conclusions coming out of the EIA study will be summarised and the recommendations presented in this section.

18. References

References will be included.

19. Appendices

Supporting documents, maps, diagrams etc. will be included in the Appendices as well as the qualifications of the EIA Team.

5.0 Team Qualifications

Ianthe T. Smith, M. Eng. Environmental Engineering, P.E., Member JIE, Member JIEP Principal Consultant/ Director Environmental & Engineering Managers Ltd.

Ianthe Smith is a Jamaican national and an Environmental Engineering Consultant. She has a BSc. in Civil Engineering (1986) from the University of the West Indies, St. Augustine, Trinidad. In 1994 she graduated from the University of Toronto, Canada, with a Master of Engineering degree in Environmental Engineering, being the recipient of a CSCE/CIDA scholarship.

Mrs. Smith's education also includes Project Management Training from the University of New Orleans (Jamaican Chapter) and Indoor Air Quality Assessment training from the Indoor Air Quality Association (IAQA). She is a trained and experienced Environmental Management Systems (EMS) Lead Auditor and also has Quality Management Systems and HACCP5 training.

She worked with the Natural Resources Conservation Authority (NRCA) (now the National Environment and Planning Agency (NEPA)) from 1994 to 1998 where she was the Senior Director for Pollution Control and Waste Management. While there she was instrumental in the development of environmental standards and legislation and worked with industries regarding the establishment of systems to manage their waste to prevent pollution and deterioration of the environment. She also played a lead role in the development of the permit and licence system for new projects that are likely to have adverse impacts on the environment.

She has been an environmental engineering consultant since 1999, was the Managing Director for Environmental and Engineering Managers Limited since its inception in 2001 until 2016 and is currently a Director of the company.

Her expertise includes Environmental Impact Assessments, Environmental Audits, Indoor Air Quality Assessments, Water and Wastewater Engineering, Solid Waste Management, Implementation of Environmental Management Systems (EMS) and Planning and Controlling Construction.

Andre Marcel Smith, EEM Environmental Scientist and Marine Specialist

Andre graduated from the University of the West Indies, Mona, Jamaica in 2013 with the BSc. Marine Biology (Major) and Conservation Biology (Minor) and Master of Environmental Management with Distinction from Massey University, New Zealand in 2018. Andre has been working at EEM in this capacity since 2013.

Dominic Neita, EEM Environmental Engineer

Dominic is an Environmental Engineer who holds a BSc. Degree (Second Class Honours) in Civil with Environmental Engineering from the University of the West Indies, St. Augustine, Trinidad (2019). He has been working at Environmental and Engineering Managers Ltd. for the past four years on several projects.

Brenton Bartley, EEM Environmental Engineer

Brenton holds a BSc. Degree (First Class Honours) in Civil Engineering from the University of the West Indies, Mona Campus (2022). He joined Environmental and Engineering Managers Ltd as an Environmental Engineer in 2022.

Kamille Dwyer-Thomas, Urban Planner and Environmental Consultant

Kamille holds a M.Sc. in Planning and Development (University of the West Indies, St. Augustine –Distinction) and a B.A. in Geography (University of the West Indies, Mona –Second Class Hons.). Over the past 14 years, she has worked on several research projects, land use surveys, and environmental and social impact assessments in the Caribbean, including Jamaica, Trinidad and Tobago, Antigua and Barbuda, and St. Kitts. She has worked with several public sector agencies in Jamaica, including the Planning Institute of Jamaica and the Ministry of Water and Housing, conducting socio-economic, land use and environmental surveys in various rural and urban communities.

Damion Whyte, Terrestrial Biologist

Damion's qualifications include:

• 2016 PhD (pending) Zoology, "To Evaluate the Goat Islands for the Re-introduction of the Jamaican Iguana", University of the West Indies (UWI), Mona, Jamaica

• 2014 Post Graduate Diploma in Environmental Management for Developing and Emerging Countries, Centre for International Postgraduate Studies of Environmental Management, Dresden University of Technology, Germany.

ANNEX 2

TROPICAL SUGAR COMPANY LIMITED (TSCL)

AIR EMISSIONS INVENTORY REPORT



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Tropical Sugar Company Limited (TSCL) - Air Emissions Inventory	April 2025
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1. INTRODUCTION

Tropical Sugar Company Limited (TSCL) was incorporated on June 23, 2023 and will be operated as a vertically integrated sugar cane cultivation and sugar production company that will be located on the Vere Plains within the constituencies of southeast and southwest Clarendon, Jamaica. TSCL intends to build a 2500 TCD Sugar Plant with 12.5 MW Co-Generation Plant at Lionel Town, Clarendon. The TSCL factory will be located next to the existing decommissioned Monymusk Sugar Factory at Vere Plains, Clarendon. Figure 1 shows the location of the facility.

In addition to sugar, TSCL expects to manufacture, distribute locally and export downstream products inclusive of molasses, cane liquor, water for retail consumption and pharmaceutical products, among others, when fully operational and equipped.

TSCL will install a power generating plant that provides steam and electric power for the sugar manufacturing process at the factory. This air emissions inventory (AEI) highlights the main air emissions sources at TSCL and outlines the average and maximum expected emissions at TSCL. This AEI will facilitate the:

- Determination of the classification of the facility
- Development of a new air dispersion model for the facility, if needed, and
- Completion of an application to the National Environment & Planning Agency (NEPA) for an Air Pollutant Discharge Licence, if needed.



Figure 1: Google Earth Image: Location of TSCL Factory

2. TSCL MANUFACTURING PROCESS OVERVIEW & FLOW CHART

Figure 2 shows the detailed process flow chart for the manufacturing processes at TSCL. The main raw material, sugarcane, is sampled and tested for quality assessment. If the sugarcane quality is unacceptable, it will be repurposed for boiler fuel. When acceptable, the cane is weighed, washed and treated with biocide before it is milled. The effluent from the cane washing operation will be treated by an on-site Effluent Treatment plant and the treated effluent will be used for irrigation of the cane fields.

Imbibition water is added during the milling process and the cane juice is extracted for further processing while the fibrous residue from the milling process (bagasse) is stored for use as fuel for the boiler (BLR1) which will be used to produce steam for power generation. The cane juice is treated with lime before it is clarified and filtered. The clarified cane juice is then evaporated to form cane syrup and condensate. The condensate is re-used as imbibition water while the syrup is further processed by treating, crystallization and separation processes to create the desired products: sugar (raw, refined), sugar jaggery (massecuite), syrup (liquid sugar, sugar syrup) and molasses.

The residue from the clarification and filtration process will be composted to bio-fertilizer. The exhaust gases from the boiler will be passed through an electrostatic precipitator (ESP) which will use pneumatic means to collect and extract particulate matter from the exhaust gases before it is emitted from the boiler stack.

TSCL intends to produce 12.5 MW of power with bagasse as the primary fuel source for its co-generation facility. It is expected that 3.5 MW will be consumed by the Factory operations, 3.0 MW will be exported for use at the farms and the remaining +5.0 MW to 7.0 MW will be sent to the Jamaica Public Service Company Ltd. (JPSCo.) for the national grid.

Raw Material Cane Sampling (Sugarcane) Is Cane Qualit Reject for Boiler Fuel Acceptable? Yes Scale Raw H₂O Cane Handling RO Plant Softener Backwash/Reject Chemical Lab Testing Treated Effluent Washing (Irrigtion) ETP (Effluent RO Plant Water Bottling Reverse Osmosis Treatment Plant) Bio Fertilizers Backwash/Reject (RO) Plant Plant Sludge (Dried (applied to cane on drying beds) fields) Cane Preparation Biocide Condensate Boiler Storage Imbibition Water Matter Grate% Fly Ash Power ESP (Electro-Lime Addition Juice Treatment Generation Static Precipitato Brick Manufacturing Floculant Facility Electricity Filtration Filtrate Clarification Addition Plant, Farms and Composting Condensate JPS. Condensate Mud Disposal Composted to Evaporation Bio Fertilizer Melter Cane Fields Dextranase & Syrup Storage Condensate Syrup Syrup/Liquid Pan Aid, Crystallization Bottling Slurry Massecuite Packaging Sugar Jaggery "A" & "B" Bottling of Centrifuge Molasses Molasses Molasses Brown Sugar Refined Sugar Bagged Sugar Refinery Bagged Process Flow KEY Process in-puts Process Flow Warehousing

Figure 2: TSCL Agro-processing Facility Process Flow Chart

3. SOURCES

TSCL has several sources of air emissions which are described in further detail in the sections 3.1 - 3.9 below.

The main air emissions sources include:

- 1. Bagasse Boiler
- 2. Diesel Generator

The significant fugitive air emissions sources include:

3. Bagasse Storage & Handling System

The insignificant fugitive air emissions sources include:

- 4. Sugar Production Process
- 5. Ash Storage & Handling System
- 6. Fuel Storage Tanks
- 7. Vehicle Engines
- 8. Paved & Unpaved Road Surfaces
- 9. Effluent Treatment Plant (ETP)
- 10. Sewage Treatment Plant

3.1 Bagasse & Wood Chips Fired Boiler

One (1) bagasse fired boiler will be used in the process to produce steam and electric power for use in the sugar manufacturing facility. The Terravista Solutions P. Ltd boiler (BLR1) will be rated for the generation of 75 MT/hr steam at 485±5°C, 6.6 MPa (66 kg/cm²). This bi-drum, natural circulation watertube type boiler has a traveling grate combustor.

The boiler will typically use bagasse as the main fuel source. However, wood chips may be used during the off-peak season when the bagasse supply is low.

The exhaust from the boiler passes through an electrostatic precipitator (ESP) for particulate removal before being conveyed to the boiler stack (BLR1STCK).

The combustion of the bagasse and wood chips by the boilers and the emission of the exhaust from the stack will be the main source of stack air emissions at TSCL.

3.2 **Diesel Generator**

There will be one (1) main standby diesel generator (TSCLGEN1) which generates power for the process as necessary when there is no power supply from the boiler. The generator will be rated at 1,010 kVA. The generator emits its exhaust from its individual stack (GEN1STCK).

The combustion of diesel by the generator and the emission of the exhaust from the diesel generator stack is a source of stack air emissions at TSCL.

3.3 Bagasse Storage & Handling System

The bagasse storage and transportation system is mainly composed of 3 bagasse silos, a mechanized conveyor system, its supporting devices and an uncovered bagasse storage area (BAGASSE). The bagasse produced at the mills is either directly fed to the boiler via the bagasse silos or stored in stockpile(s) in the available space in the open yard (~ 10,000 m²) before being fed to the boiler. The boiler will be fed from the bagasse silos using an overbed feeding system with a drum feeder below the bagasse silo and a bagasse extractor below the drum feeder.

The particulate matter generated by the crushing of the sugarcane and feeding the bagasse to the boiler occurs in enclosed areas. These activities are therefore insignificant sources of fugitive emissions at TSCL. However, the wind erosion of the particulate matter (PM) from the bagasse stockpile(s) is a significant source of fugitive air emissions at TSCL.

3.4 Sugar Production Process

Ethanol vapour is considered a Volatile Organic Compound (VOC) and it is produced during the sugar production process. This production of ethanol during the process operations will be an insignificant source of fugitive air emissions at TSCL.

3.5 Ash Storage & Handling System

The exhaust gases will contain ash from the combustion of the bagasse. The exhaust gases for the boiler will pass through the dust collecting plates in the two fields of the Electrostatic Precipitators (ESPs) to remove the ash particles before the exhaust gases are emitted from the stack. The ash that is collected by the ESP dust collecting plates will be collected in the ESP Ash hoppers. TSCL will install a Pneumatic Fly Ash Conveying system with vibrators on the hoppers to ensure the movement of the ash.

A horizontal belt conveyor will transport the ash from the discharge hoppers for the Economiser, Air heater and ESPs to an incline belt conveyor that transfers the ash to the 50 m³ Ash Storage Silo. The silo will have a conditioned fly ash extraction system equipped to facilitate unloading of the ash into an open truck. The ash may then be transported by trucks for use in brick manufacturing.

The storage, handling and transportation of the ash will be a source of insignificant fugitive air emissions at TSCL.

3.6 Fuel Storage Tank

TSCL has one above ground diesel oil fuel storage tank with an operating capacity of 990 Liters and dimensions of 1m x 1m x 1.2m height.

The evaporative and standing emission losses of Volatile Organic Compounds (VOCs) from the above ground fuel storage tank will be an insignificant source of fugitive air emissions at TSCL. This fugitive air emissions source is considered insignificant for reporting purposes.

3.7 Vehicle Engines

The operations at TSCL will involve the use of several vehicles for the transportation and handling of sugarcane. For manual harvesting of sugarcane, Tractors, Grabbers, Cane Carts and manual loading may be used. For mechanical harvesting of sugarcane, Harvesters, Cane Carts and Tractors may be used.

The combustion of fuel by these vehicles will be a source of fugitive air emissions at TSCL. These fugitive air emission sources are considered insignificant for reporting purposes.

3.8 Paved & Unpaved Road Surfaces

The operations at TSCL involve the transportation of cane from the fields to the Factory for processing, and transportation of the ash from the ESPs to the brick manufacturing site. These roads are typically unpaved roads in the cane fields and paved public and private roads which are accessed by the vehicles when loaded and when empty.

Particulate matter (PM) generated from the use of the paved and unpaved surfaces will be a source of insignificant fugitive air emissions associated with the operations at TSCL.

3.9 Effluent Treatment Plant

The Effluent Treatment plant at TSCL includes the treatment of wastewater from the cane washing process and other sugar manufacturing processes and reject from the Boiler feed water Reverse Osmosis (RO) plant. The treated effluent will be used for irrigation of the sugarcane fields. The sludge residue from the treatment plant will be dried on drying beds and applied to the sugar cane fields as bio fertilizer.

Fugitive emissions result from volatilisation of compounds at the liquid surface of storage tanks during the various treatment phases in the overall collection, treatment and storage system. This will be a source of insignificant fugitive air emissions at TSCL.

3.10 Sewage Treatment Plant

The Sewage Treatment plant at TSCL will treat the wastewater derived from the operation of bathroom facilities at the sugar factory. The treated effluent will be used for the irrigation of the sugarcane fields. The sludge residue from the treatment plant will be dried on sludge drying beds and applied to the sugar cane fields as bio fertilizer.

Fugitive emissions result from volatilisation of compounds at the liquid surface of storage tanks during the various treatment phases in the overall collection, treatment and storage system. This will be a source of insignificant fugitive air emissions at TSCL.

4. INVENTORY ASSUMPTIONS

4.1 General

- 1. The assumptions about the maximum and average operating conditions were based on the information provided by TSCL, some of which was incorporated into the TSCL Factory Operations Project Brief (Environmental & Engineering Managers Limited (EEM), 2025).
- 2. The relevant emission factors were taken from the 'US EPA AP-42 Compilation of Air Pollutant Emission Factors' (US EPA AP-42) (United States Environmental Protection Agency (US EPA), n.d.) and the Australian National Pollutant inventory (NPi) Emission Estimation Technique (EET) Manuals (Australian Government, Department of Sustainability, Environment, Water, Population & Communities, n.d.). The following chemical formulae and terms were used for the pollutants:
 - a. CH_4 Methane
 - b. CO Carbon Monoxide
 - c. NO_x Nitrogen Oxides
 - d. PM Particulate Matter of all sizes
 - e. PM₁₀ Particulate Matter with an aerodynamic diameter less than or equal to 10μm
 - f. SO₂ Sulphur Dioxide
 - g. VOC Volatile Organic Compounds
 - h. TOC Total Organic Compounds

4.2 Boiler

The overall emission rates for the boiler is calculated as the sum of the emission rates for the boiler while burning bagasse and the emission rates for the boiler while burning wood chips.

4.2.1 Bagasse Firing

- 1. The emission rates for the bagasse boiler were taken from US EPA AP-42 Chapter 1, Section 1.8 Bagasse Combustion in Sugar Mills, Table 1.8-1 (United States Environmental Protection Agency (US EPA)). The US EPA source classification code (SCC) 1-02-011-01 is applicable.
- 2. The expected bagasse composition is shown in Table 1.

Table 1: Expected Bagasse Composition

Fuel (Bagasse) Composition	% by weight as fired basis
Moisture	50
Ash	1.5
Carbon	23.5
Hydrogen	3.3
Nitrogen	0
Sulphur	0
Oxygen	21.8
Gross Calorific Value (GCV) (Kcal/kg)	2,272

(TERRAVISTA Solutions P. Ltd., 2025)

- 3. The average bagasse feed rate for the Boiler is 31 MT/hr per the boiler manufacturer.
- 4. The average annual bagasse operating hours is estimated to be 7,200 hours (~10 month operation).
- 5. The average annual bagasse consumption was estimated to be 223,200 MT/yr based on the average annual bagasse operating hours and average annual bagasse feed rate.

- 6. The maximum bagasse feed rate is reported as 35 MT/hr. This aligns with the ~33.2 MT/hr theoretically calculated based on its heating value and the 71.5% boiler efficiency reported by the manufacturer.
- 7. The maximum annual operating hours is estimated to be 8,000 hours (~11 month operation).
- 8. The maximum annual bagasse consumption is estimated to be 280,000 MT/yr based on the maximum annual operating hours and maximum annual bagasse feed rate.
- 9. The ESPs are designed to reduce the particulate matter from 2,200 mg/Nm³ to 100 mg/Nm³ (TERRAVISTA Solutions P. Ltd., 2025) and therefore has a 95.5% removal efficiency for PM/TSP which was used to adjust the AP-42 emission factor for the uncontrolled PM from 15.6 lb PM/MT bagasse to 0.71 lb PM/MT bagasse.
- 10. The emission factor for Polycyclic Organic Matter (POM) in bagasse was used to estimate the Volatile Organic Compounds (VOCs) in bagasse.

4.2.2 Wood Chips Firing

- 1. The wood residue is assumed to be dry wood which will be used in this industrial boiler. The US EPA source classification code (SCC) 1-02-009-08 is therefore applicable.
- 2. The emission factors for the combustion of wood chips in the boiler were taken from US EPA AP-42 Chapter 1, Section 1.6 Wood Residue Combustion in Boilers, Table 1.6-1/2/3/4 (United States Environmental Protection Agency (US EPA)).
 - a. The PM emission factor used is associated with the use of the ESP as a PM control device.
- 3. The dry wood chips are assumed to have a heating value of 8,000 MTU/lb per the US EPA AP-42 Section 1.6.1.
- 4. The maximum wood chip feed rate is estimated to be ~15 MT/hr based on its heating value and the 71.5% boiler efficiency reported by the manufacturer (TERRAVISTA Solutions P. Ltd., 2025).
- 5. The maximum annual wood chips consumption is reported to be 25,000 MT/yr.
- 6. The maximum annual operating hours for the boiler while using wood chips is estimated to be 1,667 hours (~69.5 days operation).
- 7. The average wood chips feed rate for the Boiler is assumed to be 80% of the maximum feed rate and is estimated to be 12 MT/hr.
- 8. The average annual wood chips operating hours is estimated to be 1,080 hours (~1.5 month operation).
- 9. The average annual wood chips consumption is estimated to be 12,960 MT/yr based on the average annual wood chips operating hours and average annual wood chips feed rate.

4.3 Diesel Generator

1. The diesel generator is classified to be a large stationary industrial diesel engine (>600 hp) and therefore the US EPA source classification code (SCC) 2-02-004-01 is applicable.

- 2. The emission factors for the combustion of diesel oil in the diesel generator were taken from US EPA AP-42 Chapter 3, Section 3.4 Stationary Internal Combustion Sources, Table 3.4-1/2/3 (United States Environmental Protection Agency (US EPA)).
- 3. The diesel fuel quality is expected to meet the current standards of local supply and was assumed to be an average of diesel fuel quality provided to similar local industrial facilities.
 - a. % Sulphur = 0.137%, Heat Content = 45,640 kJ/kg, Ash = 0.0003%, Density = 0.8485 kg/L
- 4. The average annual operating hours for the diesel generator is expected to be 500 hours as reported by TSCL.
- 5. The estimated maximum annual operating hours of the diesel generator is estimated to be 750 hours. This is estimated based on a 50% increase of the average annual operating hours.
- 6. The maximum hourly fuel consumption rate is estimated to be 117.37 L/hr for the generator based on the 1,010 kVA rating and an assumed 80% efficiency.
- 7. The maximum hourly fuel consumption rate and maximum annual operating hours result in a maximum annual fuel consumption of 88,028 L/yr for the generator.
- 8. The average hourly fuel consumption is estimated to be 82.16 L/hr for the generator, based on the assumption that the average fuel consumption rate is \sim 70% of the maximum fuel consumption rate.
- 9. The average hourly fuel consumption rate and average annual operating hours result in an average annual fuel consumption of 41,080 L/yr for the generator.

4.4 Bagasse Handling & Storage

- 1. The emissions of particulate matter from the bagasse stockpile (BAGASSE) due to wind erosion was taken from the Australian NPi EET Manual for Mining Version 3.1, January 2012 (A.1.1.18)
 - a. 0.4 kg/ha/h TSP and 0.2 kg/ha/h PM₁₀ due to wind erosion of active stockpile
- 2. The average annual bagasse storage area is ~ 0.75 ha (75% of the maximum area) and operates during the average annual boiler operating period.
- 3. The average annual operating hours is estimated to be 7,200 hours which is the operating hours for the boilers while burning bagasse.
- 4. The maximum annual bagasse storage area is 1.00 ha and operates during the maximum annual boiler operating period.
- 5. The maximum annual operating hours is 8,000 hours which is the maximum operating hours for the boilers while burning bagasse.

5. FINDINGS & RECOMMENDATIONS

The boiler and generator will be the main air emission sources at TSCL. The PM stack emission rates for the boiler due to the combustion of bagasse results in 354.5 g PM/MT bagasse input and therefore meets the 4,200 g PM/MT bagasse input emission standard for new sources. The boiler stack emission PM rates are well within compliance due to the use of the ESP to control the stack PM emissions. The facility has not yet

received fuel certificates for the diesel oil, however, it is expected to meet the NRCA standard of 0.5% maximum sulphur content.

Table 2 and

Table 3 summarize the average annual and maximum annual emissions inventory results respectively. The detailed emissions inventory results in g/s and kg/hr are shown in Appendix 1.

The data shows that TSCL is classified as a major facility as defined in the 2006 NRCA Air Quality Regulations. The Natural Resources Conservation Authority (NRCA) Air Quality Regulations, 2006 defines a "major facility" as any facility having any air pollutant emitting activity or source with the potential to emit:

- i. >100 MT/yr of one or more of the following parameters: SO₂, PM, CO and NO_x
- ii. >5 MT/yr lead
- iii. >10 MT/yr of any single priority air pollutant (PAP)
- iv. >25 MT/yr of any combination of priority air pollutants (PAPs)

In the case of TSCL,

Table 3 shows that the maximum annual PM, NO_x and CO emissions are each greater than 100 MT/yr and this results in its classification as a major facility.

As a major facility, TSCL should complete a detailed air dispersion model to predict the ambient concentrations due to these emissions and determine their compliance with Jamaica National Ambient Air Quality Standards (JNAAQS). An application should subsequently be completed and submitted to the National Environment and Planning Agency (NEPA) for a new Air Pollutant Discharge licence for the facility.

Boiler 1-Bagasse Bagasse Generator 1 & Wood Chips Storage **TOTAL Pollutant GEN1STCK** BLR1STCK BAGASSE MT/yr MT/yr MT/yr MT/yr 0.095 2.592 2.69 SO_2 PM 0.048 84.73 2.16 86.94 PM_{10} 0.039 4.15 1.08 5.27 2.19 184.72 186.91 NO_X CO 62.21 62.79 0.58 VOC (as TOC) 1.874 1.87 Pb 4.98E-03 4.98E-03 CO_2 112.86 194,313.6 194,426 CH_4 6.16E-02 0.062 Benzene 5.31E-04 5.31E-04 1.32E-04 **Xylenes** 1.32E-04 Formaldehyde 5.40E-05 5.40E-05

Table 2: Summary of TSCL Annual Average Air Emissions

1.72E-05

5.39E-06

Acetaldehyde

Acrolein

1.72E-05

5.39E-06

Boiler 1-Bagasse Bagasse **Generator 1** & Wood Chips Storage TOTAL **Pollutant BLR1STCK BAGASSE GEN1STCK** MT/yr MT/yr MT/yr MT/yr 0.203 5.20 SO_2 5.00 0.102 113.05 **PM** 110.07 2.88 9.52 0.084 1.44 PM_{10} 8.00 270.69 4.69 NO_X 266.00 1.246 121.25 CO 120.000 3.540 VOC (as TOC) 3.54000 9.60E-03 Pb 9.60E-03 257,642 241.85 CO_2 257,400 0.13192 0.132 CH_4 1.14E-03 1.14E-03 Benzene 2.83E-04 2.83E-04 **Xylenes** 1.16E-04 1.16E-04 Formaldehyde 3.69E-05 3.69E-05 Acetaldehyde Acrolein 1.16E-05 1.16E-05

Table 3: Summary of TSCL Annual Maximum Air Emissions

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Appendix 1: Detailed Emission Rates for TSCL

Table 4: Average and Maximum Emission Rates for TSCL in g/s and kg/hr

AVERAGE	, , , , , , , , , , , , , , , , , , ,	and maxii				8,		•
Pollutant	Generator 1	Boiler 1- Bagasse & Wood Chips	Bagasse Storage	TOTAL	Generator 1	Boiler 1- Bagasse & Wood Chips	Bagasse Storage	TOTAL
	GEN1STCK	BLR1STCK	BAGASSE		GEN1STCK	BLR1STCK	BAGASSE	
	g/s	g/s	g/s	g/s	kg/hr	kg/hr	kg/hr	kg/hr
SO ₂	0.053	0.667		0.719	0.19	2.40		2.59
PM	0.026	4.493	0.083	4.603	0.095	16.17	0.30	16.57
PM_{10}	0.022	1.067	0.042	1.130	0.078	3.84	0.15	4.07
NO _x	1.22	18.23		19.45	4.38	65.64		70.02
CO	0.323	16.00		16.32	1.16	57.60		58.763
VOC (as TOC)		0.458		0.458		1.648		1.648
Pb		1.28E-03		1.28E-03		4.61E-03		4.61E-03
CO_2	62.7	11,916.7		11,979.4	225.7	42,900.0		43,125.7
CH ₄	0.0342			0.034	0.123			0.123
Benzene	2.95E-04			2.95E-04	1.06E-03			1.06E-03
Xylenes	7.33E-05			7.33E-05	2.64E-04			2.64E-04
Formaldehyde	3.00E-05			3.00E-05	1.08E-04			1.08E-04
Acetaldehyde	9.58E-06			9.58E-06	3.45E-05			3.45E-05
Acrolein	2.99E-06			2.99E-06	1.08E-05			1.08E-05
MAXIMUM								
Pollutant	Generator 1	Boiler 1- Bagasse & Wood Chips	Bagasse Storage	TOTAL	Generator 1	Boiler 1- Bagasse & Wood Chips	Bagasse Storage	TOTAL
	GEN1STCK	BLR1STCK	BAGASSE		GEN1STCK	BLR1STCK	BAGASSE	
	g/s	g/s	g/s	g/s	kg/hr	kg/hr	kg/hr	kg/hr
SO_2	0.075	0.84		0.92	0.27	3.03		3.30
PM	0.038	18.36	0.100	18.50	0.136	66.10	0.36	66.59
PM_{10}	0.031	1.34	0.050	1.43	0.112	4.84	0.18	5.13
NO _x	1.74	44.47		46.21	6.25	160.09		166.34
CO	0.46	20.17		20.63	1.66	72.60		74.26
VOC (as TOC)		0.595		0.595		2.141		2.141
Pb		1.61E-03		1.61E-03		5.81E-03		5.81E-03
CO ₂	89.6	42,954		43,043.7	322.5	154,635		154,957.5
CH ₄	0.049			0.049	1.76E-01			0.176
Benzene	4.21E-04			4.21E-04	1.52E-03			1.52E-03
Xylenes	1.05E-04			1.05E-04	3.77E-04			3.77E-04
Formaldehyde	4.28E-05			4.28E-05	1.54E-04			1.54E-04
Acetaldehyde	1.37E-05			1.37E-05	4.92E-05			4.92E-05
Acrolein	4.28E-06	I		4.28E-06	1.54E-05			1.54E-05

ANNEX 3 RAPID FAUNA AND FLORA ASSESSMENT OF THE PROPERTY FOR THE PROPOSED TROPICAL SUGAR FACTORY, LIONEL TOWN, CLARENDON

Damion Whyte and Adrian Thomas

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1 Site Description

The property of interest is predominately a sugar cane (*Saccharum officinarum*) field; however, sections of the property were overgrown with vegetation. For the purpose of the study, the property was zoned into two categories: Secondary Forest, and Open Fields and Crops.



Figure 1: The Location of the Project Site; the Area Zoned as Open Fields and Crops (boundary highlighted in yellow) and Secondary Forest (highlighted in green).

1.1 Secondary Forest

The area zoned as Secondary Forest consists of areas with large trees (Figure 3) and areas with buildings (Figure 2). Activities such as small scale subsistence farming, animal husbandry and gathering/drying of castor oil beans (Figure 5) were observed in the area; a charcoal kiln was also observed in the area (Figure 4).



Figure 2: A House Observed on the Property



Figure 3: A Section of the Area on the Property Zoned as Secondary Forest.



Figure 4: Charcoal Kiln Observed in the Area Zoned as Secondary Forest



Figure 5: Castor Oil Beans Harvested in a Bag in the Cane Field and Been Dried at one of the Houses on Property

1.2 Open Field and Crop

The area zoned as Open Fields and Crops consists of mainly sugar cane field (Figure 6). On the boundary of the cane field, earthen canals with water (Figure 7) were observed; it should be noted that the water was black at the time of the visit and had a foul odour. There was also vegetation along the banks of the canals that ran along the boundary of the property.



Figure 6: The Remnant Sugar cane Field located in area zoned as Open Fields and Crops within the project area.

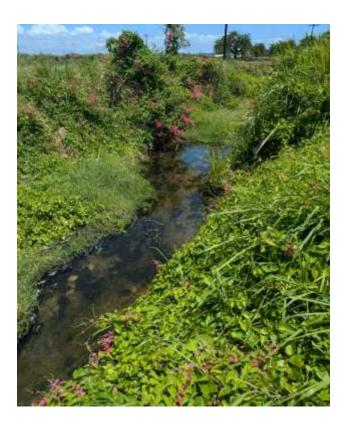


Figure 7: The Canal Located along the Northern Boundary of the Property



Figure 8: Vegetation Along the Canal Located Along the Boundary of the Property

2 Method: Fauna and Flora Assessments

The team conducted an extensive walkthrough of each sample site. The surveys, particularly fauna assessments, were conducted along the trails and footpaths to and within the sample sites. The surveys were carried out from March 29 to April 22, 2025, using the methods outlined in each section below. For each species observed, the name and the perceived dominance using the DAFOR scale (**D**ominant, **A**bundant, **F**requent, **O**ccasional and **R**are) were noted.

2.1 Flora Assessment

The vegetation on site was assessed by utilising a series of randomly distributed transects (100m x 5m each), 5 in total (T1–T5), within the boundaries of the development site (Figure 9). All plant species encountered within each transect were recorded.



Figure 9. The Location of the Transects used for the Flora Assessment.

The common names of most of the species sighted were assigned in situ. Regarding the unknown species, voucher specimens were collected and identified at the University of the West Indies (UWI) Herbarium. All plants were identified at the species level by examining morphological features such as leaf arrangement, leaf pattern, and pattern of branching and

morphology of floral and fruiting structure in conjunction with the use of Flowering Plants of Jamaica (Adams, 1972) and preserved reference specimens of the herbarium.

A total of 87 plant species from 36 families were recorded across the entire project area with relatively high diversity (Table 1). The highest number of species (48) were recorded along T4 and T2 (41), followed by T1 (37) and the lowest number of species recorded in T5 (34) and T3 (30) (Figure 10).

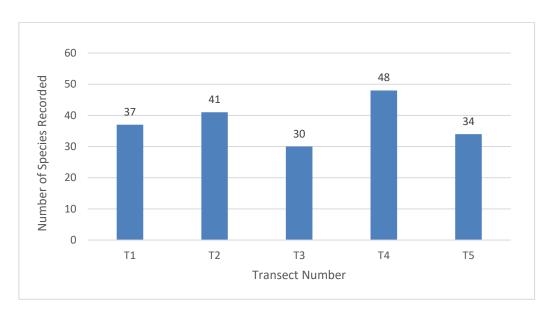


Figure 10. Graph Showing the Number of Plant Species Recorded Across Each Transect.

No endemic plant species were recorded during the assessment of the vegetation on the property. Only 2 species that are classified as Invasive Alien Species (IAS) were recorded within the study area; these were Guinea Grass (*Panicum maximum*) and Lead Tree (*Leucaena leucocephala*). It should be noted that no species with special conservation status (endangered/protected/threatened) were recorded within the study area.

Most plant species encountered during the assessment are described by Adams (1972), as commonly found in thickets, wastelands, and secondary woodlands. Most of the plant species can be classified as plants associated with anthropogenic disturbances, ornamentals, and crops. Transect 4 (T4), the area in which the most plant species were encountered, was heavily influenced by agricultural crops, as people live and do small scale farming within that area (Figure 11).

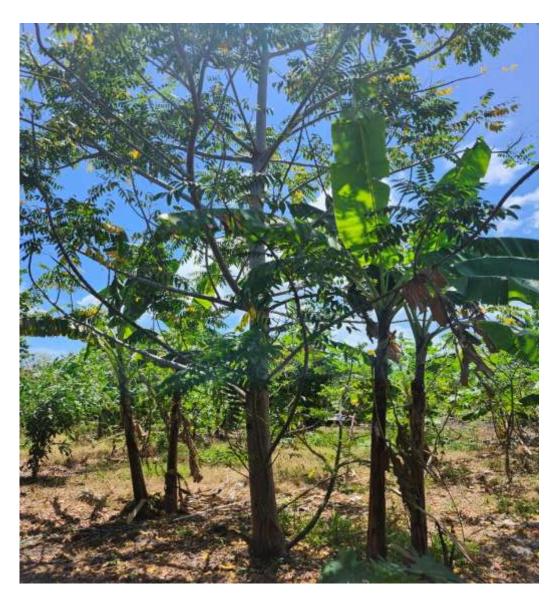


Figure 11. A Section of the Property, Along T4, that is used for Subsistence Barming; Plants in Photo include: Banana (*Musa sapientum*), June Plum (*Spondias dulcis*) and Cassava (*Manihot esculenta*).

Several pieces of infrastructure (such as building foundations, derelict canals and trails/farm roads) were scattered across this area. There was evidence of past and current agricultural activities (irrigation system and the fact that the land had been furrowed).

Table 1: List of Plant Species Identified along each Transect within the Project Area; Along with the DAFOR Ranking for each Plant Species for the Respective Transect

Family	Family Scientific Name Common Name Range According to Adams, 1972		T1	T2	T3	T4	T5	
Malvaceae	Abelmoschus esculentus	Okra	Common in cultivation				R	R
Malvaceae	Abutilon hulseanum		Locally common, a weed of waste ground	R		R		
Mimosaceae	Acacia tortuosa	Wild Poponax	Locally very common, along the south coast and on some cays, on arid limestone and at salina margins		R			R
Amaranthaceae	Achyranthes indica	Devil's Horsewhip	Common as a weed of cultivation and disturbed waste places			F		О
Amaranthaceae	Amaranthus spinosus	Wild Calaloo	Common as a weed of pastures, lawns and waste places		О			О
Poaceae	Andropogon citratus	Fever Grass	Common in cultivation in gardens and along path sides				R	
Annonaceae	Annona muricata	Sour Sop	Commonly cultivated				R	
Annonaceae	Annona squamosa	Sweet Sop	Commonly cultivated				R	
Polygonaceae	Antigonon leptopus	Coralita	Common in cultivation and escaping on to fences and hedges at low elevations	О		F	A	A
Asteraceae	Bidens pilosa	Spanish Needle	A common weed of roadsides and waste places	D	О	A		F
Sapindaceae	Blighia sapida	Ackee	Commonly cultivated and naturalized			R		
Nyctaginaceae	Boerhavia coccinea	Hog Weed	Common, as a weed of rough disturbed pastures, waste places and sand dunes	F				О
Nyctaginaceae	Boerhavia erecta		Rather common, a weed of disturbed ground, roadside banks in open areas and river gravel		О	О	R	
Nyctaginaceae	Bougainvillea peruviana		Common ornamental				R	
Fabaceae	Cajanus cajan	Gungo Pea	Common in cultivation				R	
Asclepiasaceae	Calotropis procera	French Cotton	Locally common, in arid sandy or gravely waste places			О		О

Family	Scientific Name	Common Name	Range According to Adams, 1972	T1	T2	T3	T4	T5
Euphorbiaceae	Caperonia castaneifolia		Rather uncommon, in swamps, wet meadows and rice fields	R				
Solanaceae	Capsicum baccatum	Bird Pepper					R	
Caesalpiniaceae	Cassia javanica	Pink Cassia	Common ornamental				R	
Poaceae	Chloris barbata		Very common as a weed along roadsides and in waste places		F	A	О	
Sapotaceae	Chrysophyllum cainito	Star Apple	Common, mostly along roadsides and in pastures and yards were planted				R	
Vitaceae	Cissus sicyoides	Soldier Wiss	Very common, on trees, walls, fences and in thickets			R		
Rutaceae	Citrus aurantifolia	Lime	Commonly cultivated				R	
Fabaceae	Clitoria ternatea	Blue Pea	Common in cultivation as ornamental, and escaping into waste places				О	
Arecaceae	Cocos nucifera	Coconut	t Commonly cultivated				R	R
Commelinaceae	Commelina diffusa	Water Grass	A common weed of cultivations, waste places and pastures		О			О
Asteraceae	Conyza canadensis	Canada Fleabane	Common on roadside banks and rough pastures	F	О	R	О	F
Boraginaceae	Cordia dentata	Duppy Cherry	Locally abundant on gravelly alluvial plains		R			R
Cucurbitaceae	Cucumis anguria	Wild Cucumber	Locally common, in rough waste places		О	R		R
Cucurbitaceae	Cucurbita pepo	Pumpkin	Commonly cultivated				R	R
Asteraceae	Cyanthillium cinereum		Very common, a weed of pastures and waste places	О	R		R	
Fabaceae	Desmodium incanum		Common in pastures and on banks			F		
Fabaceae	Desmodium scorpiurus		Rather common, a weed of sandy pastures and roadsides and orocky or stony waste ground		R			О
Verbenaceae	Verbenaceae Duranta repens Common on roadside banks and in thickets, also cultivated for ornament					R		

Family	Scientific Name	Common Name	Range According to Adams, 1972	T1	T2	Т3	T4	T5
Poaceae	Echinochola colonum		Widely distributed and locally common in ditches, low-lying open ground and pond margins		О			
Euphorbiaceae	Euphobia heterophylla	Japanese Poinsettia	Occasional in central and eastern parishes, a weed of roadside banks and open waste places		R			R
Euphorbiaceae	Euphorbia hirta		Very common, a weed of roadsides, waste places, lawns, pastures and cultivated grounds	F	О	О	F	F
Euphorbiaceae	Euphorbia hypericifolia		Common and abundant locally as a weed of waste places	О	R	О	О	О
Moraceae	Ficus benjamina	Chinese Banyan	Cultivated shade and ornamental tree				R	
Malvaceae	Gossypium barbadense	Sea Island Cotton	Annual forms cultivated; perennial forms naturalized in moist sheltered places.				R	
Sterculiaceae	Guazuma ulmifolia	Bastard Cedar	Very common along roadsides, in pastures and open secondary woodlands		R	О		R
Boraginaceae	Heliotropium indicum	Wild Clary	Common as a weed of pastures, cultivated ground and waste places	F	R		О	
Malvaceae	Hibiscus sabdariffa	Sorrel	Common in cultivation				R	
Euphorbiaceae	Jatropha curcas	Physic Nut	Frequent, mostly near habitations	О	О			R
Verbenaceae	Lantana camara	Wild Sage	Very common in rough pastures, waste places and thickets	О	R	R	О	О
Verbenaceae	Lantana trifolia		Common in rough pastures and waste places	R	R			
Lamiaceae	Leonotis nepetifolia		Rather common, a weed of fields, roadsides and waste ground	R				
Mimosaceae	Leucaena leucocephala**	Lead Tree	Common along roadsides and in sandy waste places and thickets		О	О	A	О
Cucurbitaceae	Luffa aegyptiaca			R				
Malvaceae	Malachra alceifolia	Wild Okra	Locally common, mainly in south-eastern parishes, a weed of roadsides and low-lying waste places	R		R		

Family	Scientific Name	Common Name	Range According to Adams, 1972	T1	T2	T3	T4	T5
Malvaceae	Malvastrum coromandelianum		Common weed of cultivated ground, pastures and waste places		О			
Anacardiaceae	Mangifera indica	Mango	Cultivated and naturalized				О	
Euphorbiaceae	Manihot esculenta	Cassava	Cultivated locally on the heavier soils				R	
Sapindiaceae	Melicoccus bijugatus	Guinep	Common along roadsides and in secondary thickets and woodlands				О	R
Convolvulaceae	Merremia dissecta	Know You	Cultivated and widely escaped on fences and in thickets and waste grounds	О				
Convolvulaceae	Merremia umbellata		Common on fences and in thickets and waste places			О	R	
Rubiaceae	Morinda citrifolia	Noni	Locally common in open areas near the sea, cultivated inland				R	
Musaceae	Musa paradisiaca	Plantain	Commonly cultivated				R	
Musaceae	Musa sapientum	Banana	Commonly cultivated				R	
Poaceae	Panicum maximum**	Guinea Grass	Very common in rough pastures, ditches and sheltered thickets			D	D	A
Asteraceae	Parthenium hysterophorus	Dog-flea Weed	Common along roadsides and in shady or open waste places	О	R			О
Poaceae	Paspalum dilatatum		Introduced and cultivated	F	О		О	
Passifloraceae	Passiflora foetida		Common in thickets, hedgerows and waste places	О	R			
Caesalpiniaceae	Peltophorum linnaei	Braziletto	Locally common, in coastal areas of the central and western parishes, in thickets and open woodlands on arid limestone		R			
Fabaceae	Phaseolus lunatus	Broad Bean	Cultivated at the lower elevations				R	
Portulacaceae	Portulaca oleracea	Pussley	Very common, a weed of cultivated ground and waste places	F		О		О
Verbenaceae	Priva lappulacea	Velvet Bur	A common weed of cultivations, roadsides and waste places		О	R	F	О
Mimosaceae	Prosopis juliflora	Cashaw Locally common, in low pastures in arid areas and on sand and shingle dunes		R	0	R		R

Family	Scientific Name	Common Name	Range According to Adams, 1972	T1	T2	Т3	T4	T5
Myrtaceae	Psidium guajava	Guava	Common in pastures and wayside thickets, sometimes cultivated				О	
Commelinaceae	Rhoeo spathacea	Mosses in the Bulrushes	Common, on limestone banks and in rocky thickets and woodland margins				О	
Fabaceae	Rhynchosia minima		Common in waste places and cultivated land	F		R	F	
Euphorbiaceae	Ricinus communis	Castor Oil	Common as cultivated plant and on waste ground	О	R	О	R	R
Acanthaceae	Ruellia tuberosa	Duppy Gunshot	Very common in pastures and waste places and on roadside banks		О			О
Poaceae	Saccharum officinarum	Sugar Cane	Abundantly cultivated, mostly at low elevations on level ground in deep soils		D	D		D
Mimosaceae	Samanea saman	Guango	Common in inhabited areas and in old pastures where planted, naturalized in riparian forest and in secondary communities on level ground		R	R	F	
Malvaceae	Sida acuta	Broom Weed	Very common in pastures, waste places and cultivations		О			О
Malvaceae	Sida spinosa		Common, as a weed of cultivations and in pastures and sandy waste places	F	О	R		О
Solanaceae	Solanum torvum	Susumber	Common in woodland clearings, thickets and waste places				О	R
Poaceae	Sorghum halepense	Johnson Grass	Locally common, gregarious and forming colonies, a persistent weed of some pastures and stony waste ground	R	R			
Anacardiaceae	Spondias dulcis	June Plum	Occasional in cultivation				R	
Poaceae	Sporobolus pyramidatus		Locally common, in drier southern coastal areas in salina margins and sandy waste places near the sea		R			
Bignoniaceae	Tabebuia rosea	Pink Poui	Cultivated				R	
Caesalpiniaceae	Tamarindus indica	Tamarind	Cultivated and naturalized				R	
Asteraceae	teraceae Tithonia diversifolia Mexican Sunflower Locally common, naturalized on roadside banks and in cultivations			R	R			

Family	Scientific Name	Common Name Range According to Adams, 1972 T		T1	T2	Т3	T4	T5
Asteraceae	Wedelia gracilis		Rather common, especially in rough damp low-lying pastures	О	F	О		
Rhamnaceae	Ziziphus mauritiana	Coolie Plum	Established and common in some waste places, occasionally forming thickets	O	R			
Poaceae	Zoysia tenuifolia		Cultivated for lawns	F				

Key: **- Invasive Alien Species (IAS): Please note: DAFOR scale (i.e., D=dominant, A= abundant, F= frequent, O=occasional and R=rare).

2.2 Avifauna Assessment

The line transect method was selected for the avifauna assessment, and it entailed walking slowly along the extensive roads and trails networks on the property, noting all the birds seen or heard in the area (Bibby, Jones, and Marsden, 2000). The birds encountered for the first time were added to the list while conducting other assessments in the area.

For the nocturnal birds, the line transect methods were conducted along the roads/trails used for the day surveys. In addition, AudioMoth recorders were used for the nocturnal bird survey (Figure 12). The devices were active from 17:30 to 06:30. The audio files were analysed using the Kaleidoscope Pro software from Wildlife Acoustics.

People encountered in the project area were informally interviewed about the birds they observed, emphasising nocturnal birds on the property.

Reference material used in species identification (pictures and calls) included the Merlin App (Merlin, 2024), Ebird (Fink, et al. 2018), and Bird of the West Indies.

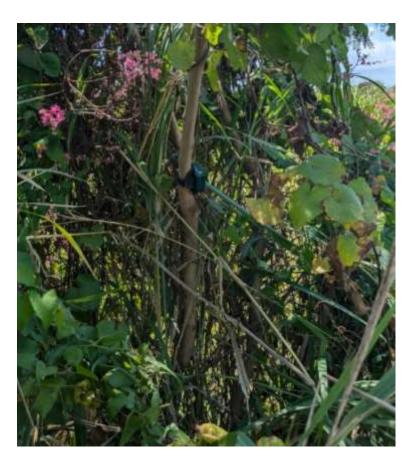


Figure 12: One of the AudioMoth Devices Deployed in the Field for the Assessment of Nocturnal Birds, Frog, Vocal Reptiles and Bats.

Forty-eight (48) species of birds were identified during the assessment, including 7 residents (endemic), 28 residents (non-endemic), 1 introduced and 12 migrants (see Table 2). Of the 7 endemic birds observed in the project, none of the species was viewed as a forest specialist.

Table 2: The Birds Observed During the Assessment of the Project Area.

#	Common Name	Scientific Name	Range	IUCN	Open Field and Crop	Secondary Forest
1	American Kestrel	Falco sparverius	Resident	LC	R	R
2	American Redstart	Setophaga ruticilla	Migrant	LC	R	R
3	Antillean Nighthawk	Chordeiles gundlachii	Migrant	LC	R	R
4	Antillean Palm-Swift	Tachornis phoenicobia	Resident	LC	О	R
5	Bananaquit	Coereba flaveola	Resident	LC		R
6	Black-and-white Warbler	Mniotilta varia	Migrant	LC	R	
7	Black-faced Grassquit	Melanospiza bicolor	Resident	LC	R	
8	Black-throated Blue Warbler	Setophaga caerulescens	Migrant	LC	R	
9	Cape May Warbler	Setophaga tigrina	Migrant	LC	R	
10	Cattle Egret	Bubulcus ibis	Resident	LC	О	R
11	Cave Swallow	Petrochelidon fulva	Resident	LC	R	
12	Common Ground Dove	Columbina passerina	Resident	LC	О	R
13	Common Yellowthroat	Geothlypis trichas	Migrant	LC	R	R
14	Glossy Ibis	Plegadis falcinellus	Resident	LC	R	
15	Gray Kingbird	Tyrannus dominicensis	Migrant	LC	R	R
16	Great Blue Heron	Ardea herodias	Resident	LC	R	
17	Great Egret	Ardea alba	Resident	LC	R	
18	Greater Antillean Grackle	Quiscalus niger	Resident	LC	R	R
19	Greater yellowlegs	Tringa melanoleuca	Migrant	LC	R	
20	Green Heron	Butorides virescens	Resident	LC	R	
21	Jamaican Euphonia	Euphonia jamaica	Endemic	LC		R
22	Jamaican Lizard-Cuckoo	Coccyzus vetula	Endemic	LC		R
23	Jamaican Mango	Anthracothorax mango	Endemic	LC		R
24	Jamaican Oriole	Icterus leucopteryx	Resident	LC		R
25	Jamaican Parakeet	Eupsittula nana	Endemic	NT		0
26	Jamaican Vireo	Vireo modestus	Endemic	LC	R	
27	Jamaican Woodpecker	Melanerpes radiolatus	Endemic	LC		R
28	Killdeer	Charadrius vociferus	Resident	LC	R	
29	Little Blue Heron	Egretta caerulea	Resident	LC	R	

#	Common Name	Scientific Name	Range	IUCN	Open Field and Crop	Secondary Forest
30	Loggerhead Kingbird	Tyrannus caudifasciatus	Resident	LC	R	О
31	Mourning Dove	Zenaida macroura	Resident	LC	R	
32	Northern Mockingbird	Mimus polyglottos	Resident	LC	R	R
33	Northern Parula	Setophaga americana	Migrant	LC	R	
34	Palm Warbler	Setophaga palmarum	Migrant	LC	R	R
35	Prairie Warbler	Setophaga discolor	Migrant	LC	R	
36	Red-billed Streamertail	Trochilus polytmus	Endemic	LC	R	R
37	Rock Pigeon	Columba livia	Resident	LC	R	
38	Smooth-billed Ani	Crotophaga ani	Resident	LC	F	О
39	Tricolored Munia	Lonchura malacca	Introduced	LC	F	
40	Turkey Vulture	Cathartes aura	Resident	LC	О	O
41	Vervain Hummingbird	Mellisuga minima	Resident	LC	R	R
42	White-crowned Pigeon	Patagioenas leucocephala	Resident	NT		R
43	White-winged Dove	Zenaida asiatica	Resident	LC	R	О
44	Yellow Warbler	Setophaga petechia	Resident	LC	R	R
45	Yellow-crowned Night- Heron	Nyctanassa violacea	Resident	LC	R	
46	Yellow-faced Grassquit	Tiaris olivaceus	Resident	LC	R	О
47	Yellow-throated Warbler	Setophaga dominica	Migrant	LC	R	
48	Zenaida Dove	Zenaida aurita	Resident	LC	R	R

*Please note: DAFOR scale (i.e., D=dominant, A= abundant, F= frequent, O=occasional and R=rare). IUCN Rating (LC = Least Concerned, and NT= Near Threatened)

Twelve (12) migrants were identified in the study area, including 8 winter migrants, 2 summer migrants and a Greater Yellowlegs. The winter migrants generally arrive in Jamaica as early as September and begin to depart in April. The winter migrants in the study mainly consist of wood warbler. The summer migrants include the Gray Kingbird and Antillean Nighthawk. The Nighthawks were heard calling during the nocturnal study.

A few wetland birds were observed in the cane field such as the Greater yellowlegs, Great Egret, Cattle Egret, Yellow Crowned Night Heron and Little Blue Heron. The Greater Yellowlegs were encountered in the canal on the property. The Yellow Crowned Night Heron was encountered foraging in the cane field during the nocturnal assessments.

Large flocks of the Tricolored Munia, an introduced species, was observed in the cane field during the study.

Two species with special conservation status, the Jamaican Parakeet and the White-Crowned Pigeon, were recorded in the assessment and are both listed as Near Threatened by the IUCN.

2.3 Herpetology

The amphibian and reptile surveys were conducted across the different microhabitat types within the project area. The habitat search included trees, stone piles, abandoned structures and other debris. All specimens seen were identified, and a DAFOR ranking was assigned to reflect their relative dominance; pictures were taken for further study if necessary.

Herpetofauna which could not be identified in the field were collected and identified using Amphibians and Reptiles of the Caribbean Islands Keys (Caribherp, 2015) and Amphibians and Reptiles of the West Indies (Schwartz & Henderson, 1991).

The AudioMoth devices used for the bird surveys were also used for the amphibians and vocal reptiles survey. The devices were active from 17:30 to 06:30. The audio files were analysed using the Kaleidoscope Pro software from Wildlife Acoustics. The acoustics were identified using expert identification and reference material (Hedges, 2023).

Amphibian. The introduced species included the Lesser Antillean Whistling Frog (*Eleutherodactylus johnstonei*) which was the only amphibian recorded on the property (Table 3Error! Reference source not found.). The introduced Cuban Tree Frog (*Osteopilus septentrionalis*) and the Cane Toad (*Rhinella marina*) have been reported in the Lionel Town area, however, they were not encountered on the project site. There was a water channel (earthen canal) on the boundary of the property but there were no signs of amphibians in the waterbody. It is believed that the chemical state of the water in the canal is the reason for no fauna being present in the waterbody.

Table 3: The Amphibians and Reptiles Recorded in the Project Area

#	Туре	Family	Scientific Name	Common Name Ra		IUCN Status	Open Fields	Secondary Forest
1	Amphibia	Eleutherodactylidae	Eleutherodactylus johnstonei	Lesser Antillean Frog	Introduced	LC	R	О
2	Reptilia	Dactyloidae	Anolis lineatopus	Jamaican Brown Anole	Endemic	LC	R	F
3	Reptilia	Dactyloidae	Anolis grahami	Jamaican Turquoise Anole	Endemic	LC	R	R
4	Reptilia	Dactyloidae	Anolis opalinus	Jamaican Opal-bellied Anole	Endemic	LC		R
5	Reptilia	Dactyloidae	Anolis sagrei	Brown Anole	Introduced	LC	R	

Please note: DAFOR scale (i.e., D=dominant, A= abundant, F= frequent, O=occasional and R=rare). IUCN Rating – LC – Least Concerned, VU – Vulnerable

<u>Reptiles</u>: Four anoles were encountered in the study area. This included 3 endemic Anoles and one introduced species, *Anolis sagrei*. The anoles were mostly observed in the secondary forest. No snakes and galliwasps were observed in the project area. No species listed in the survey are of any special conservation status.



Figure 13: A Jamaican Turquoise Anole

2.4 Invertebrate Assessment

The invertebrate assessment consisted of a series of walkthroughs within the project area and the examination of microhabitats within the project area, these included tree trunks, leaves, dry wood, and sticks. A sweep net was also used to sample insects from the foliage and insects in flight were recorded. The arthropods encountered in the field were identified on the spot; however, arthropods which could not be identified in the area were later identified using Insects

Keys (Triplehorn, Johnson and Borror 2005), iNaturalist App and collections at the University of the West Indies if necessary.

For the nocturnal insects, a light trap (bucket trap) was used to attract and collect specimens in the project area (Figure 14). The species were identified using the reference material stated above. It should be noted that the study is focussed on macro-invertebrates. Micro invertebrates such as micro lepidopterans were not classified.



Figure 14: A Bucket Light Trap used in the Study for the Nocturnal Assessment of Insects.

Twenty-one (21) butterfly species were observed in the study area. Of the 21 species, 19 native and 2 endemic subspecies were identified in the study (Table 4). None of the butterfly species identified is of any special conservation needs.

Table 4: The Butterfly Species Observed During the Assessment of the Area

#	Family	Scientific Names	Common Names	Status	Cane Field	Woodland
1	Crambidae	Spoladea recurvalis	Hawaiian Beet Webworm Moth		О	R
2	Hesperiidae	Burnsius oileus	Tropical checkered skipper	Native	R	R
3	Hesperiidae	Cymaenes tripunctus	three-spotted skipper	Native	R	
4	Lycaenidae	Hemiargus ceraunus	The Hanno Blue	Native	О	
5	Lycaenidae	Leptotes cassius	Cassius Blue	Native	О	О
6	Lycaenidae	Strymon istapa	mallow hairstreak	Native	О	R
7	Noctuidae	Utetheisa ornatrix	Bella Moth	Native	О	
8	Nymphalidae	Agraulis vanillae insularis	Gulf Fritillary	Native	R	R
9	Nymphalidae	Anartia jatrophae	White Peacock	Native	О	R
10	Nymphalidae	Dione vanillae	The Tropical Silverspot	Native	R	
11	Nymphalidae	Dryas iulia delilah	Julia	Endemic subspecies	R	R
12	Nymphalidae	Heliconius charithonia simulator	Zebra butterfly	Endemic subspecies		R
13	Nymphalidae	Junonia evarete	Tropical Buckeye	Native	R	R
14	Nymphalidae	Siproeta stelenes	The Antillean Malachite	Native	R	
15	Pieridae	Anteos maerula	yellow angled sulphur	Native	R	
16	Pieridae	Ascia monuste	Great Southern White; Antillean Great White	Native	О	
17	Pieridae	Eurema elathea	Cramer's Barred Sulphur	Native		R
18	Pieridae	Phoebis sennae	Cloudless Sulphur	Native	R	
19	Pieridae	Pyrisitia lisa	Little yellow	Native	0	
20	Psychidae	Bog worm	Bog worm Moth		О	
21	Satyrinae	Calisto zangis	Jamaican satyr	Native	R	

Please note: DAFOR scale (i.e., D=dominant, A= abundant, F= frequent, O=occasional and R=rare).

Regarding the arthropods (non-butterfly), there were 40 species (1 millipede, 5 spiders, and 34 insects). The low number of species could be as result of the area being under cultivation for several years. None of the arthropod species identified is of any special conservation needs.

Table 5: The Arthropods (Non-butterfly) Observed During the Assessment

#	Order	Family	Scientific Names	Common Names	Status	Open Fields	Secondary Forest
1	Araneae	Araneidae	Argiope trifasciata	Banded garden spider	Native	О	
2	Araneae	Araneidae	Gasteracantha cancriformis	Black Crab spider	Native	R	
3	Araneae	Sparassidae	Heteropoda venatoria	Pantropical Huntsman Spider	Native	О	R
4	Araneae	Tetragnathidae	Leucauge argyra	Orb weavers	Native	R	
5	Araneae	Cheiracanthiidae	Cheiracanthium inclusum	yellow sac spider	Native	R	
6	Blattodea	Blattoidae	Periplaneta australasiae	Australian Cockroach	Introduced	F	
7	Blattodea	Blattoidae	Periplaneta americana	American Cockroach	Introduced	0	F
8	Blattodea	Pseudophyllodromiidae	Species 1			R	
9	Blattodea	Termitidae	Nasutitermes sp	Termites, Duck ants Widespread.	Native	R	R
10	Coleoptera	Chrysomelidae	Disonycha glabrata	Pigweed Flea Beetle	Native	О	
11	Coleoptera	Cerambycidae	Oxymerus aculeatus		Native	R	
12	Coleoptera	Scarabaeidae	Strategus simson		Native	R	
13	Diptera	Dolichopodidae	Condylostylus sp	Green Fly	Native	R	
14	Diptera	Muscidae	Musca domestica	Housefly	Native	R	О
15	Hemiptera	Pyrrhocoridae	Dysdercus andreae	Cotton Stainer Bugs	Native	О	
16	Hemiptera	Rhopalidae	Niesthrea sp			R	
17	Hempitera	Pentatomidae	Ascra sp	Stink bug			R
18	Hempitera	Pentatomidae	Nezara viridula	Stink bug	Native	R	
19	Hymenoptera	Apidae	Apis mellifera		Native	F	О

#	Order	Family	Scientific Names	Common Names	Status	Open Fields	Secondary Forest
20	Hymenoptera	Formicidae	Camponotus	Carpenter and Sugar Ants	Native		0
21	Hymenoptera	Formicidae	Camponotus hannani	Red Ants	Native	F	
22	Hymenoptera	Vespidae	Polistes crinitus	Caribbean Paper Wasp	Native	F	О
23	Hymenoptera	Vespidae	Polistes major		Native	О	R
24	Hymenoptera	Xylocopinae	Xylocopa mordax		Native	R	
25	Isopetera	Termitidae	Nasutitermes costalis	Termites, Duck ants Widespread.	Native	О	О
26	Odonata	Lestidae	Lestes sp		Native	R	
27	Odonata	Libellulidae	Enallagma coecum	Antillean Bluet	Native		R
28	Odonata	Libellulidae	Erythemis vesiculosa	Great Pondhawk	Native	0	R
29	Odonata	Libellulidae	Erythrodiplax fervida	Red-mantled Dragonlet	Native	R	
30	Odonata	Libellulidae	Dythemis rufinervis	Red Setwing	Native	О	
31	Odonata	Libellulidae	Erythrodiplax umbrata	Band-winged Dragonlet	Native	О	R
32	Odonata	Libellulidae	Erythrodiplax justiniana	Antillean Dragonlet	Native	R	
33	Odonata	Libellulidae	Orthemis macrostigma	Red Dragonfly or Tropical King Skimmers	Native	R	
34	Odonata	Tettigoniidae		Green Katydids		R	
35	Orthoptera	Acrididae	Abracris flavolineata		Native	R	
36	Orthoptera	Acrididae	Orphulella punctata	Green and Brown Grasshopper	Native	О	
37	Orthoptera	Acrididae	Schistocerca pallens		Native	О	
38	Orthoptera	Acrididae	Schistocerca serialis	Short-horned Grasshoppers	Native	R	
39	Orthoptera	Gryllidae	Gryllus assimilis	Jamaica Field Cricket	Native		О
40	Spirobolida	Rhinocricidae	Anadenobolus monilicornis	Yellow-banded millipede	Native	О	

Please note: DAFOR scale (i.e., D=dominant, A= abundant, F= frequent, O=occasional and R=rare).



Figure 15: Mallow Scrub-Hairstreak (Strymon istapa)



Figure 16: Oxymerus aculeatus Observed on the Property

2.5 Bat Study

The bat survey was carried out during the day and at night. During the day all possible bat roosting areas, including manmade structures and trees, were searched. Special emphasis was placed on finding the endemic Jamaican Fig-eating Bat (*Ariteus flavescens*). The bat survey was also conducted by deploying 2 AudioMoth acoustic detectors and 1 Song meter bat mini recorder (SMB1) bat detector in selected areas on the property for 25 nights (Figure 17). The AudioMothts were configured to start recording before sunset from 17:30 to 06:00. The sample rate was 384 kHz, and the gain was set at medium. The sleep duration was 5 seconds, and the recording duration was 10 seconds. The devices were placed at a height of 3 m. The SMB1 was set to record half hour before sunset and stop at half hour after sunrise (Figure 18).

The Kaleidoscope Pro software from Wildlife Acoustics was used to ID the bat call from both acoustic devices. The software is generally used to cluster and visualise recordings, automatically identify bats, and analyse sound. The bat call library within the software only accounts for 10 of the 21 species found in Jamaica. Other bat calls were obtained from acoustic material from Windsor Research Centre (Koenig 2015), personal library, and from Google as needed.



Figure 17: Location of the Acoustic Recorders used in the Study



Figure 18: SMB1 Bat Recorder Deployed in the Field

Five species of bats were recorded and identified using the Kaleidoscope Pro Analysis Acoustic software (Table 6).

The bat species trophic guild of the detected species includes Frugivores (n=1), and Insectivores (n=4). Insectivorous bats include aerial hunters and other species that glean insects from the vegetation especially from the sugar cane. A few trees that were fruiting were encountered at the time of the study; this is likely where the Jamaica fruit bats forage for food.

There were no endemic bats or bats with special protection or deemed endangered observed/identified. No caves were reported on the property. The endemic Jamaican fig-eating bat (*Ariteus flavescens*) was not observed roosting in the project area or detected in the acoustic study.

Table 6: The Bat Species Identified in the Study

#	Scientific Name	Common Name	Diet	Roost	Foraging Behaviour
1	Artibeus jamaicensis	Jamaican Fruit Bat	Frugivore	Cave, man- made structure, foliage	Fruit Feeder: trees in forested and disturbed area
2	Molossus milleri	Pallas' Mastiff Bat	Insectivore	Cave, man- made structures	Open-space, aerial awking
3	Moormops blainvillei	Antillean Ghost- faced Bat	Insectivore	Obligate cave	semi-cluttered space; 4fluttering hunter
4	Pteronotus macleayii	MacLeay's Mustached Bat	Insectivore	Obligate cave	Background-cluttered space; fluttering hunter
5	Pteronotus parnellii	Parnell's Mustached Bat	Insectivore	Obligate cave	Highly cluttered space; fluttering hunter

2.6 Other Fauna

Three mammals were observed while carrying out the fauna study (Table 7).

Table 7: The Mammals Encountered During the Assessment of the Property

#	Order	Family	Scientific Name	Common Name	Range	IUCN Status*	Open Fields	Secondary Forest
1	Carnivora	Herpestidae	Herpestes auropunctatus	Indian Mongoose	Introduced	LC		R
2	Carnivora	Felidae	Felis catus	Cats	Introduced	LC	R	
3	Artiodactyla	Bovinae	Bos taurus	Cow	Introduced	LC		О

Please note: DAFOR scale (i.e., D=dominant, A= abundant, F= frequent, O=occasional and R=rare).

 $IUCN\ Rating-LC-Least\ Concerned,\ VU-Vulnerable$

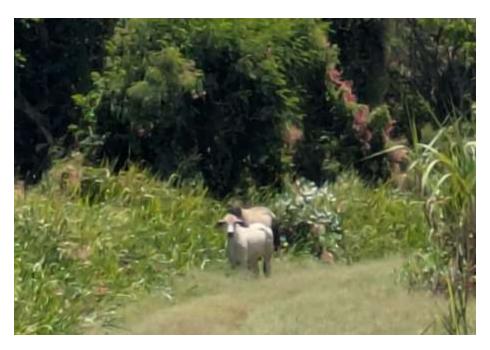


Figure 19: Cows Observed on the Property

3 Impact of the Development on Fauna and Flora

- The proposed development footprint will impact flora and fauna, as land clearance will be necessary for the undertaking of the project.
- Vegetation (even in very disturbed areas with low diversity), such as open fields and crop areas, is still actively utilised by fauna as a habitat. Fauna such as birds and herps that were recorded will be temporarily displaced; however, they will more than likely return after the initial phases of the project.

4 Recommendations

- A detailed (large tree assessment) of the larger (more mature trees) located within the area the Secondary Forest of the property boundary should be conducted. This additional information will feed into the conservation management of the property and assist in mitigating the deleterious impacts of the development.
- In instances where possible, some of the larger trees within the sample sites should be retained. This will help to maintain some of the habitat for fauna within the areas.

- The planting of native trees as a part of the landscaping when the development is complete, is encouraged, where possible, throughout the project area to bolster the habitat for fauna.
- A comprehensive assessment of the Secondary Forest within the study area, to
 determine if Jamaican Fig Eating Bats are roosting within the project area should be
 conducted. These bats are known to roost in areas close to the project area, therefore
 making this assessment necessary. This will allow for possible potential impacts the
 development will have on this species.
- Only a few fauna was observed on in the water in the earthen water channel observed along the boundary of the property. The water was black, and it had a foul odour. A water quality study should be carried out in the waterbody.

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ANNEX 4

Tropical Sugar Company Limited (TSCL)

New Sugar Factory Development in Lionel Town, Clarendon

Noise Assessment Report



May 2025

Prepared by:



Environmental & Engineering Managers Ltd.

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1 INTRODUCTION

As part of the Terms of Reference and in keeping with its focus on assessing the potential environmental impacts of the proposed project, Environmental and Engineering Managers Ltd. (EEML) has undertaken a baseline noise assessment for the proposed new sugar factory development by TSCL in Lionel Town, Clarendon. This assessment provides a description of the ambient noise levels in and around the project site, taking into consideration the community, including nearby facilities, residential areas and other potentially sensitive receptors.

No active noise mitigation strategies are proposed at this stage, however, the data collected will serve as a valuable reference point for future evaluations. Should operational conditions change, or community concerns arise, this baseline will enable informed comparisons and support any necessary follow-up assessments in accordance with applicable regulatory guidance.

The noise assessment was conducted on April 16, 2025, by a monitoring team comprised of Mr. Andre Smith (Environmental Scientist), Mr. Brenton Bartley (Environmental Engineer) and Mr. Javell Johnson (Environmental Engineer).

2 METHODOLOGY

To assess ambient noise levels at the site, a structured approach was developed and implemented as outlined below:

1. Development of Assessment Plan

A noise assessment plan was prepared to outline the procedures for data collection and analysis. This included selecting suitable measurement locations and defining the method for capturing and interpreting sound level data.

Eight (8) monitoring points were identified using satellite imagery of the site (Google Earth). The selected points were strategically distributed to ensure comprehensive coverage, with at least one monitoring location placed along each of the four boundaries of the site (Figure 2). These positions were chosen based on their proximity to potential noise sources and nearby receptors.

2. Sound Level Measurement

Noise measurements were conducted using a CR308 Sound Level Meter, a handheld device equipped with an LCD screen (see Figure 1). At each monitoring point:

- Three (3) Sound Pressure Level (SPL) readings were taken, and
- Three (3) Maximum (MAX) readings were recorded over a two-minute interval.
- The readings were averaged to provide a representative noise level for each location.

The results were tabulated and presented in a data summary table (Table 3).

2.1 Instrument Details and Measurement Parameters

2.1.1 Operating Modes

The CR308 Sound Level Meter operates in two modes: SPL and MAX. It features a linear measuring range of 32 to 140 decibels A-weighted (dBA). The 'A' weighting adjusts sound levels to reflect the sensitivity of human hearing, which is the standard method used in environmental noise assessments.

2.1.2 <u>Microphone Protection Measures</u>

A windshield was securely fitted to the microphone throughout the data collection process, protecting it from wind disturbances, as all readings were conducted outdoors in open areas exposed to varying weather conditions. This ensured that the sound levels recorded were truly reflective of the environmental noise, without significant distortion from wind gusts.

While a windshield may help reduce wind effects, it was also important to note that it may also cause slight attenuation of higher frequency sounds. However, its use was deemed essential to obtaining accurate data for the study, as wind noise could have otherwise compromised the results.



Figure 1: Cirrus CR-308 Sound Level Meter



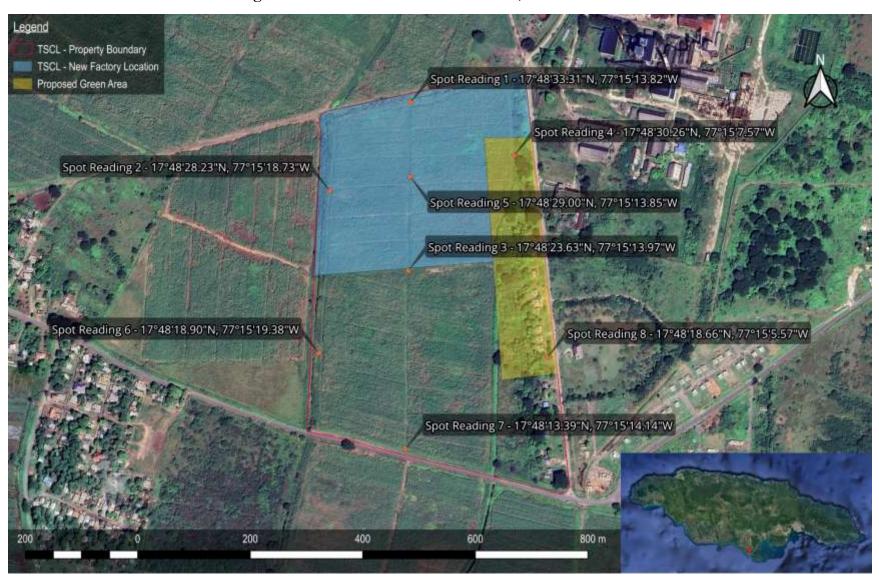


Figure 2: TSCL - Noise Assessment Plan, Assessment Locations

3 Noise Assessment Overview and Findings

3.1 Noise Exposure Criteria and Regulatory Standards

3.1.1 Ambient Noise

Ambient environmental noise refers to the background sound present in a given area under typical conditions. These sounds may originate from natural sources (such as wind, birdsong, or flowing water) or human activities (such as traffic, industry, or nearby construction). The intensity of ambient noise can vary significantly depending on the location and time of day, with quieter levels generally observed in rural and low-density residential areas, and higher levels in urban, commercial, and industrial zones.

Understanding ambient noise levels is important for assessing potential impacts on human health and well-being, especially in residential and sensitive land-use areas like schools and hospitals. These background noise levels also form the baseline for evaluating environmental noise pollution and establishing appropriate mitigation or zoning strategies.

Table 2 outlines typical ambient noise levels by area type, providing an overview of the expected sound environment in various settings during both daytime and nighttime periods.

Area Type Daytime (dBA) Nighttime (dBA) Quiet Rural Area 30-40 25-35 Residential (Suburban) 45-55 35-45 Residential (Urban) 55-65 45-55 **Commercial Areas** 60-70 50-60 65-75 **Industrial Zones** 55–65 Schools, Hospitals, Libraries 35-45 (interior) Roadside/Traffic-Dense Areas 70-85+ 60-75

Table 1: Typical Ambient Noise Levels by Area Type¹

3.1.2 Operational Noise

Exposure to excessive noise depends upon a number of factors, including:

- the loudness of the noise as measured in decibels (dBA)
- whether noise is generated from one or multiple sources

¹ Based on international standards and guidelines including the World Health Organization (WHO) Environmental Noise Guidelines (2018), the U.S. Environmental Protection Agency (EPA) Information on Levels of Environmental Noise (1974) and British Standard BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

• the duration and frequency of exposure to the noise over time

Generally, the louder the noise, the shorter the exposure time before hearing protection is required. In practice, individuals can be exposed to noise levels of 90 dBA for up to 8 hours per day without the need for hearing protection. However, at 115 dBA, hearing protection is recommended if the exposure is expected to exceed 15 minutes, due to the significantly increased risk of hearing damage. Appendix 2 presents the Decibel Levels of Environmental Sounds, which provides information on the various sounds that humans are exposed to daily.

Table 2 shows the permissible noise exposures that require hearing protection when exposed to occupational noise at specific decibel levels for particular time periods according to Occupational Health and Safety Administration (OSHA).

Duration Per Day, In Hours	Sound Level in dB – Decibel Level
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Table 2: Permissible Noise Exposures (OSHA)

These OSHA standards for the United States are similar to the Guidelines from the Occupational Safety and Health Division of the Ministry of Labour, Jamaica.

3.2 Existing Noise Profile

The TSCL property is a rural sugar cane farm which falls within the lower end of the environmental/ambient noise spectrum. This especially during non-harvest periods, where natural sounds and minimal human activity contribute to relatively quiet conditions. Under current conditions, the ambient noise levels are assessed against baseline ambient environmental standards applicable to rural zones as outline in Table 1.

3.3 Measurement Observations and Results

Noise monitoring was carried out on April 16, 2025, between 11:00 a.m. and 2:00 p.m. with eight spot readings taken across the proposed factory site and adjacent TSCL property boundaries to assess existing ambient noise conditions. The summary results of the assessment are shown in Table 3 below.

Detailed results of the assessment along with relevant site pictures are included at Appendix 1 & Appendix 4, respectively. The calibration certificates for the Sound Level Meter can be found in Appendix 5.

3.3.1 Ambient Sound Pressure Levels

The average Sound Pressure Levels (SPLs) recorded ranged from 30.60 dBA to 45.90 dBA, with individual maximum SPLs between 29.5 dBA and 50.7 dBA. The highest average SPL was observed at Spot Reading 2 – west boundary of new factory location with 45.90 dBA, followed by Spot Reading 3 – south boundary of new factory location at 45.07 dBA, both of which approached the general range of elevated ambient noise levels. In contrast, the west boundary (Spot Reading 4) recorded the lowest average SPL at 30.60 dBA, indicating relatively quiet conditions, though the reading was slightly influenced by a passing motorbike and mild wind activity.

It is important to note that most spot readings recorded SPL averages within the 30 - 45 dBA range, which aligns with typical ambient noise levels expected in quiet rural environments. Only two locations, Spot Readings 2 and 3, registered average SPLs exceeding this range (marginally) at 45.9 dBA and 45.07 dBA, respectively. These findings confirm that ambient sound conditions at the proposed factory location and surrounding TSCL property boundaries are generally low to moderate, being influenced primarily by natural elements (wind) and occasional human activity (e.g., vehicular traffic, conversations).

The relatively low SPL averages at the boundary and centre locations also suggest minimal environmental noise impact at this stage and support the conclusion that current outdoor noise conditions do not pose significant health or comfort concerns for nearby personnel or residents.

3.3.2 <u>Maximum Noise Levels and Contributing Factors</u>

The maximum average noise level recorded across the eight spot readings varied between 57.23 dBA and 73.47 dBA, reflecting moderate ambient noise conditions influenced by a mix of environmental and incidental human activity.

Spot Reading 7 at the south boundary of the TSCL property recorded the highest maximum average noise level at 73.47 dBA with a peak of 75.5 dBA presenting fairly persistent noise contributions from nearby vehicular activity along the southern roadway. The second highest maximum average noise level was observed at Spot Reading 3, at the south boundary of the proposed factory location, reaching 73.07 dBA and peaking at 76.3 dBA during one of the measurements. This elevated value coincided with a period of high wind presence, which partially amplified background noise. Spot Reading 7 lies approximately 330 metres south of Spot Reading 3, however, despite this separation from the roadway, noise levels at Spot Reading 3 remained comparable to those at Spot 7, highlighting the influence of environmental factors like wind.

Other readings, such as those at Spot Reading 8 – Lower east boundary and Spot Reading 1 – north boundary, also showed moderately high maximum levels of 75.9 dBA and 69.6 dBA, respectively. In these cases, the peak readings were attributed to localized disturbances including barking dogs, nearby conversations, and brief motor vehicle presence. In contrast, the lowest maximum levels were found at Spot Reading 4 at the east boundary of the new factory area and Spot Reading 5 at the centre of the new factory area, with values of 57.23 dBA and 57.63 dBA, respectively. These relatively low peaks reflect quieter acoustic conditions, with only occasional interruptions such as a passing motorbike or light wind.

Overall, while short-term fluctuations resulted in several relatively high maximum values, all measured peaks remained within the Jamaica National Noise Standards for industrial zones (75 dBA) (Appendix 3) and below occupational exposure limits (80 dBA). The average maximum noise levels for the majority of the assessed locations fell within the 50 – 65 dBA range, which is broadly consistent with ambient sound levels found in quiet suburban to quiet urban environments. These findings suggest that peak ambient noise across the site is influenced more by environmental conditions and intermittent human activity than by any continuous noise source and is not expected to pose any risk of hearing damage.

Table 3: TSCL Noise Monitoring Exercise Summary Results

- Cells with are within the relevant standard, and no hearing protection is required.
- Cells with recorded values between 80 and 90 dBA, and hearing protection are recommended when working in these areas.
- Cells with exceed 90 dBA, and hearing protection is required when working in these areas, based on OSHA's standards and guidelines from the Occupational Safety and Health Division of the Ministry of Labour, Jamaica.

No	Location Description	SPL Average (dBA)	Max Average (dBA)	Comments
1	Spot Reading 1 — North boundary of new factory location	2 40.17	2 62.70	Minimal wind activity and external noise influence during the reading.
2	Spot Reading 2 – East boundary of new factory location	4 5.90	6 3.67	Minimal wind activity and external noise influence during the reading.
3	Spot Reading 3 – South boundary of new factory location	⊘ 45.07	⊘ 73.07	High wind presence.
4	Spot Reading 4 – West boundary of new factory location	⊘ 30.60	⊘ 57.23	Low levels overall; assessment influenced by a passing motorbike to the west and light wind activity.
5	Spot Reading 5 — Centre of new factory location	41.30	⊘ 57.63	Minimal external noise influence during the reading.
6	Spot Reading 6 – Lower west boundary of TSCL property	⊘ 37.70	⊘ 59.10	The sound of motor vehicles was audible to the south of the reading location.

No	Location Description	SPL Average (dBA)	Max Average (dBA)	Comments
7	Spot Reading 7 – South boundary of TSCL property	⊘ 34.87	⊘ 73.47	Multiple vehicles passed on the adjacent southern road during the assessment.
8	Spot Reading 8 — Lower east boundary of TSCL property	44. 10	⊘ 66.97	Background noise included barking dogs, passing vehicles, and nearby conversations among residents.

4 CONCLUSION AND RECOMMENDATIONS

The baseline noise assessment conducted has provided a comprehensive overview of the current acoustic environment around the proposed sugar factory site, capturing the influence of local traffic, wind conditions, and community activity. The maximum average noise levels observed ranged from 57.23 dBA to 73.47 dBA, with the highest levels recorded at the southern boundary of the TSCL property (Spot Reading 7), primarily due to vehicular activity. Elevated readings at the southern boundary of the proposed factory site (Spot Reading 3) were also observed, likely influenced by high wind conditions during measurement. In contrast, the north, east, and central factory boundary locations recorded lower and more stable noise levels, indicating minimal external noise influence in those areas.

Overall, both the average Sound Pressure Level (SPL) and maximum measurements confirm that ambient noise levels in the area range from those typically associated with quiet rural environments (30–40 dBA) to those resembling residential suburban settings at peak times (>65 dBA).

With the proposed development of a sugar processing factory on the site, the acoustic landscape of the area is expected to change. Once the factory becomes operational, the site would be more appropriately evaluated in accordance with the industrial zone limits specified by the Jamaica National Noise Standards (Appendix 3). These standards allow for higher permissible noise levels, reflecting the increased activity and equipment-related noise typically associated with industrial operations.

At present, the average ambient sound levels around the proposed sugar factory site were all below the Jamaica National Noise Standards for industrial zones, which specify allowable sound levels of 75 dBA during the day (7 a.m. to 10 p.m.) and 70 dBA at night (10 p.m. to 7 a.m.). Given the nature of the planned operations, the noise levels during the factory's operational phase are not expected to exceed these regulatory thresholds. While some increase in sound levels is anticipated due to machinery, vehicle movements, and processing activities, these changes are expected to remain within the acceptable bounds at the boundary of the site.

However, to ensure that sound pressure levels at the property boundaries do not exceed 75 dBA once the facility is operational, a proactive noise management strategy is recommended. This should include:

Tropical Sugar Company Ltd. (TSCL), New Sugar Factory Development — Noise Assessment Report (May 2025)

- **Design considerations**, such as positioning high-noise equipment away from property boundaries and incorporating shielding or enclosures where feasible.
- **Regular maintenance of machinery** to prevent avoidable mechanical noise and ensure optimal operation of sound suppression systems.
- Operational phase noise monitoring at key boundary points to ensure compliance and allow for prompt corrective action if levels approach or exceed thresholds.
- Community engagement measures, such as clear communication channels and response protocols for noise-related complaints, to foster transparency and responsiveness.

By establishing a clear baseline and proactively implementing the recommended noise mitigation strategies, the proposed sugar factory can be developed in a way that supports operational efficiency while ensuring boundary noise levels remain below 75 dBA. With careful planning and adherence to these recommendations, the proposed factory can operate efficiently while maintaining acceptable noise levels and minimizing disturbance to the surrounding environment and community.

Appendix 1: Complete Data Set from TSCL Noise Monitoring Exercise Results

Legend: >90 dBA Between 80 dBA and 90 dBA

No	Location Description	SPL 1	Max 1	SPL 2	Max 2	SPL 3	Max 3	SPL Average	Max Average	Comments
1	Spot Reading 1 - North boundary of new factory location	47.1	69.6	36.7	63.9	36.7	54.6	40.17	62.70	Minimal wind activity and external noise influence during the reading.
2	Spot Reading 2 – West boundary of new factory location	46.3	62.4	40.7	63.3	50.7	65.3	45.90	63.67	Minimal wind activity and external noise influence during the reading.
3	Spot Reading 3 – South boundary of new factory location	42.5	68.6	45.1	74.3	47.6	76.3	45.07	73.07	High wind presence.
4	Spot Reading 4 – East boundary of new factory location	30.6	57.3	31.7	58.4	29.5	56.0	30.60	57.23	Low levels overall; assessment influenced by a passing motorbike to the west and light wind activity.
5	Spot Reading 5 - Centre of new factory location	46.1	58.7	38.2	57.7	39.6	56.5	41.30	57.63	Minimal external noise influence during the reading.
6	Spot Reading 6 – Lower west boundary of TSCL property	43.5	64.6	36.3	54.9	33.3	57.8	37.70	59.10	The sound of motor vehicles was audible to the south of the reading location.
7	Spot Reading 7 – South boundary of TSCL property	31.6	70.7	33.5	75.5	39.5	74.2	34.87	73.47	Multiple vehicles passed on the adjacent southern road during the assessment.
8	Spot Reading 8 - Lower east boundary of TSCL property	46.9	75.9	47.0	63.4	38.4	61.6	44.10	66.97	Background noise included barking dogs, passing vehicles, and nearby conversations among residents.

Appendix 2: Decibel Levels of Environmental Sounds

Source – Dangerous Level	dBA SPL
Produces Pain	120–140
Jet Aircraft During Take-off (at 20 meters)	130
Snowmobile	120
Tractor Without Cab	120
Rock Concert	110
Die Forging Hammer	100–105
Gas Weed-Whacker	100–105
Chain Saw	100–105
Pneumatic Drill	100–105
Home Lawn Mowers	95–100
Semi-trailers (at 20 meters)	90

Source	dBA SPL
Discomfort Level	Above 80
Heavy Traffic	80
Automobile (at 20 meters)	70
Vacuum Cleaner	65
Conversational Speech (at 1 meter)	60
Quiet Business Office	50
Residential Area at Night	40
Whisper, Rustle of Leaves	20
Rustle of Leaves	10
Threshold of Audibility	0

Appendix 3: Excerpt of Jamaica National Noise Standards

The Recommended Zone Limits:

ZONE	7 a.m. to 10 p.m.	10 p.m. to 7 a.m.
Industrial	75 dBA	70 dBA
Commercial	65 dBA	60 dBA
Residential	55 dBA	50 dBA
Silence	45 dBA	40 dBA

Extracted from the Recommendations for National Noise Standards for Jamaica, 1999

Notes:

The measurements are to be at the property line form which the sound is emitted or at the nearest point possible beyond that line. If the source of the sound is on public property, then measurements are to be made at a distance of 3m and 4m form the source. This excluded the mechanical noise made by moving vehicles but includes other noise (such as music) form such vehicles.

Industrial Zone

Lands designated *Industrial Zone* shall generally be industrial where protection against damage to hearing may be required, and the necessity for conversation is limited. The land uses in this category would include, but not be limited to, manufacturing activities, transportation facilities, warehousing, mining, and other lands intended for such uses.

Appendix 4: Pictures from Noise Assessments

Figure 3: TSCL Property – Proposed Sugar Factory Development Area



Figure 4: North Boundary of Proposed Factory





Figure 5: West Boundary of Proposed Factory

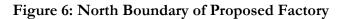


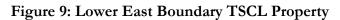




Figure 7: Lower West Boundary of TSCL Property

Figure 8: South Boundary TSCL Property

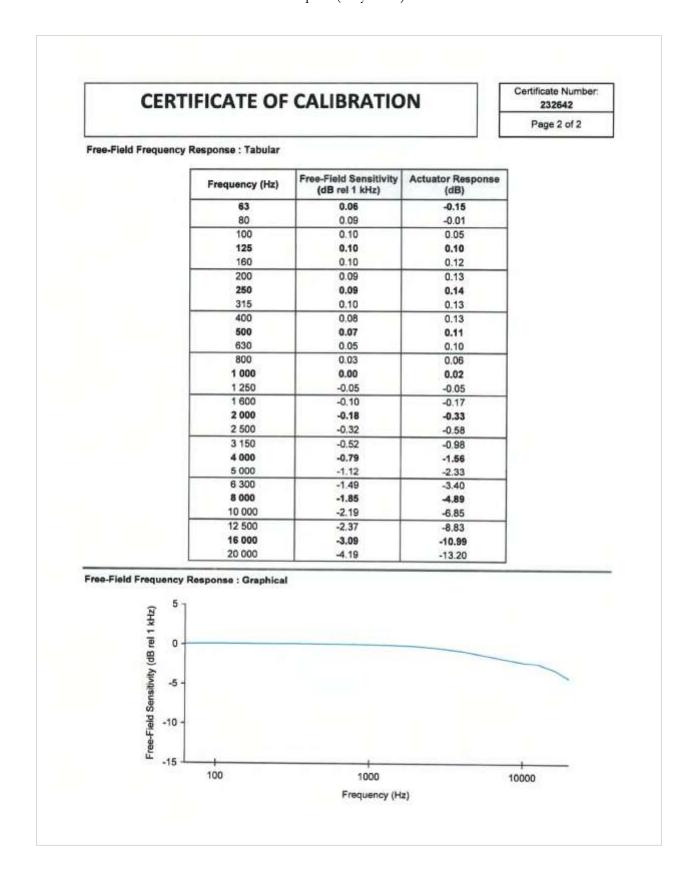






Appendix 5: Calibration Certificates for Sound Level Meter, Microphone and Calibrator





Certificate Number: 232595 Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:

Pressure: 101.41 kPa
Temperature: 23.5 °C
Humidity: 34.8 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Distortion Meter	Keithley	2015	1063074
Environmental Monitor	Comet	T7510	21962628

Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	94.00	94.00	94.00	93.98	93.99	-0.01	±0.75	0.11 dB
Distortion (%)	< 4.00	0.39	0.37	0.39	0.39	0.39	+4.00	0.13 %
Frequency (Hz)	1000.0	1000.2	1000.4	1000.2	1000.3	0.3	±20.0	0.1 Hz

The measured quantities or deviations (as applicable), extended by the expanded combined uncertainty of measurement, must not exceed the corresponding tolerance.

End of results

ISSUED BY

Noisemeters

DATE OF ISSUE 11 February 2025

CERTIFICATE NUMBER 232595

NoiseMeters

NoiseMeters **Acoustic House Bridlington Road** Hunmanby YO14 0PH United Kingdom www.noisemeters.com Page 1 of 2

Approved signatory A.Windrass

Electronically signed:

Sound Calibrator : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc

Notes:

CR:514 Model: Serial number: 97787

Class:

Test summary

Date of calibration: 11 February 2025

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC60942_2003 Annex B -Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the Class 2. requirements of IEC 60942:2003.

The manufacturer's product information indicates that this model of sound calibrator has been formally pattern approved to IEC60942_2003 Annex A to Class 2. This has been confirmed by PhysikalischTechnische Bundesanstalt (PTB). Notes:

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a

ISSUED BY

Noisemeters

DATE OF ISSUE 11 February 2025

CERTIFICATE NUMBER 232652

NoiseMeters

NoiseMeters Acoustic House **Bridlington Road** Hunmanby YO14 0PH United Kingdom www.noisemeters.com Page 1 of 2

Approved signatory

A.Windrass

Electronically signed:

Sound Level Meter: IEC 61672-3:2013

Instrument information

Manufacturer:

Cirrus Research plc

Notes:

Model:

CR:308

Serial number.

SH01555

Class:

V0.1.1 Firmware version:

Test summary

Date of calibration: 11 February 2025

The calibration was performed respecting the requirements of ISO/IEC 17025:2017. Periodic tests were performed in accordance with procedures from IEC 61672-3:2013.

The sound level meter submitted for testing successfully completed the class 2 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 because (a) evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to determine that the model of sound level meter fully conformed to the class 2 specifications in IEC 61672-1:2013 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approved of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Certificate Number: 232652

Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:

Before Pressure: 101.40 kPa Temperature: 21.3 °C Humidity: 39.8 %

After Pressure: 101.39 kPa Temperature: 21.4 °C Humidity: 39.9 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	SIGLENT	SDG1032X	SDG1XDDQ6R6309
Attenuator	Cirrus Research	ZE:952	78700
Multi-frequency Calibrator	Bruel and Kjaer	4226	2532068

Additional instrument information

Instruction manual: User Manual

Reference level range: Single range

Pattern approval: No Source of pattern approval: -

Preamplifier

Manufacturer - Manufacturer Hunan Acoustic Instrument and Control Technology Co, Ltd

 Model:
 Model:
 HY:205

 Serial number:
 Serial number:
 07043

Test results summary

Test	Result
Self-generated noise	Complies
Long-term stability	Complies
Acoustic frequency weightings	Complies
Electrical frequency weightings	Complies
Weightings at 1 kHz	Complies
Linearity	Complies
Toneburst response	Complies
C-weighted peak	Complies
High-level stability	Complies

Acoustic Calibrator

Microphone

Manufacturer: Cirrus Research plc

Model: CR:514 Serial number: 97787

Calibration

Calibration check frequency: 1000 Hz
Calibrator's certificate ref: 232595
Level before adjustment: 94.10 dB(A)
Level after adjustment: 93.70 dB(A)

ANNEX 5

Social Impact Assessment Report

For Tropical Sugar Company Limited Factory

May 2025

Kamille Dwyer-Thomas

INTRODUCTION

OBJECTIVES

The objective of the social impact assessment (SIA) is to undertake the identification, assessment, evaluation and reporting of the potential socio-economic impacts associated with the construction and operation of a new agro-processing and manufacturing factory in Lionel Town, Clarendon, Jamaica. The assessment will provide a description of:

- 1. The social setting in which the proposed factory and supporting infrastructure are being considered for construction and operation
- 2. The potential impacts the proposed construction and operation of the factory are anticipated to have on the existing social setting in the short to long-term within the area of project occurrence
- 3. The mitigation measures recommended to prevent, reduce and/or eliminate potential adverse impacts, and enhance potential positive effects associated with the operation of the factory
- 4. The social monitoring programme(s) to be adopted in the management of associated and residential socio-economic effects

METHODOLOGY

This social impact assessment was conducted using a mixed-method approach, involving quantitative and qualitative research and participatory approaches. The methodology is in line with the general requirements of the Terms of Reference approved by the National Environment and Planning Agency (NEPA), the World Bank Environmental and Social Framework and standards for conducting environmental and social impact assessments, the International Finance Corporation (IFC) performance Standards on Environmental and Social Sustainability and the International Association of Impact Assessment (IAIA). Relevant data for the impact assessment was identified, reviewed and gathered using the following methods:

- Quantitative method involved the administration a socio-economic and beneficiary perception survey to households within the communities located in the designated project site study area.
- Qualitative methods included a desk review, focus group discussion and key informant interviews.

SPATIAL BOUNDARY

The spatial boundaries for the social impact assessment study area included a site study area and a local study area. For the assessment, the site study area, which is the anticipated area of direct social disturbance and influence associated with all phases of the agro-processing facility (sugar factory) project, was defined as all lands, water and valued social components within a 3km radius of the project site. The local study area, which encompasses the site

study area, included all lands, water and valued social components located within a 10km radius of the site study area.

QUANTITATIVE APPROACH

The quantitative data collection consisted of the administration of a socio-economic and community perception survey (Appendix 1). The survey was executed in three phases:

- 1. Design and development of instrument and data collection procedures, including recruitment and training of interviewers.
- 2. Data collection and Processing
- 3. Analysis of data

The socio-economic and community perception survey was designed to capture data on key priority socio-economic variables and indicators related to respondents, their prior experiences and interaction with sugar manufacturing operations, project knowledge and attitude, as well as their overall perception of the proposed project.

Sampling and Target population

The sample frame for the survey design was based on data from the 2011 Population and Housing Census. The target population for the study was households located within the defined spatial boundaries of the SIA. The perception survey was administered to household representatives (18 years and over, and who are usual residents) found in the communities located within the site study area.

Sample Size (Perception Survey)

The sampling frame for the study was the 2011 Population and Housing Census. The census identifies 1,995 eligible households stratified by communities located within the site study area (Table 1). The sample size for the study was 80 households calculated with a margin of error of 10.5% with a confidence level of 95%. The sampling allocation for the study was calculated proportional to the number of households in the communities located within the site study area. The survey data was collected using a convenience-based sampling technique.

Table 1: Distribution of Sample by community

Community	Household	% of total	Survey distribution
		households	
Lionel Town	1,207	60	48
Perrins/Monymusk (Lionel Town)	136	7	5
Chesterfield (Lionel Town)	123	6	5
Alley / Amity	529	27	22
	1,995	100	80

Survey Response

The socio-economic and community perception survey was completed by 86 households, resulting in a survey response rate of 100 %. All respondent data was included in the analysis.

QUALITATIVE APPROACH

Desk Review

A comprehensive literature review was conducted of national demographic, labour, economic, and parish/community specific research documents to review key socio-economic development indicators for communities in the project area to better understand existing the socio-demographic development context. The review also assisted in the identification of socio-economic development issues of concern.

Focus Group Discussions

Although it is not intended to be representative of the general population, qualitative data must be adequate enough to provide an in-depth analysis of the varied dimensions related to beneficiaries' experiences and perceptions of the proposed project.

A focus group session was held with community members residing in the site and local study areas. Participants were recruited from communities outlined in Table 2. The FGD session was completed on April 11, 2025. A total of twelve (12) persons participated in the session from the following communities.

Table 2: Focus Group Discussion Participants by Community

No.	Community Name	Participants
1	Lionel Town	2
2	Amity Hall/Alley	2
3	Hayes	1
4	Hunter's Village	1
5	Longwood	1
6	Mitchell Town and Morelands	1
7	Portland Cottage	1
8	Race Course	1
9	Rocky Point	1
10	Salt Savanna	1
	Total	12

A focus group guide was used in steering the discussion with attendees. The FGD served to gather more detailed information and get deeper insights into the factory interactions and experiences of the resident population. Participants were engaged in discussions around ten

main questions outlined in the guide. The themes explored from these questions included: livelihoods and employment, factory interaction and experiences, and project perceptions.

Key Informant Interviews and Consultations

Key informant interviews (KIIs) and consultations were held with government stakeholders, private sector entities, civil society organisations (CSOs), and non-governmental organisations (NGOs) to get a more comprehensive understanding of socio-economic and cultural landscape of communities within the project area. A total of thirteen (13) KII were conducted. The list of organisations and institutions participating in interviews is presented in Appendix 1. Consultations were held with representatives of the Lionel Town and Milk River Development Area Committees. Interviews and consultations were held to:

- (i) identify and gain insights on organisational interactions and experiences with manufacturing operations within the project area
- (ii) understand the role of the state machinery, including their capacities in facilitating the implementation and monitoring of project activities
- (iii) identify opportunities and constraints associated with the proposed project, and
- (iv) gather recommendations on measures and areas for intervention to ensure potential adverse impacts are mitigated and monitored.

Gender Analysis

A gender analysis was undertaken to assess the impact the proposed development activities may have on females and males. Using the Gender-Based Analysis Plus (GBA+) approach, the study assessed how females and males might be affected by proposed plans to restore sugar manufacturing in Southern Clarendon.

LIMITATIONS

Sample size and representativeness

Due to financial constraints, the sample size for the survey data was not statistically representative. Project funding timelines also limited the data collection period for the assessment. Nevertheless, the data collected from the survey provided updated demographic and economic baseline data for residents in the site study area, and was essential given the absence of recent national demographic data for the communities in the project area. Key and meaningful insights were also gleaned regarding the proposed project. The data collected as part of the social assessment was also not limited only to survey data, but included interviews, consultations and focus group sessions to capture the full complexity of the project's potential impacts from the perspective of key stakeholders and groups.

HUMAN (SOCIAL) ENVIRONMENT SETTING

SOCIO-ECONOMIC BASELINE

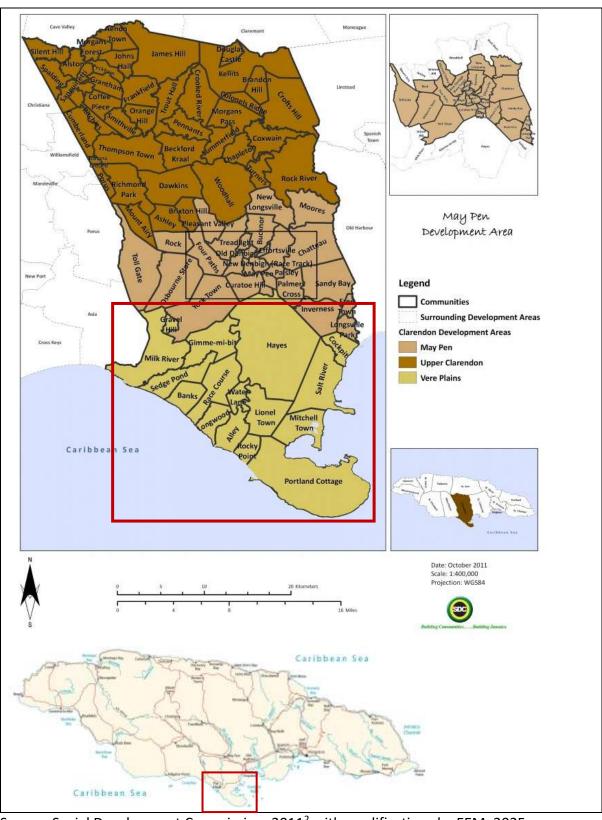
The project is located within the boundaries of the Vere Plains (Figure 1), which includes two Development Areas- Lionel Town and Milk River.¹ There are sixteen communities located within the boundaries of the project (Table 3).

Table 3: Communities Located within Project Boundaries

DEVELOPMENT AREAS AND COMMUNITIES			
LIONEL TOWN	MILK RIVER	MAY PEN	
Alley Halse Hall Hayes Lionel Town Mitchell Town Portland Cottage Rocky Point Salt River Water Lane	Gravel Hill Gimme Me Bit Milk River Race Course Longwood	York Town	

¹ Note: One parcel of cane field, located in the south-eastern section of the York Town community, falls within the project's boundaries. York Town is part of the May Pen Development Area. Some socio-economic baseline information is included in this report for the community.

Figure 1: Project Boundaries and Location



Source: Social Development Commission, 2011² with modifications by EEM, 2025

 $^{^2\} https://earnwhileyouonline.wordpress.com/wp-content/uploads/2015/07/clarendon_communities-791x1024.jpg$

In 2011, the population of the Vere Plains was estimated at 50,591 people (STATIN, 2019) [Table 4]. Disaggregation of the population data by sex shows males represented 50.1 per cent of the total population within the project's boundaries. By age, the data shows children (0-14 years) accounted for approximately 28 per cent of the total population.

Table 4: Total Population by Community and Development Area

DEVELOPMENT AREA AND COMMUNITIES					
LIONEL TOWN		MILK RIVER		MAY PEN	
Alley	1,582	Gravel Hill	ravel Hill 1,896 York Town	York Town	3,593
Halse Hall	5,089 Gimn	Gimme Me Bit	1,675		
Hayes	11,241	Milk River	2,701		
Lionel Town	4,419	Race Course	5,195		
Mitchell Town	1,743	Longwood	999		
Portland Cottage	4,502	936			
Rocky Point	2,936				
Salt River	1,007				
Water Lane	2013				
Sub-total	34,532		12,466		3,593
Grand Total					50,591

Source: Statistical Institute of Jamaica and Planning Institute of Jamaica, 2019³

Housing

Housing statistics from the 2011 census showed the communities within the project's boundaries had 13,157 dwelling units and 14,312 households (Table 5).

Table 5: Overview of Housing Characteristics

DEVELOPMENT AREA	DWELLING UNITS	HOUSEHOLDS
Milk River*	3,505	4,956
Lionel Town	9,652	9,356
Total	13,157	14,312
*Includes York Town		·

Source: Clarendon Municipal Corporation, 2016⁴ and Planning Institute of Jamaica, 2025⁵

Small pockets of informal settlements are also situated within the project's boundaries in the communities of Lionel Town, Salt River, Hayes (Corn Piece and Raymonds), Rocky Settlement and Portland Cottage.

³ https://statinja.gov.jm/pdf/Mapping%20Poverty%20Final%2013.5.2019%20-%20Disseminated.pdf

⁴ Clarendon Local Sustainable Development Plan. https://ubwp.buffalo.edu/foodlab/wp-content/uploads/sites/68/2019/04/Clarendon-Local-Sustainable-Development-Plan-Clarendon-Parish-Jamaica-English forwebsite.pdf

⁵ https://goj.maps.arcgis.com/apps/StoryMapBasic/index.html?appid=3ec0ff9c25534912af0bef66d48f3d14

MUNICIPAL SERVICES

Health

Residents in the Vere Plains are served by six (6) health centres and one hospital (1). The Lionel Town Hospital, a Type C facility, is a 47-bed facility providing services to more than 36, 000 persons in Clarendon.⁶ There are four (4) health centres in the Lionel Town Health District and two (2) in the Race Course Health District.⁷

Education

There are fifteen (15) public educational institutions from the early childhood to the secondary educational level in the project Development Areas.

Utilities and Sanitation

Communities in the project area are supplied with domestic water from groundwater sources. Water is supplied to the Development Areas via eight (8) systems, which include the Kemps Hill, Lionel Town and Hayes Treatment Facilities operated by the National Water Commission (NWC).⁸ The NWC owns and operates six (6) sewage treatment plants in the Lionel Town Development Area.

Electricity to the communities is supplied by the Jamaica Public Service Company Limited via the Parnassus and Monymusk Substations. In 2016, 87 per cent of households in the Milk River Development Area had access to electricity and 71 per in the Lionel Town Development Area.⁹

Protection and Emergency Services

The Lionel Town Police Station and May Pen Fire Station provide policing and fire services for communities located in the project area.

ECONOMIC DEVELOPMENT: LABOUR MARKET AND ECONOMIC ACTIVITIES

Agriculture is the main economic activity in the project area. Other economic activities in the project area are linked to the mining, service, and retail and wholesale sectors.

⁶ https://www.srha.gov.jm/chd.html

⁷ Lionel Town, Mitchell Town, Raymonds, Rocky Point, Milk River and Race Course

 $^{^8}$ https://www.nwcjamaica.com/uploads/document/Draft%20%20Clarendon%20%20PPlan%20%20October%2012%202011.pdf

⁹ Clarendon Local Sustainable Development Plan. https://ubwp.buffalo.edu/foodlab/wp-content/uploads/sites/68/2019/04/Clarendon-Local-Sustainable-Development-Plan-Clarendon-Parish-Jamaica-English_forwebsite.pdf

Agriculture and Fishing

The agricultural and fishing sector accounted for 7.7 pr cent of Jamaica's gross domestic product (GDP) in 2023. The sector earned US\$90.6 million in 2023, an increase of 11.4 per cent over 2022 earnings. An estimated 183,000 persons are employed in the sector (Planning Institute of Jamaica, 2024). Nearly three-quarters, 74.1 per cent, of all workers employed in the industry are males.

As at May 15, 2025, there were 5,259 farmers registered in the farming extension of Lionel Town, accounting for 12.9 per cent of Clarendon's registered farmers (Table 6). Males represented 58.1 per cent of the total share of registered farmers in the Lionel Town extension (Rural Agricultural Development Authority, 2025)¹⁰.

Table 6: Farmer Registration by Sex

	Farmer Registration Information		
	Males Females Total		
Clarendon	26,446	14,446	40,892
Lionel Town Extension	3,058	2,201	5,259

Source: Rural Agricultural Development Authority, 2025¹¹

The Portland Cottage and Rocky Point communities located south of Lionel Town are major fishing villages in the parish of Clarendon. In 2021, there were 2,390 registered fishers in the parish of Clarendon, representing 9.8 per cent of the total number of registered fishers in Jamaica. The parish had 707 registered fishing vessels, accounting for 9.9 per cent of the total number of registered fishing vessels operating on the island (Wade et al., 2023). ¹²

The most recent employment data for the development areas showed employment rates of 48 per cent in the Milk River Development Area, and 58 per cent in Lionel Town in 2016.

Sugar Industry

In 2023, approximately 14,000 hectares of land was dedicated to sugar cultivation in Jamaica, a 41 per cent reduction compared to 2018, when 24,000 hectares of land area was cultivated. The industry earned US\$4.4 million in 2023, a 56.8 per cent reduction compared to 2019 when the industry earned US\$10.2 million.

Mining

The mining and quarrying sector accounted for 1.8 per cent of Jamaica's gross domestic product (GDP) in 2023. The sector earned US\$ 551.5 million in 2023, a 68.2 per cent increase in export earnings over 2022 earnings (Planning Institute of Jamaica, 2024). Based on the

¹⁰ https://abis.gov.jm

¹¹ https://abis.gov.jm

¹² https://link.springer.com/article/10.1007/s10745-023-00444-

^{7#:~:}text=The%20fishing%20industry%20is%20primarily,Authority%20of%20Jamaica%2C%202021).

industrial classification there are 3,200 people in the Mining and Quarrying industry labour force.¹³ Males account for higher share of workers in the Mining and Quarrying Industry, accounting for 90.6 per cent of all workers.

LAND USE

The Clarendon Sustainable Development Plan estimates that 50 per cent of land use/ land cover in the parish of Clarendon is woodlands. Agricultural land uses accounted for 18 per cent of total land use, while residential land use accounted for close to 14 per cent of land use in the parish. Woodlands and agricultural land use account for an estimated 70-75 per cent of existing land use and land cover in the Development Areas of Milk River and Lionel Town. Residential land uses in the Development Areas comprise mainly of low-density residential land uses. There are also small pockets of industrial land uses in Lionel Town.

There are several recreational amenities and facilities within the study area. These are identified in Table 7.

Table 7: Recreational Centres in Project Area

Name	Location	Areas Served
Pawsey Park Community Centre	Lionel Town	Alley, Gayle, Alley Downer, Amity Hall, Lionel Town, Bog, Morelands, Salt Savannah
Mitchell Town Community Centre	Mitchell Town	Mitchell Town
Rocky Point Community Centre	Rocky Point	Rocky Point, Rocky Settlement, Portland Cottage, Salt Savannah, Land Settlement, Coffee Piece, Red Ground
Rhymesbury Community Centre	Rhymesbury	Rhymesbury, Land settlement
York Town Community Centre	York Town	York Town, York Circle, Parnassus

Protected Areas

The Portland Bight Protected Area (PBPA), the largest protected area in Jamaica, is located within the Lionel Town Development Area.

Planned Land Uses

The Government of Jamaica has approved the development of the Lionel Town Community Park and Home Work Centre Project. The parish's Local Sustainable Development Plan has outlined a list of proposed land use developments for the Lionel Town and Milk River Development Areas, which includes agricultural, industrial and tourism land use developments.

¹³ https://statinja.gov.jm/LabourForce/NewLFS.aspx

HAZARDS

All communities in the project area, except Salt River, Gimme me bit and Gravel Hill, are flood prone. Rocky Point and Portland Cottage are also prone to coastal flooding. Droughts and bush fires also threaten the communities within the Development Areas.

SOCIAL CHALLENGES

High incidence of poverty is one of the main social challenges affecting the parish of the Development Areas of Lionel Town and Milk River. Prevalence poverty rates show, on average, an estimated 22 per cent of the population residing in these areas are poor (STATIN, 2019).¹⁴

The Lionel Town community, which includes the surrounding communities of Alley and Amity, has been identified by the Planning Institute of Jamaica as the 9th most vulnerable and 57th most volatile community in Jamaica. The community had a poverty rate of 16.1 per cent and 25.1 per cent in 2011 and 2016 respectively, and faces challenges related to squatting, literacy, child abuse and adolescent pregnancy, service and infrastructure accessibility and crime and violence, including presence of gangs. ¹⁵¹⁶

Court statistics show in the four-year period, 2020 and 2023, the Lionel Town Police Station accounted for the second highest share of criminal charges filed at police stations in the parish of Clarendon (Table 8). The percentage share of charges filed in 2023 (11.3%), have nearly doubled the percentage share recorded in 2017 (6.2%).

Table 8: Percentage distribution of Total Parish Criminal Charges Filed at Lionel Town Police Station

Year	Total (%)
2023	11.3
2022	15
2021	17.67
2020	14.8

Source: Court Statistics Unit, Supreme Court of Jamaica, 2020-2024

¹⁴ Statistical Institute of Jamaica (2019). Mapping Poverty Indicators. Consumption based poverty in Jamaica. Accessed from https://statinja.gov.jm/pdf/Mapping%20Poverty%20Final%2013.5.2019%20-%20Disseminated.pdf

¹⁵ http://lslandr.com/crp/wp-content/uploads/sites/6/2021/05/CRP-Community-Selection-Process_February-10-2021.pdf

¹⁶ http://lslandr.com/crp/wp-content/uploads/sites/6/2021/01/Volatility-and-Vulnerability-index_Top-100-Communities.pdf

STAKEHOLDER ENGAGEMENT AND PERCEPTION FINDINGS

SOCIO-DEMOGRAPHIC PROFILE

SEX AND AGE

Males represented nearly two-thirds, 62.8 per cent, of survey respondents.

Disaggregation of the demographic data by age showed more than half, 59.8 per cent, of household respondents were aged 45 years and over. The highest share of respondents, 40.2 per cent, were aged 45 to 64 years, while the smallest share belonged to the youth age group category, 18-24 years, with a total share of 6.9 per cent (Table 9).

Table 9: Age of Respondents

AGE GROUP	TOTAL (%)
18-24	6.9
25-44	31.0
45-64	40.2
65 and over	19.5
No response	2.3
Total	100.0

Further disaggregation of age by sex showed the highest share of female household respondents (43.8%) were aged 25-44 years, while most male household respondents (44.4%) were aged 44-64 years.

EDUCATION AND TRAINING

More than two-thirds, 71 per cent, of respondents reported secondary education as the highest level of education they had completed- most at the upper secondary level (57%). Sixteen percent (16%) reported completing some form of pre-primary (early childhood) or primary education, 1.2 per cent completed higher education at a university, and 10.5 per had not received any formal education (Table 10).

By sex, the findings on education show 78 per cent of women have completed secondary education, compared to 67 per cent of men. More women (12.5%) than men (9.3%) however reported not receiving any formal education. The data on trade certification revealed no household respondent had completed a formal trade certification programme.

While the data on respondents' educational attainment aligns with Jamaica's overall educational attainment distribution for the labour force¹⁷, key stakeholders directly engaged

¹⁷ https://statinja.gov.im/LabourForce/NewLFS.aspx

in the communities¹⁸ have expressed concerns about the populations' growing lack of proficiency in literacy and lower levels of skills, particularly among the youth aged population, which has created lower employment opportunities and outcomes for community members. Stakeholders also revealed that a significant share of the highly educated youth and adult population from the communities across the study area chose to, or were forced to migrate due to the lack of job opportunities.

Table 10: Education Level of Household Representative by Sex

EDUCATION LEVEL	TOTAL (%)	TOTAL (%)	
	Female	Male	
None	12.5	9.3	
Early Childhood/ Pre-Primary	0.0	1.8	
Primary (Grades 1-6)	9.4	18.5	
Lower Secondary/High School (7-9)	15.6	13	
Upper Secondary (10-11)	62.5	53.7	
Bachelor's Degree	0.0	1.85	

HOUSING AND HOUSEHOLD CHARACTERISTICS

HOUSEHOLD COMPOSITION AND PROFILE

Analysis of the demographic profile of households showed there were 275 people living in 86 households, revealing an average household size of 3.19. The average household size represents a marked decline when compared to the average size of 4.08 recorded by the Social Development Commission in 2016. The survey findings do, however, align with information gathered from key stakeholders who reported that migration of key population groups- youth, persons with higher education and job seekers- has led to overall changes in the composition and profile of households in the study area. Household sizes have, and continue to decline, and a growing share of households are being led by the elderly or comprise only the elderly.

Based on the results of the survey, more than a third, 34.5 per cent, of households surveyed had no children living in them and adults accounted for a higher share of household occupants at 80 per cent. Less than a tenth of households (3.4%) reported having an occupant with a disability and less than a quarter (19.7 per cent) had a member who had a health problem or long-term condition.

Housing Ownership

Less than half, 48.8 per cent, of surveyed respondents reported that the dwelling in which they lived was owned by a member of their current household, while 18.6 per cent reported rent or lease as the tenure status of the dwelling occupied by members of their household. This data on ownership is in line with previous housing ownership data recorded for Lionel

¹⁸ Employers, political representatives and community development officers.

Town area (PIOJ and STATIN, 2012). The remaining households reported rent free (8.2 per cent), other-company house (3.5 per cent) or provided no response (3.5 per cent). The total share of dwellings owned among surveyed households is below the national average of 55.6 per cent.¹⁹

Informal Housing

From the consultations held with key community and local government representatives it was reported that informal housing and settlements are part of the housing landscape in the study area. These informal settlements are found primarily in vacant cane field areas. Local government figures estimate there are approximately 200 informal settlements in Lionel Town and an estimated 100 in the Mitchell Town community.²⁰

VUI NERABI E GROUPS

Groups identified as being vulnerable and/or marginalized include:

- Youth age population (predominantly males)
- Elderly
- Children
- Small farmers

LABOUR MARKET

EMPLOYMENT

At the time of the survey, over half, 52.3 per cent, of respondents surveyed reported they were employed; either self-employed (33.7%) or working in paid employment (18.6%). Nearly a third reported they were not in paid work and were seeking a job (30.2 per cent), while the remaining respondents were not in paid work and not seeking a job (15.1 per cent), or did not provide a response (2.4%) [Table 11].

Table 11: Employment Status of Household Representative by Sex

Employment Status	Sex		Total (%)
	Female (%)	Male (%)	
No- not in paid work and looking for a job	40.6	24.1	30.2
No- not in paid work and not looking for a job	9.9	18.5	15.1
Yes- working in paid employment	18.8	18.5	18.6

¹⁹ Planning Institute of Jamaica (2023. Jamaica Survey of Living Conditions 2021

²⁰ Winston Maragh, Councillor Rocky Point Division, and Former Mayor of May Pen, Personal Communication, 2025

Employment Status	Sex	Sex	
	Female (%)	Male (%)	
Yes, self-employed	31.2	35.2	33.7
No response	0.0	3.7	2.4
Total	100	100	100

Disaggregated by sex, the data did not show any significant gender gap in labour force participation. By sex, the data showed 50 per cent of female respondents were engaged in paid employment (18.8%) or self-employed (31.2%), while 53.7 per cent of males were engaged in paid employment (35.2 per cent) or self- employed (18.5 per cent). However, there was a noted gap in the proportion of women seeking employment (40.6 per cent) compared to men (24.1%).

The high level of unemployment among respondents revealed in the survey has been identified by stakeholders as a wider socio-economic issue impacting a significant share of the population both within the study area, and the wider Vere Plains region. Stakeholders have linked the high levels of unemployment directly to the closure of the Monymusk Sugar Factory in 2018, which directly and indirectly provided employment and supported most households and businesses in the Vere Plains region, particularly in Lionel Town. At its peak, Monymusk Sugar Factory is said to have directly employed 3,000 workers, and provided indirect employment for an estimated 15,000 persons.²¹

OCCUPATION

The findings of the survey and stakeholder consultations revealed the majority of the working population in the study area is engaged in elementary and trade related occupations- agriculture, fishing, labourers (including construction workers), electrical and machinery workers, domestic workers, and drivers (taxi and truck). The survey results showed, at the time of the survey, all employed respondents were engaged in elementary, trade related or service and sales related occupations. The results also indicate a high proportion of respondents are part of the informal sector.

Consultation participants from the parish and local area development committees²² and political directorate²³ identified agriculture related occupations as the main occupational category to which most (between 75-80%) of the working age population of the communities in the study area belong. Occupational fields identified, include agriculture and livestock labourers (farmers) and fishers- most of whom are small farmers and fishers.

Although both men and women are involved in agriculture, key community stakeholders highlighted that more men are involved solely in agriculture related occupations compared to women, who, in addition to agriculture, are more likely to engage in other types of

²¹ Nigel Myrie, SCJ Holdings Limited, Manager Land and Lease Management Unit, Personal Communication 2025

²² (1) Clarendon Parish Development Committee Benevolent Society (2) Lionel Town Development Area Committee, and (3) Milk River Local Development Area Committee

²³ Joel Williams- Mayor, May Pen; Winston Maragh, Member of Parliament; Kijana Johnson, Councillor

elementary occupations as domestic workers, vendors and labourers. Key insights from the consultations related to age group revealed there is a high level of disinterest among youths regarding careers in farming and fishing, with youth males in particular showing greater interest in construction and trade related occupations.

INCOME AND INCOME SOURCES

Surveyed households reported that the main sources of income for their household were 'money earned from own work (59%), remittances from friends and family (11.6%), support from family in Jamaica (7%) and pensions (3.5%). The remaining respondents reported their household had no main source of income (5.8%) or did not provide a response (7%).

From the total share of household respondents (66) that provided a response to the question asked on monthly income, 50 per cent reported a monthly income below \$20,000 Jamaican dollars and nearly a quarter (23%) reported incomes ranging between \$20,000-\$39,000.00 monthly. Less than a tenth (3%) reported monthly income levels above \$100,000.00 Jamaican dollars (Table 12). Among respondents who reported being employed, 44 per cent reported earning less than \$40,000.00 Jamaican dollars monthly.

Table 12: Monthly Income of Household Representative by Sex

Income	Sex		Total (%)
	Female (%)	Male (%)	
Below \$20,000	56	46.3	50
\$20,000 - \$39,999	24	22	22.7
\$40,000 - \$59,999	12	19.5	16.7
\$60,000 - \$79,999	8	2.4	4.6
\$80,000 - \$99,999	-	4.9	3
\$100,000 to \$199,999	-	4.9	3
Grand Total	100	100	100

SUGAR INDUSTRY INTERACTION AND EXPERIENCES

Two-thirds, 66.3 per cent, of households surveyed had at least one member who was a previous employee at the Monymusk Sugar Factory (Table 13). This finding is consistent with information gathered from consultations, including the FGD, where stakeholders reported the Monymusk Sugar Factory directly and indirectly supported most, if not all, households in the communities located within the Southern Clarendon and Vere Plains region.

Nearly half, 46.2 per cent, of former employees had been employed at the factory for more than 10 years.

Table 13: Total Share of Households with at least one former employee of Monymusk Sugar Factory

	Female (%)	Male (%)	Total (%)
No	12.8	18.6	31.4
Not sure	1.2	1.2	2.3
Yes	23.2	43.0	66.3
Total	37.2	62.8	100.0

Impact of Factory Closure

See, my community, I love it very much. But it's kind of run down since the closure of the factory. We all are suffering down here now.

Male participant, FGD

For many residents in the study area, the closure of Monymusk led to widespread adverse social and economic impacts- many of which are still being experienced today. The findings of the survey showed more than three-quarters, 76.7 per cent, of participating households reported a loss of income as the main impact the factory's closure had on their household. For nearly half, 46.5 per cent, the closure also impacted personal savings, housing expenditure on food, pension and overall livelihood security (Table 14). The loss of pension, in particular, was highlighted by participants in the FGD as one of the main challenges which adversely affected many households. Participants reported that many former Monymusk workers were not paid the pension that was commensurate with the length of their employment service following redundancy exercises and ultimate closure of the factory. It was revealed that some workers received pension payments for only a few years (1-2 years) due to potential administrative filing errors with the National Insurance Scheme (NIS), which left many without income security having entered retirement. Finding jobs have also proved challenging for former workers.

Lack of Employment Opportunities

The survey results also showed among the total share of households with former Monymusk employees, 44 per cent reported that former workers living in their households have been unsuccessful in finding employment since the closure of Monymusk. Among those able to secure employment following the factory's closure, the data showed 41.3 per cent did so in less than 12 months, 21 per cent in 1-2 years, for 27.5 per cent it took more than 2 years and for 10.3 per cent the length of time taken to secure employment was uncertain.

Table 14: Impact of Monymusk Sugar Factory Closure on Households

Types of Impacts	Total (%)
Loss of income	76.7
Loss of savings	46.5

Types of Impacts	Total (%)
Loss of livelihood security	46.5
Unable to feed family	46.5
Loss of pension	40.7
Unable to pay for child's/children's education	34.8
Emotional distress and anxiety	30.2
Loss home	15.1
Unable to pay mortgage	15.1
Loss business	5.8

A lot of people out here now, they are burning coal. Coal for fire coal. And quite a few guys go and do a little fishing, but you know, that's about it. Male participant, FGD

Many former labourers residing across the Vere Plains, including those formerly employed in non-farming roles, have engaged in animal husbandry/livestock farming (cattle, goat and pig), castor oil farming, fishing and charcoal burning to support themselves and their families. Others have migrated to other places locally (Ocho Rios and St. Mary) and overseas to gain employment in construction or other fields. Some workers have also found employment in the sugar industry in Clarendon.²⁴

Burning of the fire coal...now gone down they don't have anybody coming in to buy the fire coals anymore. Female participant, FGD

However, stakeholders have noted the precarity of the economy and job market, which has made it difficult for community members to maintain stable employment. The impact of the COVID-19 pandemic further exacerbated economic and employment challenges.

Business Losses

In keeping with the findings of the survey (Table 15), FGD participants and key stakeholders reported that the closure of the factory led to a rapid decline in community development, as the closure triggered a torrent of negative social and economic impacts. In addition to the losses of employment and income, the consultations revealed the widespread closure of businesses and the loss of critical services across many of the communities, particularly in Lionel Town, where the impact was greatest. Stakeholders shared in the consultations that banking services and facilities, provided solely by the National Commercial Bank, were permanently relocated from the community to May Pen. Many locally owned businesses, which provided goods and services to workers and community members, including gas stations, restaurants, retail stores, grocery stores, and electrical and mechanic businesses, were all shuttered. Nearly nine in ten (87.2 per cent) survey respondents reported a significant decline in economic and business activities following the closure of the factory. In recent times, businesses that were able to withstand the initial shock of the factory's closure, are on the brink of closing or have closed due to the impact of COVID-19.²⁵

²⁴ The Clarendon Chamber of Commerce estimates there are between 70-80 farmers involved in the cultivation and harvesting of sugar cane currently.

²⁵ Hanif Brown, Representative, Clarendon Chamber of Commerce. Personal Communication May 2025

Table 15: Impact of Monymusk Sugar Factory Closure on Community

TYPES OF IMPACTS	TOTAL (%)
Increase in Unemployment	94.2
Increase in poverty	77.9
Increase in crime	70.9
Non-resident factory workers left the community	37.2
Improvement in the quality of water resources	10.4
Improvement in air quality	9.2

Declining Quality of Life

But the community really need to be developed, you know? Really need to be developed. We can't go on living like this. We are, you know, people in the community are human beings like anybody else ... We need people to come in and do something. You know? Look, the youth, they need something to do, you know? Male participant, FGD

The closure of the factory has had significant adverse impacts on health, educational attainment and outcomes, crime and community engagement and cohesion. Consultations held with health and business stakeholders in the community revealed key insights into the socio-economic challenges affecting residents. As unemployment and poverty levels have risen, health representatives have reported that the current levels of malnourishment observed in the population served at the Lionel Town Hospital is concerning. Growing food insecurity has been identified by stakeholders as one of the challenges affecting community members, particularly children and the elderly, which has contributed to declining health status. As large segments of the population struggle with income inadequacies, their overall purchasing power has impacted their spending on essential amenities and services such as food, health and education services.

This reduction in spending has, according to feedback from stakeholders, translated into unmet nutritional needs, infrequent healthcare check-ups, lower attendance rates at the primary and secondary level, higher secondary school dropout rates and low educational performance among the youth population²⁷ and an increase in criminal activities. In the communities of Lionel Town and Rocky Point gang violence, which continues to plague the area, has been linked to the challenging social and economic conditions faced by community members- driven primarily by the lack of employment opportunities and successes for residents. Education and training intervention efforts by the Government of Jamaica,²⁸ targeting the youth population in the Vere Plains region, have not had the desired impact, as the response to the tuition-free programmes have been described by stakeholders as 'underwhelming.'

²⁶ Nadine Preddie, Chief Executive Officer, Lionel Town Hospital. Personal Communication 2025

²⁷ Key stakeholders reported that Alley Primary and Bustamante High School in Lionel Town have reported declines in school attendance and overall student performance.

²⁸ The Government of Jamaica in 2023 removed all tuition and administrative fees for HEART-NSTA Trust programmes up to level four (associate degree). The programme became effective April 1, 2023.

Other community initiatives spearheaded by the private sector and various Non-governmental Organisations (NGOs) and Community Based Organisations (CBOs) have sought to address some of the socio-economic challenges affecting the communities, with varying levels of success. Welfare programmes have sought to address food security issues, training programmes have been developed to help tackle literacy challenges and ongoing community engagement programmes are focused on community development, youth empowerment and crime reduction.

PROJECT PERCEPTIONS AND POTENTIAL IMPACTS

PROJECT AWARENESS

All key stakeholders consulted were aware of the proposed project, although the level and depth of information known about the intended development varied among stakeholders. Most survey respondents, 82.5 per cent, also reported being aware of the proposed project to resume sugar factory operation. Most had been made aware by a fellow community member (91.5%).

PROJECT SUPPORT

The consultations demonstrated there is broad support for the proposed project, with no stakeholder raising an objection or opposition to the new construction and operation of the agro-processing facility (sugar factory). Stakeholders, instead, emphasised the necessity of the project in supporting the redevelopment of the local communities across the Vere Plains region, and highlighted the social and economic opportunities to be derived from the project.

The survey results showed all respondents supported the project and 99 per cent agreed the development was necessary. Overall, there was general consensus among stakeholders that the project will bring about an improvement in the quality of life for residents, create employment, provide opportunities for new business investments in the study area and wider parish, help to re-establish social cohesion, and rebuild the vibrancy of the Lionel Town area.

PROJECT IMPACTS AND CONCERNS

Analysis of the perception data on project impact showed while stakeholders associated mostly positive impacts with the proposed project, there were also a few concerns expressed about the project.

Perceived Project Benefits

For all groups engaged as part of the consultations, the proposed project represents hope and an opportunity for community renewal and development. Key stakeholders also noted the national development opportunity offered by the project, given its alignment with

national development goals and priorities centred around job creation, economic diversification, modernisation of the agricultural sector and food security.²⁹

Employment opportunities (96.5%) and potential increases in income (95.3%) were the two main community benefits survey respondents associated with the proposed project (Table 16). The project was also seen as likely to assist in the reduction of poverty (81.5%) and crime (79.1%) and lowering of the overall employment rate (59.3%).

Table 16: Expected Community Benefits from Proposed Project

BENEFITS	TOTAL (%)
Provide employment/create job opportunities	96.5
Increase in wages/income	95.3
Reduce poverty	81.4
Reduce crime	79.1
Lower employment rate	59.3
Support/stimulate growth of local businesses	62.8
Provide opportunities for re-establishment and growth of local small businesses	51.2
Influx of migrant workers	12.8

Most survey respondents also identified employment opportunities (83.7%) and potential increases in income (80.2%) as the main personal benefits they associated with the proposed project. More than half of all respondents also reported the project's potential impact in reducing poverty (74.4%) and emotional distress (66.2%). For 10.2 per cent of respondents, however, the project was not expected to have any personal impact or offer any personal benefits (Table 17).

Table 17: Expected Individual/Personal Benefits from Proposed Project

BENEFITS	TOTAL (%)
Provide employment/create job opportunities	83.7
Increase in wages/income	80.2
Reduce poverty	74.4
Reduce emotional distress and anxiety	66.2
No benefit	10.2

In discussing the potential impacts of the proposed project, participants in the FGD shared that community members are anxious for the project to get started. Many shared their hope that the project would finally create job opportunities for people in their communities and support the re-establishment of businesses that have been shuttered in recent years. For

²⁹ Marlene Porter, Manager Agribusiness and Investment Linkages, JAMPRO, Personal Communication, 2025

others, the project presents a worthwhile opportunity for youth engagement, through the provision of training and job opportunities. Participants suggested that a successful youth engagement programme would help to keep the youth population out of illicit activities and ensure safety in the communities. With respect to community development and corporate social responsibility (CSR), many participants indicated their desire to see the new developers of the sugar factory contribute to the development of the communities by supporting local initiatives and collaborating on community projects and events.

Key stakeholders, when asked about potential impact of the project, identified similar social and economic benefits shared in the FGD and survey, including job creation, increased commercial activity, and opportunities for youth engagement. Stakeholders also reported the potential to reap broader national benefits, including generation of tax revenues, increase in exports and trade, generation of foreign exchange earnings and expansion and diversification of the agricultural sector.

It is also important to note that respondents to the survey and key stakeholders did not identify any marginalized or vulnerable groups that they believed would be disproportionately impacted by the project. Neither were any existing nor proposed industrial activity reported which could potentially conflict with the proposed development.

I think the opportunity for employment for persons in the area- that's a positive, but it has to be employment at a level that takes them out of poverty. it has to be something that has long lasting positive impact. C-CAM, consultation

Additionally, although stakeholders anticipated a number of positive outcomes from the project, for many it is important that the project offers long-term and sustainable opportunities for community members to ensure the achievement of tangible socioeconomic and health outcomes for residents and potential workers.

Perceived Adverse Impacts and Concerns

The survey found only a small share of respondents, 2.3 per cent, were 'somewhat' concerned about the adverse environmental impacts of the project. The findings showed air pollution was the main environmental concern for respondents. This finding was not particularly remarkable as when survey respondents were asked about the environmental impacts of Monymusk's operation in the community, 79.1 per cent, stated there had been none, while 95.3 per cent stated that the factory's operations had never impacted their own personal health or that of a family member.

When asked about other concerns or adverse impacts, 8.1 per cent of respondents expressed being 'slightly' concerned about potential disturbances and disruptions from construction activities and the health and respiratory effects associated with the proposed project activities. Nearly a quarter of households, 23.2 per cent, reported that at least one member of their respective household suffers from a respiratory illness or disease.

Stakeholders engaged in the consultations however identified environmental areas of concern, along with or areas of key interest and concerns. Some of the main issues identified were:

- The potential for the project to pollute groundwater resources and increase saline intrusion
- Increase in air pollution sources during construction and operation of the factory
- Proper management of waste generated from the factory
- The importance of providing adequate compensation for farmers to ensure the profitability of the venture for farmers, as well as the developers/operators.
- Displacement of livestock farmers and informal land occupants and threats to livelihoods and social cohesion
- The importance of developing innovative training and youth engagement strategies to attract and retain youth involvement.

Additional concerns provided by stakeholders are outlined in Table 18

Table 18: Summary of Stakeholder Feedback on Potential Impacts and Recommendations

ORGANISATION	ISSUES AND CONCERNS	BENEFITS AND AREAS OF OPPORTUNITY	RECOMMENDATIONS
Caribbean Coastal Area Management Foundation (C-CAM)	 Source of water for the project and the impact increased extraction of groundwater may have on increasing saline intrusion in the project areas The impact of waste on water sources and water quality The potential impact on wildlife, including birds and crocodiles The impact of resettlement on informal settlers and potential disruption of livelihoods The return of charcoal burning in the protected area due to reclamation of cane lands for project 	 Create employment/job opportunities Provides an opportunity to support community development Opportunity to engage community and build community partnership 	 Develop a comprehensive water quality monitoring programme to address water pollution Workers should be provided with guaranteed job security, and liveable and attractive compensation packages Consideration should be given to allocating marginal (fringe) cane lands to community members that support their livelihoods through the burning of charcoal and will be relocated as a result of the project Develop tourism product by Converting the defunct Monymusk Factory and old housing barracks into a heritage museum or tour Identify and outline mitigation and monitoring measures to address environmental impacts Develop a community engagement strategy and programme
JAMALCO	 Concerned about the long-term sustainability of the proposed project 	Create employment/job opportunitiesProvide support for local initiatives and programmes,	 Appoint a designated community liaison officer to manage community engagement and

ORGANISATION	ISSUES AND CONCERNS	BENEFITS AND AREAS OF OPPORTUNITY	RECOMMENDATIONS
	 Impact of air pollution and proposed plans to address environmental and social impact of air pollution Engagement of youth population in community 	easing the burden on existing businesses - Provide training and upskilling opportunities for community members	develop a community engagement strategy and programme
Lionel Town Hospital	 Handling, treatment and management of waste Impact of air pollution and proposed plans to address environmental and social impact of air pollution Engagement of young men in community 	 Create employment/job opportunities Provides an opportunity to support Improvement of health outcomes, particularly for children and the elderly Provides an opportunity to support community development 	 Train and recruit locals for job opportunities, particularly young men and women. Provide support to local initiatives and collaborate with community on various programmes
Chamber of Commerce	 Concerned about the length of time taken for project to be approved and started The importance of having proper security measures, protocols and mechanism in place to safeguard field and factory operations 	 Create employment/job opportunities Reduce poverty Increase export and trade revenue (foreign exchange earnings) Provide training and upskilling opportunities for community members Provides an opportunity to support community development 	 Local contractors in the community should be given priority during the contractor recruitment process Develop a security management plan to safeguard field and factory operations Mitigation and monitoring measures to address environmental impacts should be clearly outlined

ORGANISATION	ISSUES AND CONCERNS	BENEFITS AND AREAS OF OPPORTUNITY	RECOMMENDATIONS
Municipal Corporation (representatives)	 Concerned about the Impact and disruptions relocation of cattle farmers may have on their livelihoods Handling, treatment and management of waste 	 Create employment/job opportunities Increase export and trade revenue (foreign exchange earnings) Increase government revenue (taxes) Provides an opportunity to support community development Create linkages across various sectors e.g., transportation, tourism. 	 Invest in community infrastructure, particularly those in the education and health sectors Provide support to local initiatives and collaborate with community on various programmes Train and recruit locals for job opportunities, particularly young men and women. Establish grievance mechanisms, protocols and procedures to address community concerns during construction and operation Develop a comprehensive relocation plan to limit disruptions of farming livelihoods
Clarendon Parish development Committee and Benevolent Society	 Potential influx and recruitment of workers from outside the community and 'shutting out' of locals Pollution of water sources and overall impact on water quality Impact of run-off on fauna and fish species in water ways 	 Create employment/job opportunities Provide training and upskilling opportunities for community members Provides an opportunity to support community development Provides the opportunity to improve and develop education programmes focused on sugar 	 Develop a detailed corporate social responsibility programme, Develop procedures and strategy for field operations, which covers protocols, procedures, timelines and schedules for field and factory activities and operations Train and recruit locals for job opportunities

ORGANISATION	ISSUES AND CONCERNS	BENEFITS AND AREAS OF OPPORTUNITY	RECOMMENDATIONS
	 Concerned about soil contamination from use of fertilisers and pesticides Impact of dust emission sources e.g., haulage trucks, burning of bagasse and foul odours from cane fermentation process on air quality Displacement of local jobs in the long-term or reduction in wages Occupational health and safety of field workers, including risk of loss, injury or death during construction and operation The importance of offering proper compensation for farmers to ensure long-term sustainability of project Initial start-up costs for farmers Concerned about farmers and workers not being properly compensated for additional value-added products Concerned about disaster management and safety of workers 	production and agricultural diversification	 Workers should be provided with guaranteed job security, and liveable and attractive salary packages, which include healthcare, occupational health and safety and pension benefits In the project's start-up phase, labourers/farmers should be assisted with initial start-up inputs e.g., fertilizer, tools Appoint a designated community liaison officer to manage community engagement Conduct 'walk-throughs' in communities where project activities will occur and engage in dialogue with residents Develop a comprehensive water and soil contamination monitoring plan Establish grievance mechanisms, protocols and procedures to address community concerns during construction and operation Ensure disaster management protocols, systems and services are extended to farmers and contractors

ORGANISATION	ISSUES AND CONCERNS	BENEFITS AND AREAS OF OPPORTUNITY	RECOMMENDATIONS
			 Partner with small businesses to support entrepreneurship, using mechanisms such as grants, training etc.
JAMPRO		 Create employment/job opportunities Advances technological development and modernizes agricultural production Create linkages across various sectors e.g., transportation, tourism. Increase export and trade revenue (foreign exchange earnings) Increase government revenue (taxes) Support the diversification and expansion of the agricultural sector Provides the opportunity to improve and develop educatio programmes focused on sugar production and agricultural diversification Promotes energy efficiency and use of renewable energy technologies 	n

ORGANISATION	ISSUES AND CONCERNS	BENEFITS AND AREAS OF OPPORTUNITY	RECOMMENDATIONS
SCJ Holdings Limited	Concerned about the impact and damage nomadic cattle farming is having on cane lands	 Support bringing 15,000 acres of cane lands into productive agricultural use Support redevelopment and rehabilitation of irrigation infrastructure and systems Creates the opportunity to introduce a new approach for rearing and management of cattle Supports diversification of sugar industry and agricultural sector with production of a range of value-added products Supports expansion of new export markets for Jamaican made products Promotes energy efficiency and use of renewable energy technologies No burning of cane fields, eliminating the main source of air pollution in field operations 	- Implement security systems and measures to address protection of cultivated areas and factory operations

IMPACT IDENTIFICATION AND ASSESSMENT

This section identifies and assesses the potential and likely impacts and outcomes of the proposed project on the valued social-economic components³⁰ in the project area. Presented using the 'with' or 'without' scenario, the assessment examines the social baseline conditions that are likely to remain unchanged, the types of changes that are likely to occur and the resultant effects on the valued components and social receptors, including their communities, and the systems and services on which they depend, if the proposed project is implemented or there are no interventions in current baseline conditions (Table 19).

The impacts that are identified and assessed are based on the preliminary design concepts for the agro-processing and manufacturing facility. It is anticipated that final detailed designs, including detailed engineering works, may require amendments. Such amendments can be considered during the implementation of the proposed mitigation and monitoring measures, which should be responsive to changes in the project scope and activities.

Table 19: Impact Identification

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
POPULATION -PUBLIC HEAL	TH, SAFETY AND WELL-BEING	
Population Dynamics- Migration	 Without No change to existing baseline conditions. The findings of the consultations revealed ongoing community migration has been a key contributing factor to the shrinking, and unchanged population sizes observed in 	 <u>Construction and Operation</u>: The project presents an opportunity for local skill sets to be utilised, and local capacity developed through training and other capacity building programmes and activities. The project could

³⁰ Valued social-economic components are classified as the fundamental social, economic, cultural/heritage, and environmental elements and features of a community, and its systems that are considered significant and/or valuable and may be affected by the proposed project.

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
	some communities across the study area. Migration from the communities has largely been driven by individuals- mainly belonging to the youth aged population- leaving in search of economic opportunities and improved standards of living.	therefore support talent retention in the community, and potentially slow or reduce the overall pace of migration.
	With	
	Based on the findings of the survey and information gathered from the consultations, most of the labour force in the communities are low-wage workers or workers without advanced formal educational training. The overall data suggests there is unlikely to be sufficient local capacity to fill both non-technical and technical roles during construction and for factory operations. However, it is anticipated that there will be sufficient local capacity to fill more than 50% of the roles required for field operations (cultivation, harvesting and transportation). It is therefore anticipated there will be an inflow of transient workers from outside the communities during the construction phase, mainly from across the island. This is likely to lead to an increased demand for housing, and other local infrastructure and services within the Vere Plain	
	region and other areas providing ease of access to the construction site. Transient workers can also change	
	community and family structures, depending on the number of transient workers and their location of	

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
	origin (i.e., foreigners and non-residents). Workers will be hired for the project during the construction phase. During the operational phase an estimated 10 per cent of workers are expected to be foreigners. Locals from outside the study area are also likely to seek and benefit from employment and other business opportunities.	
Noise and Vibration	 Without No change to existing baseline conditions. anthropogenic sources (conversations, music etc.) and road traffic are the main noise emitting sources across the project area. The baseline noise assessment (Annex 4) results showed average ambient noise levels ranging between 30-74 decibels (dBA) during the daytime.	Construction: The construction period is relatively short, given the scale of the project, and is not expected to exceed 14 months. This will reduce social receptors' length of exposure to noise nuisances. Additionally, construction activities will not be concentrated or take place near community service facilities where vulnerable and key sensitive receptors are located e.g., schools, health centres, day cares etc.
	 With Construction: Given the rural nature of the project area, pre-construction and construction activities (excavation, earthworks, land stripping and clearance, road works and the operation of construction vehicles and equipment) will generate noise emissions that exceed current ambient noise levels within the project area. 	Operation: Sound barrier walls will be erected along property boundaries bordering residential communities. Green spaces/areas will also be created along the roadsides and areas bordering the communities to help in deflecting and absorbing noise.

Negative (Without & With) • Construction related activities are expected to increase noise levels above the discomfort level of 80dBA, reaching between 115-120dBA, based on the typical noise measurement levels for construction vehicles and equipment. However, noise levels are expected to fall to approximately 55-60 dBA in areas located at least 100m from the central construction area. Construction workers are therefore expected to be the		IMPACTS	VALUED SOCIAL AND ECONOMIC COMPONENT
noise levels above the discomfort level of 80dBA, reaching between 115-120dBA, based on the typical noise measurement levels for construction vehicles and equipment. However, noise levels are expected to fall to approximately 55-60 dBA in areas located at least 100m from the central construction area. Construction workers are therefore expected to be the)	Negative (Without & With)	
main social receptors to face direct exposure to construction related noise emitting sources for an extended period and are also the most likely to face the most severe public health threats such as hearing loss. Similarly, informal settlers located on the eastern boundary of the project site are also likely to be impacted by the increase in nuisance noise, if they are not relocated prior to the start of construction, along with the residential population of the Alley community situated on the immediate south and south-western boundary of the site. Sensitive receptors such as children, the elderly and persons with auditory sensitivities, are expected to be the most impacted by changes baseline noise levels in these areas. • Sensitive receptors that are users of community)	• Construction related activities are expected to increase noise levels above the discomfort level of 80dBA, reaching between 115-120dBA, based on the typical noise measurement levels for construction vehicles and equipment. However, noise levels are expected to fall to approximately 55-60 dBA in areas located at least 100m from the central construction area. Construction workers are therefore expected to be the main social receptors to face direct exposure to construction related noise emitting sources for an extended period and are also the most likely to face the most severe public health threats such as hearing loss. Similarly, informal settlers located on the eastern boundary of the project site are also likely to be impacted by the increase in nuisance noise, if they are not relocated prior to the start of construction, along with the residential population of the Alley community situated on the immediate south and south-western boundary of the site. Sensitive receptors such as children, the elderly and persons with auditory sensitivities, are expected to be the most impacted by changes baseline noise levels in these areas.	ECONOMIC COMPONENT

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	rs	
	Negative (Without & With)	Positive (With)	
	 (>500m) from the central construction area, where ambient noise levels associated with construction activities are expected to decline below 50dBA at these locations. The Lionel Town Hospital's location along the main access route to the site is however likely to expose receptors using that facility to temporary noise nuisances caused primarily from the movement of equipment and materials during the construction period. Noise emissions are not expected to pose long-term adverse risks to social (human) receptors in the residential and community facilities found within the project area given: No blasting is anticipated to be required The distance of the receptors from the construction site The relatively short duration of the construction period (13-14 months) The availability of noise mitigation and best practice options and techniques to minimise noise 		
Air Quality	 Without No change to existing baseline conditions. There are no major existing sources that emit the main air pollutants of concern- particulate matter, carbon monoxide, sulfur dioxide and nitrogen dioxide. 	Operation: The agricultural practice of sugarcane burning will not be used for the harvesting of cane. Green cane harvesting is the harvesting method that will be used, and will involve the use of mechanical harvesters. This approach will lead to the reduction in air	

VALUED SOCIAL AND ECONOMIC COMPONENT	: IMPACTS	
	Negative (Without & With)	Positive (With)
	With Construction: Pre-construction and construction activities (, excavation, earthworks, land stripping and clearance, vegetation clearance, the construction of road infrastructure, and the operation of construction vehicles and equipment) will increase the volume of particulate matter and chemicals of potential concerns in the project areas. Construction workers and other workers at the sites are expected to be the most affected by changes in air quality given their direct involvement in construction related activities, and general proximity to dust generating activities. Public health issues of concern associated with fugitive dust and reduced air quality may include irritation of eyes, asthma attacks and other respiratory induced effects such as wheezing, difficulty breathing and coughing. While no adverse health effects related to poor air quality are anticipated for the residential population located within the study area during pre-construction and construction, the increased presence of fugitive air emissions and air emissions from construction and land preparation activities (cane fields) may lead to negative health impacts, particularly for sensitive social receptors with existing respiratory health concerns. Other sensory	pollutants and exposure to air pollution by social receptors located within the study area.

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
	emissions such as odours may also have a similar impact on vulnerable groups.	
	Operation: During the operational phase, human exposure to air pollution emissions, including fugitive emissions will be primarily from the Bagasse Boiler, Diesel Generator and Bagasse Storage and Handling System. Particulate matter from the bagasse stockpile is expected to be the primary source of air pollution which may pose an adverse threat to human health. The use of electrostatic precipitators for particulate removal from the boilers (wood chip firing and bagasse firing) will reduce particulate matter from 2,200 mg/Nm³ to 100 mg/Nm³ (a 95.5% removal efficiency for PM/TSP), controlling the stack PM emissions. Air emission reduction measures will need to be put in place for the generator to ensure compliance with the legal requirements of 0.5% maximum sulphur content (Annex 2).	
Occupational health and	 Without No change to existing baseline conditions. With	Operation: The project is likely to support the introduction of improved operational health and safety standards in the sugar industry with the automation and adoption of advanced
safety	<u>Construction:</u> There is the potential for work place and occupational risks and accidents during the undertaking of pre-construction and construction activities. It is expected that construction workers will	technology. Automation will help to reduce the use of manual labour in tasks and areas with increased exposure to occupational risks, such as harvesting and fertilization.

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
	face the greatest threats given their direct involvement in project related activities, and also the length of exposure time to potential safety risks during the construction period. Injuries from the operation of machinery and equipment, working at elevated heights, handling various types of chemicals and waste materials and vehicular accidents are the occupational hazards and threats most likely to pose health risks to workers. Users of the roadways leading to the project site, which includes pedestrians, motorcyclists and cyclists, may also face potential health and safety risks. Road accidents can occur during the transportation and movement of construction materials and equipment.	
	 Operation: Occupational accidents during field and factory operations are likely. Potential risks to workers may include, but are not limited to: physical injuries from the operation, maintenance and repair of machinery and equipment, and falls associated with working at elevated levels and heights, increased risks of chemical injuries due to exposure to chemical hazards e.g., chemical burns Increased risks of hearing loss due to exposure to high noise levels 	

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS Negative (Without & With) Positive (With)	
	 Increased risks of eye injury from exposure to bagasse and operation of machinery and equipment Biomechanical injuries associated with lifting heavy loads or overextending of muscles and ligaments in arms, legs, shoulders etc. during land preparation, harvesting etc. Road accidents and risks of physical, and psycho-social injuries during transportation of sugar cane. Members of the local population are also likely to face potential occupational health risks associated with the transportation of sugar cane and the movement of heavy equipment. 	
Road Access and Safety	 Without No change to baseline conditions. Some of the roadways previously used by Pan Caribbean are overgrown, and/or in poor condition. With During pre-construction and construction, all materials and equipment will be transported via existing access routes within the study area. Disruptions to the existing transportation service network are expected mainly in the community of Lionel Town- mostly in the 	Operation: Rehabilitation of access roads is expected to improve the overall capacity of the road infrastructure network to support the movement of materials and equipment. Additionally, upgrading of the road infrastructure can help to improve overall access for other users of the local roadways.

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS		
	Negative (Without & With)	Positive (With)	
	main business centre. While periodic and temporary disruptions are expected for road users in the communities where cane fields are situated, these disruptions are not expected to be significant given the volume of traffic and users on the roadways, and the smaller volume of materials and equipment to be transported in those areas. The use of appropriate transportation equipment and adherence to safe loading standards must be met to reduce the likelihood of infrastructure deterioration, and ensure the safety of other users of roadways in the study area.		
Gender based violence and human trafficking	 With Construction is considered a high-risk environment for gender-based violence and harassment (GBVH). The industry remains a largely male-dominated industry, and can attract significant numbers of foreign workers. Incidents of violence within the industry affect workers, community members and service users. Similarly, construction workers are also vulnerable to exploitation and harassment. Labour trafficking remains a concern in Jamaica (US State Department Trafficking in Persons Report, 2024),³¹ and therefore, keen attention will need to be paid to the recruitment and employment procedures used in securing workers. 	 There is an opportunity for information to be disseminated throughout the communities via (i) workers who have undergone training in GBV, sexual harassment and trafficking as part of the project and (ii) the distribution of information leaflets. Jamaica has also recently passed the Sexual Harassment (Protection and Prevention) Act (2021), mandating preventative policies in workplaces. 	

³¹ https://www.state.gov/reports/2024-trafficking-in-persons-report/jamaica/

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
Population Health	 Without No change to baseline conditions. High unemployment rates, high prevalence of poverty and inadequate sources of income have significantly impacted the health outcomes of the resident population in the study area. Food insecurity, concerning levels of malnourishment among the elderly and child-aged population, and mental health challenges-mostly affecting the youth population- are likely to increase in the absence of comprehensive intervention measures and support mechanisms. 	Construction & Operation: The proposed project will create direct and indirect job opportunities and improve income for the resident population in the study area. This is expected to provide individuals and households, particularly vulnerable groups, with the resources to better afford food and healthcare services to meet their basic needs, improve health outcomes, and enhance their way of life.
Social Amenities and Services	Without No change to baseline conditions. Most of the residential population in the study area has access to basic social services and amenities including healthcare, education, and infrastructure. The provision of services and amenities are however inadequate and have not kept pace with the needs of the population. Issues of access and distribution, scarcity of varying types of resources and insufficient investments in the upgrading and expansion of social amenities, services and infrastructure have contributed to the inadequacy of current social services and amenities. With During the construction and operation phase there will be an increased demand on existing social amenities and services. Current inadequacies may impact the	Operation: TSCL has made a commitment to work with local communities through their corporate governance support programmes to identify areas of priority and assist, where possible, in contributing to the sustainable development of the communities.

VALUED SOCIAL AND ECONOMIC COMPONENT	T IMPACTS	
	Negative (Without & With)	Positive (With)
	quality of life and well-being of some workers due to access constraints and other limiting factors. It is therefore important that the relevant services and support that may be needed for workers be identified prior to the start of construction works and coordinating mechanisms put in place to ensure workers can readily access the relevant services, as may be required.	
ECONOMY	·	
Socio-economic Livelihood and Security	• Lack of economic opportunities, inadequate income and increasing poverty have led to a deterioration of socio-economic livelihoods within the communities. The inadequacy of household and individual financial resources has also impacted access to food and key social services, including healthcare and education, which in turn, has adversely affected the well-being of the population. Based on the socio-economic survey 30% of respondents to the survey are seeking employment and more than a half of those employed, are in low-wage jobs, and in some instances vulnerable (informal) jobs. Without intervention, these existing baseline conditions are likely to be exacerbated.	 The project is expected to have a significant impact on the economy and labour force in the communities in the study area and is expected to directly support the socioeconomic livelihoods of more than half of the population residing in the study area as a result of direct and indirect employment and business opportunities. The resumption of sugar manufacturing and the inclusion of new value-added products will also provide an opportunity for diversifying and broadening the economic opportunities that can be derived from the project to support and sustain livelihoods. In the first year of factory operations, TSCL has committed to providing some of the essential inputs needed by farmers to begin

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
		the cultivation of sugar cane. This will include such items as fertilizer and equipment, which will help to lower the start-up costs for farmers engaged indirectly.
Employment and Business Opportunities	 Unemployment, poverty levels and business closures are expected to continue rising sharply, if long-term and sustainable economic opportunities are not created. With Construction projects generally attract a large number of migrant workers, which can limit the opportunities available for local labourers. Given the concerns regarding the literacy and skill level of the local population, it is unlikely, without training and capacity building, locals will be recruited for high-skilled jobs and may have to compete for low-skilled jobs. 	• Employment is a major policy priority of the Government of Jamaica, and the project is expected to create employment and business opportunities for residents and other stakeholders across multiple sectors and industries during the construction and operational phases. The estimated 750 jobs to be supported in the operational phase will increase the employed labour force by 0.05%, based on current total employment nationally (1,473,900). While the impact of the development's operational phase on employment nationally is expected to be negligible, the impact on local employment is expected to have a more significant impact. A maximum of 200 persons will be employed directly at the factory and an estimated 500 labourers and other workers will be employed indirectly for field operations through third party contractor arrangements with four (4) contractors. Ninety percent. (90%) of all workers will be local. In the construction phase employment

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
ECONOMIC COMPONENT		opportunities will be created. Both skilled and unskilled workers are expected to benefi from employment opportunities. It is also expected that workers will be chosen on merit, with opportunities also offered/extended to women and persons with disabilities. • Other Indirect employment opportunities will also be created as a result of the project during the construction and operation phase Based on the magnitude of the impact of Monymusk's direct employment on indirect employment opportunities, it is anticipated that direct employment opportunities created by the project could lead to the creation of twice as many indirect employment opportunities. • Local businesses are expected to accrue revenues and other benefits as a result of the procurement of materials, goods and services. Local sourcing of various raw materials and equipment will ensure support for local suppliers, manufacturers and companies who produce and/or distribute construction materials, goods and services benefit from the project, and extend the socio-economic benefits of the project

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
		beyond the study area. Local community businesses are also likely to receive some benefits from the proposed project as workers on site are likely to patronize nearby community businesses.
Revenue and Tax	WithoutNo change to baseline conditions	 Operation: The GOJ will earn increased revenue through taxation due to the increase in economic activity
Skills Development and Training & Knowledge Sharing	Without ■ No change to baseline conditions.	 Construction and operation: TSCL has committed to providing training and capacity building opportunities aimed at equipping locals to benefit directly and indirectly from the project. This will include training for field and factory workers, which will be done in partnership with HEART-NSTA Trust. Commitments have also been made to implement knowledge sharing programmes aimed at engaging and teaching children about modern agricultural technology and practices. SCJ Holdings Limited as part of its relocation plans for livestock farmers, will undertake training with local farmers, introducing new, and more land efficient animal husbandry farming techniques and practices. Approximately 60-70 farmers will benefit

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS					
	Negative (Without & With)	Positive (With)				
		from the training in the first phase of the relocation plan.				
LAND RESOURCES						
Use, Rights and Access	 Without No change to baseline conditions. SCJ Holdings Limited is the owner of all the lands designated for the proposed project. Presently, pockets of cane field lands are being used informally by farmers to rear animals and by locals to grow castor oil and burn coal. Small areas of land for the proposed project are also occupied by informal settlers. With Informal users and occupants of lands designated for the project will be relocated. Relocation is expected to cause temporary disruption to the livelihood of farmers. However, there is expected to be no long-term access restrictions for farmers, who are currently engaged in stakeholder consultations with the SCJ Holdings Limited regarding the use of other lands owned by the entity for animal rearing. 	 Presently, there are no developments approved and/or being proposed on the lands designated for the project. There are also no existing commercial nor industrial land users and uses that are likely to create potential sources of conflicts. The project will not result in any significant changes to current land use activities and patterns within and immediately surrounding the project areas based on the current tenure status of the lands within the project areas. The use of the lands for agricultural development is expected to continue in the long-term. The proposed development aligns with the land use designation established by the Clarendon Parish Development Order (CPDO). The lands proposed as the location for the sugar factory has been designed for heavy industrial use in The Lionel Town Local Planning Area Land Use Plan. All land areas identified for sugar cane cultivation by the project are land areas designated for agricultural use in the CPDO. 				

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
INFRASTRUCTURE AND SER	RVICES	
Access Road infrastructure	WithoutNo change to baseline conditionsWithNone	 Construction: The project will result in the rehabilitation of access roads within the study area, which could support and improve the overall accessibility and safety of the road network for other users of the local roadways.
Water Supply	Without No change to baseline conditions	Construction and Operation: There will be no demand on existing potable water supplies provided to the communities by the National Water Commission to support the operation of the factory. Forty-three (43) wells and four (4) pumps owned by the SCJ Holdings Limited/National Irrigation Commission, and previously used by the defunct Monymusk Sugar Factory, will be rehabilitated to meet the water needs of the project in the construction and operation phases (factory and field operations).
Waste Management	 Without No change to baseline conditions. With Construction: During the pre-construction and construction phases of the project, varied types, and fairly moderate volumes of solid waste are likely to be 	 Operation: Several treatment plants will be constructed and operated onsite at the factory. This will include an effluent treatment plant to treat wastewater generated from the industrial processes sewage treatment plant to treat domestic wastewater

Negative (Without & With) generated. Solid waste will be generated as a result of civil construction/works, earth works and domestic activities. Solid waste is likely to include: Construction debris: vegetation, soil, rocks and other excavated materials; construction materials and packaging; cardboard, plastics, paper, wood, Styrofoam, metals etc.; food waste; Organics (food), recyclables and food packaging. Poor containment and stockpiling of solid waste can result in the pollution of land and water resources, which is also likely contribute to a reduction	
civil construction/works, earth works and domestic activities. Solid waste is likely to include: Construction debris: vegetation, soil, rocks and other excavated materials; construction materials and packaging; cardboard, plastics, paper, wood, Styrofoam, metals etc.; food waste; Organics (food), recyclables and food packaging. Poor containment and stockpiling of solid waste can result in the pollution of land and water	
 in the visual aesthetics of the landscape. The operation of construction facilities for workers e.g., shower and bathroom facilities, if put in place, will lead to the generation of wastewater, including sewage. Additionally, activities involving the use of water for equipment and vehicle (fleet) maintenance and dust control will lead to wastewater generation. Measures and facilities must be put in place to ensure wastewater is not released in any surface water sources. Rehabilitation of access roads will require the use of hazardous materials. Petroleum products and other chemicals are expected to be the most utilised hazardous materials. Hazardous materials can also be 	

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS						
	Negative (Without & With)	Positive (With)					
	materials have the potential to result in contamination of soil and the terrestrial and marine environments, resulting in pollution of water and resources, and possibly public health impacts for community members.						
Renewable Energy (Irrigation and Water Supply System)	With and without No change to baseline conditions	Operation: TSCL will undertake the rehabilitation of the irrigation and water supply system used previously by Monymusk. As part of the rehabilitation, the proponents will install wind and solar powered pumps. The use of renewable energy to support agricultural production is in line with previous policy commitments by the Government of Jamaica. The construction and operation of solar and wind farms are also being considered for future investments in the project area.					
Housing and Resettlement	 Without No change to baseline conditions. Former worker housing and accommodations (sugar barracks) remain in a desolate state, and have been deemed unsuitable for human occupation. 	Construction: SCJ Holdings Limited will be undertaking a relocation programme that is expected to result in the relocation of seventeen (17) families currently informally occupying lands which have been designated as the proposed site for the sugar factory. Inventory assessments conducted by the SCJ have shown restoration of the former sugar					

³² https://www.moa.gov.jm/node/1332

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS			
	Negative (Without & With)	Positive (With)		
	 Construction: The proposed project is expected to lead to the resettlement of seventeen (17) families from the community of Lionel Town. The community of Springfield, Clarendon, has been identified as the resettlement site, a former resettlement under the Sugar Barracks Relocation Programme. Limited access to critical services- water, electricity, transportation and education- and lack of economic opportunities have been identified by community members as challenges faced by families resettled in the community under the previous relocation programme. Faced with these challenges, some families returned to areas where they originally resided, leaving behind vacant houses- some of which have been subjected to vandalism. To support the successful integration of families to be resettled, mechanisms must be put in place to address issues related to service accessibility, economic opportunities and housing security. 	barracks is not cost-effective, and the dilapidated state of the houses (sugar barracks) have made them unsuitable for human occupation. SCJ Holdings Limited is seeking to partner with Food for the Poor to provide housing assistance and/or support to the families. Although relocation plans and arrangements have not yet been finalised, the resettlement exercise is expected to improve housing standards for the impacted families. Access to other essential services will be needed to ensure successful integration of the families. Operation: If necessary, TSCL has indicated a small number of housing units will be constructed and provided for technical staff at the factory.		
Agriculture Infrastructure	Without: No change to baseline conditions	Construction: The proposed project will see US\$40 million invested in the development of the factory. This investment will serve to enhance and modernize agricultural facilities and infrastructure, increase food processing capacity, promote and diversify agri-		

VALUED SOCIAL AND ECONOMIC COMPONENT	IMPACTS	
	Negative (Without & With)	Positive (With)
		businesses, create jobs, and build capacity and competitiveness of local small farmers.
SECURITY AND VIOLENCE		
Crime (gang activity)		
	Gang activity and incidents of violence are issues in the community of Lionel Town. Incidents of gang violence and crimes have been occurring with greater frequency in the community in the past 5 years. High prevalence of poverty and high levels of unemployment have been identified as two of the factors driving the surge in criminal and gang-related activities.	Operation: The project provides an opportunity for additional corporate governance support in the communities. The overall support can assist in (i) improving and enhancing community engagement, (ii) increasing support for local initiatives that can address community needs (iii) increasing support for education and social service interventions and (iv) promoting sustainable development practices to benefit the long-term well-being of the community and its members. It also presents various social and economic opportunities that could support youth engagement.

Presented in Table 20 and Table 21 is a classification of the impacts in the construction and operational phases of the project. The impact analysis examined the relative importance of the issues through the application of an impact matrix, and presents the significance rating for each impact identified from the reference scenario in Table

There are three (3) major/high social negative impacts associated with the construction phase of the project and one in the operational phase. There are two (2) major/high positive impacts identified in the construction phase and five (5) in the operational phase.

Table 20: Significance Social Impact Classification in the Construction Phase

SOCIAL- ECONOMIC COMPONENT	DIRECTION	MAGNITUDE	GEOGRAPHIC EXTENT	DURATION	FREQUENCY	REVERSIBILITY	SIGNIFICANCE/IMPACT RATING
POPULATION -PU	BLIC HEALTH, SAF	ETY AND WELL-BE	ING		-		
Population dynamics- migration	Negative	Low	Local	Short-term	Infrequent	Yes	Minor
Noise Nuisances & Emission	Negative	Low	Local	Short-term	Continuous	Yes	Minor
Air Quality	Negative	Moderate	Local	Short-term	Continuous	Yes	Minor to Moderate
Road Access and Safety	Negative	Medium	Local	Short-term	Continuous	Yes	Moderate
Waste	Negative	Medium	Regional	Short-term	Continuous	Yes	Moderate
Occupational Health and Safety	Negative	High	Local	Long-term	Continuous	No	Major
Gender-Based Violence and Sexual Harassment	Negative	High	Regional	Long-term	Infrequent	Yes	Major
Population Health	Neutral	low	Local	Short-term	continuous	Yes	Minor
ECONOMIC							
Socio-economic Livelihood and Security	Positive	Moderate	Local	Short-term	Continuous	Yes	Moderate (locally)

SOCIAL- ECONOMIC COMPONENT	DIRECTION	MAGNITUDE	GEOGRAPHIC EXTENT	DURATION	FREQUENCY	REVERSIBILITY	SIGNIFICANCE/IMPACT RATING
Employment and Business Opportunities	Positive	Moderate	Regional	Short-term	Continuous	Yes	Major (locally)
Skills Development and Training	Positive	High	National	Long-term	Continuous	No	Major
LAND AND RESOL	IRCE USE						
Use, Rights and Access	Neutral	Low	Local	Short-term	Infrequent	Yes	Negligible
INFRASTRUCTURE	AND SERVICES	<u>:</u>	<u>:</u>	<u>i</u>	<u>:</u>	<u>i</u>	
Water supply	Neutral	Negligible	Local	Short-term	Continuous	Yes	Negligible
Waste	Negative	Moderate	Local	Short-term	Continuous	Yes	Major
Housing and Resettlement	Neutral/Negative	Low	Local	Short-term	Infrequent	No	Minor to Moderate
SECURITY AND VI	OLENCE		4		de .		
Crime	Negative	Low to medium	Local	Short-term	Infrequent	Yes	Minor-Moderate

Table 21: Significance Social Impact classification in the Operational Phase.

SOCIAL- ECONOMIC COMPONENT	DIRECTION	MAGNITUDE	GEOGRAPHIC EXTENT	DURATION	FREQUENCY	REVERSIBILITY	SIGNIFICANCE/IMPACT RATING
POPULATION -PU	BLIC HEALTH,	SAFETY AND WE	LL-BEING				
Population dynamics-migration	Positive	Low to moderate	Local	Medium term	Continuous	Yes	Minor to moderate
Noise Nuisances & Emission	Neutral	Low	Local	Long-term	Continuous	Yes	Minor
Air Quality	Neutral	low	Local	Long-term	Continuous	Yes	Minor
Road Access and Safety	Positive	Low	Regional	Long-term	Continuous	Yes	Minor
Waste	Negative	low	Local	Long-term	Continuous	Yes	Minor to Moderate
Occupational Health and Safety	Negative	High	Local	Long-term	Continuous	No	Major
Population Health	Positive	High	Local	Long-term	Continuous	Yes	Major
ECONOMIC							
Socio-economic Livelihood and Security	Positive	High	National and Local	Short-term	Continuous	-	Negligible (nationally) Major (locally)
Employment and Business Opportunities	Positive	High	National and Local	Long-term	Continuous	-	Negligible (nationally) Major (locally)
Revenue and Tax	Positive	Low	National	Long-term	Continuous		Minor to Moderate

SOCIAL- ECONOMIC COMPONENT	DIRECTION	MAGNITUDE	GEOGRAPHIC EXTENT	DURATION	FREQUENCY	REVERSIBILITY	SIGNIFICANCE/IMPACT RATING
Skills Development and Training	Positive	High	National and Local	Long-term	Continuous	-	Negligible (nationally) Major (locally)
INFRASTRUCTUR	RE AND SERVIC	ES					
Water supply	Neutral	Negligible	Local	Long-term	Continuous	Yes	Negligible
Waste	Negative	Low	Local		Continuous	Yes	Minor
SECURITY AND VIOLENCE							
Crime	Positive	High	National	Long-term	Continuous	Yes	Major

MITIGATION AND MONITORING

STAKEHOLDER ENGAGEMENT

Communication and information sharing with stakeholders is a very critical component of the project. Information regarding the project should be clear, concise and easily accessible. The information shared should include at a minimum, project activities to be undertaken, the potential negative and positive impacts of the proposed project, and the available mitigation options to address adverse impacts. This communication process is important in keeping stakeholders, and community members engaged throughout the project development process. A stakeholder engagement plan should be prepared for the preconstruction, construction and operational phase of the project to facilitate ongoing dialogue between the developers, key stakeholders, community members and the general public on the benefits and challenges of the project. The plan, in addition to describing the types of engagement strategies to be employed, the resources and responsibilities required for implementation, should also outline a grievance mechanism that will be implemented to receive, record and address complaints which may arise during construction of the project, and if required, the operational/maintenance phase.

Prior to the start of construction, a construction schedule should be made available to the public.

AIR QUALITY

To offset and alleviate public health threats associated with reduced air quality, steps must be undertaken to manage the various types of air emissions. Proposed measures to protect community members and workers against adverse threats should include at a minimum.

- The provision of approved personal protective equipment for workers e.g., N95 masks
- The use of dust screens to section off work areas and the covering and periodic wetting
 of excavated areas soil, aggregates and other earth and construction materials on site
- The covering of vehicles transporting aggregates and other earth materials to prevent exposure along the network of access routes leading to the project areas. During dry periods, the wetting of access roads and disturbed areas is recommended to reduce dust generation.
- Inspection of project construction vehicles to ensure engines and exhaust systems are functioning and have been properly maintained. It is recommended that vehicles and equipment showing excessive emissions of exhaust gases do not operate until repairs are carried out.
- Timely disposal of waste
- Suspension of construction activities during periods of excessive winds, if dust suppression measures are inadequate
- During operation, trucks transporting ash from the factory should be properly covered to minimize the erosion of fugitive dust along transport routes.

Noise

Construction noises are expected to exceed baseline conditions and it is therefore proposed that noise barriers and/or temporary sound walls be erected to reduce noise nuisance exposure, where necessary. The construction schedule should take into consideration traditional sleep hours and aim to carry out construction activities during reasonable hours. This can be determined following further consultation with locals and based on the requirements outlined in local laws.

To protect workers, all requisite personal protective equipment (PPE) e.g., noise cancelling earphones and/or ear plugs must be provided. The contractor in charge should also ensure all PPE are worn properly and at all times.

During operation, factory operations should implement OSHA's recommended permissible exposure limits for noise to minimize hearing losses.³³

WASTE MANAGEMENT

It is expected that site preparation and other construction related activities can result in the pollution of the physical and biological environment and the surrounding land areas within close proximity to project site. Increased run-off also has the potential to increase the presence of polluting agents within these environments, posing a direct public health threat to residents who are users of these resources.

Proper waste management is therefore crucial for limiting land and water pollution at the project sites. It is therefore recommended that a Waste Management and Pollution Control Plan be prepared. The plan should outline the methods and procedures that will be employed to address the proper containment and safe disposal of polluting agents that will be generated as a result of construction. This includes land clearance residue (soil and vegetation), solid waste (construction materials, packaging materials, food items etc.), liquid waste (wastewater) and hazardous waste (fuels/oils, chemicals, flammable materials etc.). Specific mitigation measures to be considered in protecting human health include:

- The separation of solid waste materials into organics, recyclables and garbage on site, prior to disposal. Recyclables can be disposed of at approved recycling centres, if available.
- Containment of garbage and construction debris onsite until disposal at an approved local disposal site using receptacles/bins with lids that can be secured to prevent unwanted intrusion by feral animals
- Periodic emptying of waste bins/receptacles to prevent the overflow of solid waste
- Prohibiting burning of solid waste on project site.
- Providing portable sanitary conveniences and showers onsite for workers. Portable toilets and showers should be connected to an onsite drainage system attached to

³³ **OSHA PEL:** OSHA's permissible exposure limit for noise is 90 dBA averaged over an 8-hour workday. **NIOSH REL:** NIOSH recommends limiting noise exposure to 85 dBA over an 8-hour workday

temporary wastewater storage tanks or utilise the services of a reputable company that should only dispose of sewage at an approved municipal treatment plant. In the absence of approved treatment systems, alternative arrangements should be made with the local authorities for the safe disposal of effluent/liquid waste

- Clear labelling of all facilities designated for the storage of hazardous waste and separation and storage of hazardous according to manufacturing requirements.
- Training of all workers in the handling, use, care, storage and disposal of hazardous materials
- Hazardous materials must be separated and stored according to manufacturers' requirements
- Prior to construction and in consultation with residents and key government stakeholders, develop an Emergency Preparedness and Response Plan and training plan for all emergencies, including responding to spills

ROAD ACCESS AND SAFETY

Construction vehicles and equipment should aim to limit the use of the local roadway during peak periods when pedestrians are frequenting the roadways to ensure minimal disruption to community members. This includes early morning between 7:30-8:00am when children are walking to school and afternoons, between 3:00-4:00p.m. when children are leaving school. Persons who will be tasked with operating construction vehicles and equipment should be properly trained, with designated drivers and operators mandated to provide official proof of their qualifications to operate construction related vehicles and equipment before being hired. Speed limits of no more than 30 kilometres per hour should be implemented on controlled roads for construction to limit noise, fugitive dust, and reduce risks of accident. It is also recommended that safety and traffic signage be erected along access routes leading to the construction sites, alerting both locals and visitors of ongoing roadway use. Flag persons should also be designated to assist with coordinating vehicular and pedestrian movements. It is also recommended that safety and traffic signage be erected along the single access route leading to the construction site, alerting both locals and visitors of ongoing roadway use.

Finally, it is recommended that a road usage and safety plan be developed by the contractor and reviewed by the relevant authorities to support the project. The plan should outline safety measures and the type of alternative access routes which will be put in place to ensure there are access restrictions for current users and no threats to the overall safety of residents. The timing of construction activities and the utilisation of the roadways for the movement of materials and equipment should also be included.

EMPLOYMENT OPPORTUNITIES

A job recruitment programme should be developed for the project to identify locals who may possess the requisite skill sets required by the project. Though all qualified candidates should be considered under the programme, preference should first be given to qualified candidates who are residents within the study area. As part of a broader social responsibility

platform, training and skills development opportunities being offered as part of the project, should also give first priority to residents in the study area. These requirements should be included in any agreement made between the agency with responsibility for project implementation and the selected contractor.

The programme should also prioritise diversity and inclusivity to reach a broader pool of candidates. Gendered descriptions which have traditionally been used within the construction industry should be eliminated. This will help to ensure locals and members of both sexes, including persons with disabilities are given priority consideration for job opportunities. It is proposed that locals, both men and women, with the requisite skill sets be offered, where possible, specialised training prior to the start of the project that can help them to secure employment in the construction phase of the project, and if required, for the monitoring and management phase of the coastal infrastructure.

TRAINING AND CAPACITY BUILDING

It is important that local skilled and unskilled labourers are actively recruited and engaged in capacity building exercises, which will provide them with an opportunity to benefit both directly, and indirectly from the proposed project.

SAFETY AND SECURITY

Security measures, procedures and protocols should be established to help safeguard field and factory operations, protect against threats and ensure the protection and safety of workers. Consideration should be given to the following security features:

- Surveillance systems for monitoring, including motion detectors, cameras
- Security fencing: gates and barriers
- Access control systems to control entry and exits
- Anti-climb devices, such as spikes and thorny bushes/shrubs
- Security guards

MONITORING PROGRAMME

It is the responsibility of the project manager and contractor to ensure all mitigation measures recommended during the pre-construction and construction phase are implemented and monitored to ensure compliance and reduction in the potential severity of negative impacts on social receptors, particularly vulnerable groups. Periodic audits of construction activities are to be undertaken, and identified issues resolved in a timely manner. During the operational phase of the project, Tropical Sugar Company Limited, through its designated representative(s), has responsibility for the monitoring and management of factory and field operations to ensure continued functionality and safety for workers and community members. The representative(s) should develop a monitoring (follow up) Plan to monitor the effects of the project on the socio-economic conditions of residents in the study area as a result of field and factory operations, and where required, develop measures if any adverse effects of the project are noted. The results of all

monitoring exercises should be communicated according to reporting procedures outlined in the communication plan established for project monitoring.

RESETTLEMENT

A resettlement plan and community engagement programme should be prepared, outlining the approach to managing the relocation of families in Lionel Town. The plan should include but not limited to: overview of persons to be impacted by relocation, compensation and rehabilitation measures, resettlement schedule, grievance mechanism and community engagement strategy. The plan should also be developed with a human rights and gendersensitive approach to ensure the equitable treatment of marginalized and vulnerable groups.

RECOMMENDATIONS

- Conduct community walk-throughs/walk abouts and engage residents in dialogue regarding the proposed project. This is important to get buy in and local support, and to gain a more in-depth understanding of community structures, priorities and areas for further development. It is also recommended that dialogue and consultations be held with other business operators in the area to garner additional insight on community structures, dynamics, decision-making processes, and development initiatives, interventions and challenges.
- Develop a corporate social responsibility framework and policy to guide operations and establish a committee to manage and oversee social risks and opportunities
- Appoint a designated community engagement/liaison officer to help drive CSR efforts in surrounding communities.
- Develop a Security Management Plan

CONCLUSIONS

Project aligns with the Government of Jamaica's economic priorities of achieving sustained economic growth and long-term development through economic diversification.

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Appendix 1: Proposed Interviewees

Name	Position	Contact Information
Municipal Representatives	3	
Joel Williams	Mayor- Clarendon	Email: j.williams.78@hotmail.com Phone: 876-582-0967 (876-353-2058, Ms. Mitchell-Asst)
Kijana Johnson	Councillor-Race Course Division	Email: kijanajohnson47@gmail.com Phone: 876-426-9875
Winston Maragh	MP-	Email: wmaragh@hotmail.com Phone: (D)876-375-0139
Nearby Businesses		
Clarendon Distillers Ltd- Suzette Latchman	AEHS Officer	Email: slatchman@monymuskrums.com Phone: 876-407-2673
Jamalco- Andrea Spence	EHS Director	Email: andrea.spence@jamalco.com Phone: 876-986-2561
Jamaica Aggregates- Junior Subratie	Senior Supervisor	Email: <u>subratiejun@yahoo.com</u> Phone: 876-599-0265 (O); 876-362- 3970 (C)
New Yarmouth Estate- Sean Davis	Distillery Manager	Email: Sean.Davis@campari.com Phone: 876-471-6352
SCJ Holdings- Nigel Myrie	Manager, Land and Lease	Email: nmyrie@scjholdings.gov.jm
3CJ Holdings- Nigel Wylie	Management Management	Phone:876-360-6828
01 1 01 1 6	D :1	
Clarendon Chamber of Commerce- Winsome Witter	President	Email: maypenchamber of commerce@gmail.com Phone: 876-871-8960
Hanif Brown	Cousins Construction (representing the MPCC)	Email: hanif.brown@bushville.biz Phone: 876-383-4276
NGO's		
C-Cam*- Ingrid Parchment	Executive Director	Email: <u>iparchment@yahoo.com</u> Phone: 876-986-3344 (O); 876-383- 2184 (C)
Clarendon Parish Development Committee- Eurica Douglas	General Manager	Email: <u>clarendonpdcbs@yahoo.com</u> Phone: 876-876-442-3007/ 876 430 - 0347(Digi); 876-898-5570
Hospital	1	
Lionel Town Hospital- Nadine Preddie	CEO	Email: <u>Nadine.preddie@srha.gov.jm</u> Phone:876-986-3226 (O); 876-318-0470 (CUG)

Name	Position	Contact Information
JAMPRO- Marlene Porter		Email:
		mporter@dobusinessjamaica.com
		Phone: 876-579-7652
Noel McLean- TSCL	Director	Email: noelgmmclean@gmail.com
		Phone: 876-832-7868
Dr. Edward Wright		Email: edwardlc6@msn.com
Beverly Boothe	Parish Coordinator- Milk	Email: beverlyboothe2020@gmail.com
	River/Springfield Area	Phone: 876-396-4062

ANNEX 6

Water Quality Sampling Certificates of Analysis 2024

Table 1: Monthly Water Sample Codes - COA

Month	Top Surface (Sand Mine)	Middle Surface	Bottom Surface	Middle Well
January 25, 2024	2	3	1	4
February 27, 2024	1	4	3	2
March 26, 2024	3	1	2	PW3
April 24, 2024	1	2	3	4
May 28, 2024	3	2	4	1
June 26, 2024	1	2	3	PW3
July 25, 2024	4	1	2	3
August 28, 2024	4	3	2	1
September 25, 2024	2	3	1	PW3
October 31, 2024	2	4	1	3
November 28, 2024	-	2	-	PW2
December 11, 2024	2	3	1	PW3

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745

E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24012532-35 & 37-39

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number:	24012532-39
SPN:	-
Date of Report:	03/05/2024
Revision Date:	Not Applicable
Sample(s) Collected:	25/01/2024
Sample(s) Submitted:	25/01/2024
Temperature on Arrival:	2.5°C
Number of Samples:	8
Analysis Started:	25/01/2024
Analysis Completed:	22/02/2024
Prepared By:	Reena McKenzie, Quality Management Systems Manager
Verified By R. Stephen	3. Approved By
Raheem Stephens,	Jaidene Webster-Jones,

Chemistry Analyst

Quality Control Officer

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: 2 (Surface Water) $-\Box C(B) \boxtimes C(C) \Box C(L)$

Sumple ID (Matrix) Que	anner. 2 (Buria			
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	259 @ 24.5°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.04	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	11 9020	4.8	D(D)	0.1 - 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	1.1	P(P)	-
Sulfate (mg SO4 ²⁻ /L)	H-8051	25	E(M1), P(1)	3.0 - 10.0
Total Suspended Solids (mg/L)	SM-2540 D	3.9	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	21	P(P)	-
Chloride (mg Cl ⁻ /L)	H-8206	40.1	P(1)	5.0 – 20.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.6	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	1229	P(P), P(1), D(C)	740-5000
Zinc (μg Zn/L)	EPA 200.7	<11.8	P(P), P(1), BDL	
Iron (μg Fe/L)	EPA 200.7	155	P(P), P(1)	
Lead (μg Pb/L)	EPA 200.7	28.2	P(P), P(1), D(I)	
Copper (µg Cu/L)	EPA 200.7	10.1	P(P), P(1)	

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: 3 (Surface Water)

 $-\Box C(B) \boxtimes C(C) \Box C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	22900 @ 24.0°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.04	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	6.6	E(M1) D(D)	0.1 - 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	1.5	E(M1), P(P)	-
Sulfate (mg SO4 ²⁻ /L)	H-8051	1200	E(M1), P(1), D(C)	3.0 - 10.0
Total Suspended Solids (mg/L)	SM-2540 D	12.9	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	20	P(P), D(I)	-
Chloride (mg Cl ⁻ /L)	H-8206	11600.0	D(C), P(1)	5.0 – 20.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.3	E(M3)	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	236086	P(P), P(1), D(C)	740-5000
Zinc (µg Zn/L)	EPA 200.7	<11.8	P(P), P(1), E(M3), BDL	-
Iron (μg Fe/L)	EPA 200.7	156	P(P), P(1), E(M3)	-
Lead (μg Pb/L)	EPA 200.7	58.9	P(P), P(1), D(C)	-
Copper (µg Cu/L)	EPA 200.7	10.1	P(P), P(1), E(M3)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: 1 (Surface Water)

 $-\Box C(B) \boxtimes C(C) \Box C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	30400 @ 24.4°C	-	120.0 – 300
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	0.03	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	11 2020	8.4	E(M1) D(D)	0.1 - 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	1.9	E(M1), P(P)	-
Sulfate (mg SO4 ²⁻ /L)	H-8051	1600	E(M1), P(1), D(C)	3.0 - 10.0
Total Suspended Solids (mg/L)	SM-2540 D	8.1	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	80	P(P), D(I)	-
Chloride (mg Cl ⁻ /L)	H-8206	16200.0	D(C), P(1)	5.0 – 20.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.6	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	337715	P(1), P(P), D(C)	740-5000
Zinc (μg Zn/L)	EPA 200.7	23.4	P(P), P(1), E(M3)	-
Iron (μg Fe/L)	EPA 200.7	125	P(P), P(1), E(M3)	-
Lead (μg Pb/L)	EPA 200.7	74.0	P(P), P(1), D(C)	-
Copper (µg Cu/L)	EPA 200.7	22.9	P(P), P(1), E(M3)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: 4 (Surface Water)

 $-\Box C(B) \boxtimes C(C) \Box C(L)$

				NRCA
Parameters (Unit)	Test Method	Results	Qualifier	AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	1252 @ 24.8°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.12	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	9.7	E(M1), D(C),	0.1 - 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	2.2	P(P)	-
Sulfate (mg SO ₄ ² -/L)	H-8051	73	E(M1), P(1), D(C)	3.0 - 10.0
Total Suspended Solids (mg/L)	SM-2540 D	<1.6	BDL	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	15	P(P)	-
Chloride (mg Cl ⁻ /L)	H-8206	356.0	D(C)	5.0 – 20.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	0.5	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	4144	P(P), P(1)	740-5000
Zinc (μg Zn/L)	EPA 200.7	<11.8	P(P), P(1), BDL	-
Iron (μg Fe/L)	EPA 200.7	<12.9	P(P), P(1), BDL	-
Lead (μg Pb/L)	EPA 200.7	7.9	P(P), P(1)	-
Copper (µg Cu/L)	EPA 200.7	<5.3	P(P), P(1), BDL	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent)

 $-\Box C(B) \boxtimes C(C) \Box C(L)$

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.30 @ 23.1°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	71.60	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	6071.4	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	95750	D(C), P(P)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	8010	P(1), D(C), E(M3)	<30
Potassium (g K/L)	EPA 200.7	5.68	P(P), P(1), D(C)	-
Zinc (μg Zn/L)	EPA 200.7	1470	P(P), P(1), D(C)	-
Iron (μg Fe/L)	EPA 200.7	57170	P(P), P(1), D(C)	-
Lead (µg Pb/L)	EPA 200.7	2439	P(1), P(P), D(C)	-
Copper (µg Cu/L)	EPA 200.7	3564	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D2 (Trade Effluent)

 $-\Box C(B) \boxtimes C(C) \Box C(L)$

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.35 @ 23.0°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	89.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	20666.7	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	148000	D(C), P(P)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	17326	P(1), D(C)	<30
Potassium (g K/L)	EPA 200.7	9.54	P(P), P(1), D(C)	-
Zinc (μg Zn/L)	EPA 200.7	1823	P(P), P(1), D(C)	-
Iron (μg Fe/L)	EPA 200.7	64366	P(P), P(1), D(C)	-
Lead (µg Pb/L)	EPA 200.7	2267	P(P), P(1), D(C)	-
Copper (µg Cu/L)	EPA 200.7	7395	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D3 (Trade Effluent)

 $-\Box C(B) \boxtimes C(C) \Box C(L)$

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.17 @ 23.1°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO4 ³ -/L)	H-8048	63.50	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	12000.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	92500	D(C), P(P)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	14256	P(1), D(C)	<30
Potassium (g K/L)	EPA 200.7	6.94	P(P), P(1), D(C)	-
Zinc (μg Zn/L)	EPA 200.7	1543	P(P), P(1), D(C)	-
Iron (μg Fe/L)	EPA 200.7	54548	P(P), P(1), D(C)	-
Lead (µg Pb/L)	EPA 200.7	2774	P(P), P(1), D(C), E(R)	-
Copper (µg Cu/L)	EPA 200.7	22391	P(P), P(1), D(C)	-

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Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: T. Thompson, J. Webster-Jones, S. Crooks Date of Analysis: 26/01/2024

Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Crooks Date of Analysis: 25/01/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909 – 928	918	24.7

Parameter: pH (DR)

QEHL Personnel: S. Crooks Date of Analysis: 25/01/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 – 4.04	4.02	22.7
6.90 - 7.10	7.02	22.7
9.96 - 10.04	10.04	22.9

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: R. Stephens Date of Analysis: 26/01/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
PD		30.7	1.9
BD		31.3	1.9
SRS	68.7-85.9	78.0	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: J. Williams Date of Analysis: 25/01/2024

	Standard Concentration (mg PO4 ³⁻ /L)	Determined Concentration (mg PO ₄ ³ -/L)	RPD (%)
MB		< 0.02	
RB		< 0.02	
DD.		70.00	2.92
BD		72.00	2.82
SRS	1.95-2.05	1.98	

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Parameter: Turbidity (EPA 180.1)

QEHL Personnel: J. Williams Date of Analysis: 25/01/2024

	Standard Concentration (NTU)	Determined Concentration (NTU)	RPD (%)
BD		0.65	1.5
שם		0.66	1.3
SRS	9.0 - 11.0	10.6	

Parameter: Sulfate (H-8051)

QEHL Personnel: R. Stephens Date of Analysis: 26/01/2024

	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ²⁻ /L)	RPD (%)
MB		<1	
BD		335	1 5
ΒD		340	1.3
SRS	62-66	63	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 31/01/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<11	
PD		497	0.4
BD		499	0.4
SRS	488-512	503	

Parameter: Fats, Oil and Grease (EPA 1664B)

QEHL Personnel: S. Robinson Date of Analysis: 30/01/2024

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 31/01/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
BD		40	2.5
שם		41	2.5
SRS	121-129	121	

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Parameter: Chloride (H-8206)
OFHI Personnel: R Brown

QEHL Personnel: R. Brown		Date of Analysis: 26/01/2024		
	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration	RPD (%)	
MB	(lilg C1/L)	(mg Cl ⁻ /L) <3.0		
RB		<3.0		
BD		5.3	1.9	
BD		5.2	1.9	
SRS	97.0-103.0	100.4		

Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Ford Date of Analysis: 26/01/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.8	
RB		0.7	
DD		< 0.3	
BD		< 0.3	-
SRS	8.6-11.4	11.2	

Parameter: Total Coliform (SM-9221)

QEHL Personnel: K. Williams Date of Analysis: 25/01/2024

Media/Test Item (Batch #)	DS LTB (23/01/2024)	BG (26/01/2024)
Sterile (Yes/No)	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical

Parameter: E. coli (SM 9221)

QEHL Personnel: K. Williams Date of Analysis: 25/01/2024

		· · · · · · · · · · · · · · · · · · ·
Media/Test Item (Batch#)	DS LTB (23/01/2024)	EC MUG (11/01/2024)
Sterile (Yes/No)	Yes	Yes
Media performance (Typical, not typical)	Typical	-

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Standard Additions

QEHL Personnel: R. Ford Date of Analysis: 26/01/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
	Standard		2.5	1.7	68
addition	addition	1.1	5.0	3.5	70
	checks*		7.5	5.3	71

^{*}Equation of the line y = 0.708x + 1.07

Standard Additions

QEHL Personnel: R. Ford Date of Analysis: 26/01/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
Standard addition checks*	1.4	2.5	1.8	72	
		5.0	3.7	74	
	checks*		7.5	5.5	73

^{*}Equation of the line y = 0.736x + 1.39

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla

 $*Additional\ Quality\ Control\ Information\ can\ be\ provided\ upon\ request.$

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 20/02/2024

*Additional Quality Control Information can be provided upon request.

Date of Analysis: 31/01/2024

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Glossary

%	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA	Bile Esculin Azide Agar
BG	Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BSA	Bismuth Sulfite Agar
C(D)	parameter analysed in the field
C(B)	Samples collected by the client and picked up by an ESL bearer
C(C)	Samples collected by the client and delivered to ESL
C(H)	Analytical sample submitted in incorrect container. This may affect data quality.
C(L)	Samples collected by ESL
C(S) CFU	Sample collected by the client then sub-sampled and delivered by ESL. Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
Col	Compendium of Methods for the Microbiological Examination of Foods Colourimetry
CVAAS	Cold Vapour Atomic Absorption Spectroscopy
D(I)	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D (C)	Sample diluted due to high concentration of target analyte
DR	Direct Reading
DS ADB	Double Strength Azide Dextrose Broth
DS LTB	Double Strength Lauryl Tryptose Broth
DS PAB	Double Strength Pseudomonas Asparagine Broth
EB	Equipment Blank
E(E1)	Estimated Value. Data acquisition affected by equipment malfunction.
	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this
E(L1)	may be affected by same bias.
E(L2)	Estimated Value due to the nature of the sample matrix.
E (M 1)	Estimated Value. Result calculated using calibration curve.
E(M2)	Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
	recovery.
E(M3)	Estimated Value. Sample performance indicate presence of interference
E(R)	Estimated Value. RPD value was outside control limits.
EC	E. coli Media
E(V)	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EC-MUG	E. coli Media with 4- m ethyl u mbelliferyl-β-D- g lucuronide
EHU	Environmental Health Unit
EPA	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy
FAES	Flame Atomic Emission Spectroscopy
FB	Field Blank
FD FL DDO	Field Duplicate
FL-PRO	Florida Petroleum Range Organic Method
GC-MS	Gas Chromatography Mass Spectrometry Health Water Applying Workhook
H H(A)	Hach Water Analysis Workbook
H(A)	Off-scale high data obtained. Actual value may be greater than value given.
ICP ISE	Inductively Coupled Plasma Ion Selective Electrode
ISE	ion Selective Electrode

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	(00-0.110.11
LCA	Listeria Chromogenic Agar
LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thusand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23 rd Edition
SRS	Standard Methods for the Examination of Water and Wastewater 23 Edition
SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
T(H)	Samples arrived at ESL-QEHL outside holding temperature (≤4.0°C).
TIT	Titrimetry
ТРН	Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Figure Tryptic Soy Broth
TSA + YE	Tryptic Soy Agar + Yeast Extract
TTC	2,3,5 Triphenyl-2H-Tetrazolium Chloride
	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference
UMR	within the sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate
1211	Taylore Dyonic Decoxycholate

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745 E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24022707-11 & 13-15

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number: 24022707-15

SPN: -

Date of Report: 02/05/2024

Revision Date: Not Applicable

Sample(s) Collected: 27/02/2024

Sample(s) Submitted: 27/02/2024

Temperature on Arrival: 2.2°C

Number of Samples: 8

Analysis Started: 27/02/2024

Analysis Completed: 22/03/2024

Prepared By: Reena McKenzie, Quality Management Systems Manager

Senior Analyst

Approved By

Jaidene Webster-Jones, Quality Control Officer

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #1 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	244 @ 23.1°C	-	120.0 – 300
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	<0.02	UMR	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	11 9020	<1.3	BDL, P(P) P(1)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	<0.3		-
Chloride (mg Cl ⁻ /L)	H-8206	40.0		5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	31	P(1), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	2.1	1	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	10	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.8	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	1093	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #4 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

		<u> </u>		
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	29100 @ 23.6°C	-	120.0 - 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	< 0.02	BDL	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	10.1	E(M1), P(P)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	2.3		•
Chloride (mg Cl ⁻ /L)	H-8206	16400.0	D(C), P(1)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	2425	D(C), P(1), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	15.8	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	105	P(P), D(I)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.3	-	0.8 - 1.7
Fats, Oil & Grease (mg/L)	EPA 1664 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	337861	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #3 (Groundwater) - \Box C(B) \boxtimes C(C) \Box C(L)

	<u> </u>	<u> </u>	1 1 1	* *
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	32600 @ 24.0°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.02	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	13.6	E(M1), P(P)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	3.1		•
Chloride (mg Cl ⁻ /L)	H-8206	18500.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	2650	D(C), P(1), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	17.8	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	135	P(P), D(I)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.4	-	0.8 - 1.7
Fats, Oil & Grease (mg/L)	EPA 1664 B	7.5	P(P)	-
Potassium (μg K/L)	EPA 200.7	389315	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #2 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	1233 @ 24.1°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.12	-	0.01 - 0.8
Nitrate (mg NO ₃ -/L)	11 0020	7.7	D(I), P(P), E(M1)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	1.8		-
Chloride (mg Cl ⁻ /L)	H-8206	348.0	D(C), P(1)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	68	D(C), P(1), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	2.0	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	14	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	0.6	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	4299	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: AH (Groundwater)

- $\square C(B) \boxtimes C(C) \square C(L)$

Sample 1D (Matrix) - Quamier: 1111 (Groundwater)			- 🗆 e(b) 🚨 e(e) 🗀 e(l)	
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	6.98 @ 23.2°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	2340 @ 23.5°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1519 @ 23.5℃	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	H-8039	7.6	E(M1),	0.1 – 7.5
Nitrate as Nitrogen (mg NO ₃ - N/L)	П-8039	1.7	D(I), P(P)	-
Total Coliform (MPN/100mL)	SM-9221	2.0	-	-
Faecal Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Sulfate (mg SO4 ²⁻ /L)	H-8051	74	D(C), E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	508.0	D(C)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	773.9	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.4	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	147825	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	83.8	P(P), P(1), D(C)	-
Magnesium (μg Mg/L)	EPA 200.7	39293	P(P), P(1), D(C)	3600 – 27000
Potassium (µg K/L)	EPA 200.7	3874	P(1), P(P), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.15 @ 23.1°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	89.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	11350.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	136000	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	25954	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	8.09	P(1), P(P), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D2 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.08 @ 22.6°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	128.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	7500.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	66500	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	23227	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	3.52	P(1), P(P), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D3 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Sumple 12 (Materia) Qualifier 22 (Trade Efficient)			() _	
Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.10 @ 23.9°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	51.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	15466.7	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	101500	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	21006	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	5.68	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: T. Thompson, J. Webster-Jones, S. Crooks Date of Analysis: 28/02/2024

Parameter: pH (DR)

QEHL Personnel: C. Davis

Date of Analysis: 27/02/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	4.04	24.9
6.90 - 7.10	7.07	24.8
9.96 - 10.04	10.01	25.0

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: R. Stephens Date of Analysis: 29/02/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		2528.6	4.6
BD		2414.3	4.0
SRS	68.7-85.9	81.5	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: J. Williams Date of Analysis: 27/02/2024

	Standard Concentration (mg PO ₄ ³ -/L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		0.02	
RB		< 0.02	
BD		51.00	0.0
PD		51.00	0.0
SRS	1.95-2.05	1.99	

Parameter: Sulfate (H-8051)

QEHL Personnel: R. Stephens Date of Analysis: 04/03/2024

	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ²⁻ /L)	RPD (%)
MB		<1	
BD		2650	0.0
ъD		2650	0.0
SRS	49-59	56	

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Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 05/03/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)	
MB		<11		
BD		13700	1.5	
		13500		
SRS	488-512	502		

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 05/03/2024

•	•	•	
	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
BD		56	1.0
		57	1.8
SRS	121-129	126	

Parameter: Chloride (H-8206)

QEHL Personnel: R. BrownDate of Analysis: 29/02/2024

V ===== = 0.00111010 110 = 10 1/12		= 000 01 1111011		
	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)	
MB		<3.0		
RB		<3.0		
BD		18600	1.1	
		18400		
SRS	90.0-110.0	99.6		

Parameter: Total Hardness (SM-2340 C)

OEHL Personnel: J. Williams Date of Analysis: 08/03/2024

QETTE I CISOTHEL. 3. Williams		Date of Allarysis. 00/03/202		
	Standard Concentration	Determined Concentration	RPD	
	(mg CaCO ₃ /L)	(mg CaCO ₃ /L)	(%)	
Duplicates		768.0	1.5	
		779.7		
SRS	0.91 - 1.09	1.01		

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Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Ford Date of Analysis: 28/02/2024

	Standard Concentration (mg NO3 ⁻ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)	
MB		0.7		
RB		0.7		
BD		6.7	0.0	
		6.7	0.0	
SRS	8.6-11.4	11.2		

Standard Additions

QEHL Personnel: R. Ford Date of Analysis: 28/02/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
# Standard addition	Standard	1.4	2.5	1.5	60
	addition		5.0	3.0	60
	checks*		7.5	4.5	60

^{*}Equation of the line y = 0.6x + 1.4

Standard Additions

QEHL Personnel: R. Ford Date of Analysis: 28/02/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
₩ addi	Standard	1.7	2.5	1.4	56
			5.0	2.7	54
			7.5	4.1	55

^{*}Equation of the line y = 0.544x + 1.71

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Parameter: Conductivity (DR)

QEHL Personnel: C. Davis

Date of Analysis: 27/02/2024

Standard (µS/cm)	Instrument Reading (µS/cm)	Temperature (°C)
1399-1427	1418	23.8

Parameter: Total Dissolved Solids (DR)

QEHL Personnel: C. Davis

Date of Analysis: 27/02/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909-928	920	23.8

Parameter: Faecal and Total Coliform (SM-9221)

QEHL Personnel: T. Russell Date of Analysis: 27/02/2024

				v
Media/Test Item	DS LTB	SS LTB	BGB	EC
(Batch #)	(23/02/2024)	(23/02/2024)	(06/02/2024)	(28/02/2024)
Sterile (Yes/No)	Yes	Yes	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical	Typical	Typical

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 22/03/2024

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 21/03/2024

^{*}Additional Quality Control Information can be provided upon request.

^{*}Additional Quality Control Information can be provided upon request.

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Glossary

W 1055	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA	Bile Esculin Azide Agar
BG	Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BSA	
	Bismuth Sulfite Agar parameter analysed in the field
C(P)	
C(B)	Samples collected by the client and picked up by an ESL bearer
C(C)	Samples collected by the client and delivered to ESL
C(H)	Analytical sample submitted in incorrect container. This may affect data quality. Samples collected by ESL
C(L)	
C(S)	Sample collected by the client then sub-sampled and delivered by ESL.
CFU	Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
CVAAG	Colourimetry
CVAAS	Cold Vapour Atomic Absorption Spectroscopy
D(I)	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D(C) DR	Sample diluted due to high concentration of target analyte
DS ADB	Direct Reading
DS ADB	Double Strength Azide Dextrose Broth Double Strength Lauryl Tryptose Broth
DS L1B DS PAB	
	Double Strength Pseudomonas Asparagine Broth
EB E(E1)	Equipment Blank
E (E 1)	Estimated Value. Data acquisition affected by equipment malfunction.
E (L 1)	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this
E(L2)	may be affected by same bias.
	Estimated Value due to the nature of the sample matrix.
E (M1)	Estimated Value. Result calculated using calibration curve. Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
E (M2)	
E(M2)	recovery.
E(M3) E(R)	Estimated Value. Sample performance indicate presence of interference Estimated Value. RPD value was outside control limits.
	Estimated value. RFD value was outside control mints. E. coli Media
EC	
E(V)	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EC-MUG	E. coli Media with 4-methylumbelliferyl-β-D-glucuronide
EHU	Environmental Health Unit
EPA	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy
FAES	Flame Atomic Emission Spectroscopy
FB	Field Blank
FD FL DDG	Field Duplicate Florida Petroleum Range Organic Method
	Florida Petroleum Range ()rganic Method
FL-PRO	
GC-MS	Gas Chromatography Mass Spectrometry

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ICP	Inductively Coupled Plasma
ISE	Ion Selective Electrode
LCA	Listeria Chromogenic Agar
LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23 rd Edition
SRS	Standard Reference Solution
SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
T(H)	Samples arrived at ESL-QEHL outside holding temperature (≤4.0°C).
TIT	Titrimetry
TPH	Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Agai Tryptic Soy Broth
TSA + YE	Tryptic Soy Agar + Yeast Extract
TTC	2,3,5 Triphenyl-2H-Tetrazolium Chloride
110	
UMR	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference
WITO	within the sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745 E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24032644-49 & 51-53

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number: 24032644-53

SPN:

Date of Report: 05/06/2024

Revision Date: Not Applicable

Sample(s) Collected: 26/03/2024

Sample(s) Submitted: 26/03/2024

Temperature on Arrival: 3.2°C

Number of Samples: 9

Analysis Started: 26/03/2024

Analysis Completed: 23/04/2024

Prepared By: Reena McKenzie, Quality Management Systems Manager

Travis Garnett, Senior Analyst.

Verified By

Jaidene Webster-Jones, Quality Control Officer

Approved By

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #3 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	284 @ 23.1°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.02	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	11 0020	1.3	P(P), P(1)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	0.3		-
Chloride (mg Cl ⁻ /L)	H-8206	56.4	P(1)	5.0 – 20.0
Sulfate (mg SO4 ² -/L)	H-8051	28	P(1), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	4.2	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	<3	UMR, P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.5	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (µg K/L)	EPA 200.7	1012	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

CDL 23092739-48 Page **3** of **17**

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Sample ID (Matrix) - Qualifier: #1 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	24500 @ 22.9°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	< 0.02	UMR	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	8.8	E(M1), P(P)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	2.0		-
Chloride (mg Cl ⁻ /L)	H-8206	13800.0	D(C), P(1)	5.0 – 20.0
Sulfate (mg SO ₄ ²⁻ /L)	H-8051	2350	P(1), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	7.6	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	85	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	9.3	E(M3)	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	262004	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #2 (Groundwater) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	32800 @ 23.4°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.02	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	11 9020	10.1	E(M1), P(P)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	2.3		-
Chloride (mg Cl ⁻ /L)	H-8206	18600.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	3200	D(C), P(1), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	8.1	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	270	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	13.3	E(M3)	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	381979	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: PW3 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Sample ID (Matrix) - Qu			_ (=) _	
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	7.63 @ 23.9°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	1917 @ 22.5℃	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1246 @ 22.6℃	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	H-8039	10.1	E(M1),	0.1 – 7.5
Nitrate as Nitrogen (mg NO3 ⁻ -N/L)	11-0037	2.3	D(I), P(P)	-
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.10	-	0.01 – 0.8
Total Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Faecal Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Sulfate (mg SO4 ²⁻ /L)	H-8051	84	D(C), P(1) E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	408.0	D(C), P(1)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	509.5	P(1), P(P)	127.0 – 381.0
Total Suspended Solids (mg/L)	SM-2540 D	2.4	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	<3	UMR, BDL	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	0.9	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Sodium (µg Na/L)	EPA 200.7	181048	P(P), P(1)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	141	P(P), P(1)	-
Magnesium (µg Mg/L)	EPA 200.7	20479	P(P), P(1)	3600 – 27000
Potassium (µg K/L) *Plue sheded parameters are	EPA 200.7	4167	P(1), P(P)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: CH (Groundwater)

 $- \square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	7.55 @ 23.4°C	b(1)	7.00 - 8.40
Conductivity (µS/cm)	DR	2400 @ 23.0°C	-	150.0 - 600
Total Dissolved Solids (mg/L)	DR	1560 @ 22.8°C	-	120.0 - 300
Nitrate (mg NO ₃ -/L)	11 0020	13.3	E(M1),	0.2 – 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	3.0	D(I), P(P)	-
Total Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Faecal Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Sulfate (mg SO4 ² -/L)	H-8051	88	D(C), E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	552.0	D(C), P(1)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	692.4	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	0.8	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	193001	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	234	P(P), P(1), D(I)	-
Magnesium (μg Mg/L)	EPA 200.7	52629	P(P), P(1), D(C)	3600 – 27000
Potassium (µg K/L)	EPA 200.7	3849	P(1), P(P), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: PW2 (Surface Water)

- $\square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	7.19 @ 23.8°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	2100 @ 24.8°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1365 @ 24.8°C	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	H-8039	12.7	E(M1),	0.1 – 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	Н-8039	2.9	D(I), P(P)	-
Total Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Faecal Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Sulfate (mg SO4 ² -/L)	H-8051	71	E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	480.0	D(C)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	653.1	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.0	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	142156	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	62.0	P(P), P(1), D(I)	-
Magnesium (μg Mg/L)	EPA 200.7	34446	P(P), P(1), D(C)	3600 – 27000
Potassium (μg K/L)	EPA 200.7	2930	P(1), P(P), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	3.93 @ 23.7°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	34.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	2142.8	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	76500	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	11828	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	3.64	P(1), P(P), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D2 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

_				
Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	3.88 @ 23.2°C	b(1)	6.5 - 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	31.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	7640.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	101000	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	13629	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	5.04	P(1), P(P), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D3 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	3.88 @ 23.6°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	60.50	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	4100.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	76750	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	12930	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	4.54	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Parameter: pH (DR)

QEHL Personnel: S. Crooks Date of Analysis: 27/03/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	4.02	23.8
6.90 - 7.10	7.08	24.2
9.96 - 10.04	10.04	23.8

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: R. Brown Date of Analysis: 29/03/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		34.4	1.2
ви		34.8	1.2
SRS	68.7-85.9	81.5	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: R. Stephens Date of Analysis: 27/03/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³ -/L)	RPD (%)
MB		< 0.02	
RB		< 0.02	
pp.		5.20	2.0
BD		5.30	2.0
SRS	1.95-2.05	1.95	

Parameter: Sulfate (H-8051)

QEHL Personnel: R. Brown Date of Analysis: 05/04/2024

	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ²⁻ /L)	RPD (%)
MB		<1	
BD		36	0.0
BD		36	0.0
SRS	49-59	59	

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Date of Analysis: 15/04/2024



Parameter: Sulfate (H-8051) QEHL Personnel: R. Brown

	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ²⁻ /L)	RPD (%)
MB		<1	
BD		24	0.0
DD		24	0.0
SRS	49-59	59	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 30/03/2024

•	-	•	
	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
DD		32	0.0
BD		32	0.0
SRS	121-129	124	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 30/03/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<11	
BD		78000	0.6
DD		77500	0.0
SRS	488-512	501	

Parameter: Chloride (H-8206)

QEHL Personnel: J. Williams, T, Thompson Date of Analysis: 27/03/2024

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
BD		992.0	0.0
ВD		992.0	0.0
SRS	90.0-110.0	101.2	

Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: T. Thompson, J. Webster-Jones, S. Crooks Date of Analysis: 28/03/2024

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Parameter: Total Hardness (SM-2340 C)

QEHL Personnel: J. WilliamsDate of Analysis: 10/04/2024

	Standard Concentration (mg CaCO ₃ /L)	Determined Concentration (mg CaCO ₃ /L)	RPD (%)
Dunliaataa		<18.3	
Duplicates		<18.3	-
SRS	0.91 - 1.09	1.00	

Parameter: Conductivity (DR)

QEHL Personnel: S. Crooks Date of Analysis: 27/03/2024

Standard (µS/cm)	Instrument Reading (µS/cm)	Temperature (°C)	
1399-1427	1419	24.9	

Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Ford Date of Analysis: 27/03/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.6	
RB		0.5	
BD		3.0	0.0
BD		3.0	0.0
SRS	8.6-11.4	9.3	

Standard Additions

QEHL Personnel: R. Ford Date of Analysis: 27/03/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
	Standard		2.5	1.5	60
#1	addition	1.1	5.0	2.9	58
	checks*		7.5	4.5	60

^{*}Equation of the line y = 0.596x + 1.09

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Standard Additions

QEHL Personnel: R. Ford Date of Analysis: 27/03/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
	Standard		2.5	1.6	64
#3	addition	1.3	5.0	3.2	64
checks*		7.5	5.0	67	

^{*}Equation of the line y = 0.664x + 1.26

Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Crooks Date of Analysis: 27/03/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909-928	921	24.8

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 23/04/2024

Parameter: Fats, Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 10/04/2024

Parameter: Faecal and Total Coliform (SM-9221)

QEHL Personnel: T. Russell Date of Analysis: 26/03/2024

Media/Test Item	DS LTB	SS LTB	BG	EC
(Batch #)	(26/03/2024)	(26/03/2024)	(03/04/2024)	(03/04/2024)
Sterile	Yes	Yes	Yes	Yes
(Yes/No)	1 68	1 68	1 68	1 68
Media performance	7D 1	70. 1	7D 1	7D 1
(Typical, not typical)	Typical	Typical	Typical	Typical

^{*}Additional Quality Control Information can be provided upon request.

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Glossary

%	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA	Bile Esculin Azide Agar
BG	Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BSA	Bismuth Sulfite Agar
c	parameter analysed in the field
C(B)	Samples collected by the client and picked up by an ESL bearer
C(C)	Samples collected by the client and delivered to ESL
C(H)	Analytical sample submitted in incorrect container. This may affect data quality.
C(L)	Samples collected by ESL
C(S)	Sample collected by the client then sub-sampled and delivered by ESL.
CFU	Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
Col	Colourimetry
CVAAS	Cold Vapour Atomic Absorption Spectroscopy
$\mathbf{D}(\mathbf{I})$	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D(C)	Sample diluted due to high concentration of target analyte
DR	Direct Reading
DS ADB	Double Strength Azide Dextrose Broth
DS LTB	Double Strength Lauryl Tryptose Broth
DS PAB	Double Strength Pseudomonas Asparagine Broth
EB	Equipment Blank
E (E 1)	Estimated Value. Data acquisition affected by equipment malfunction.
E(L1)	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this
	may be affected by same bias.
E(L2)	Estimated Value due to the nature of the sample matrix.
E (M 1)	Estimated Value. Result calculated using calibration curve.
E (M2)	Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
	recovery.
E(M3)	Estimated Value. Sample performance indicate presence of interference
E(R)	Estimated Value. RPD value was outside control limits.
EC	E. coli Media
E(V)	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EC-MUG	E. coli Media with 4-methylumbelliferyl-β-D-glucuronide
EHU	Environmental Health Unit
EPA FAAS	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy Flame Atomic Emission Spectroscopy
FB	Fiame Atomic Emission Spectroscopy Field Blank
FD	Field Duplicate
FL-PRO	Florida Petroleum Range Organic Method
GC-MS	Gas Chromatography Mass Spectrometry
H	Hach Water Analysis Workbook
H(A)	Off-scale high data obtained. Actual value may be greater than value given.
11(A)	Off-scale high data obtained. Actual value may be greater than value given.

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ICP	Inductively Coupled Plasma
ISE	Ion Selective Electrode
LCA	Listeria Chromogenic Agar
LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	
	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (0) N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23rd Edition
SRS	Standard Reference Solution
SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
T(H)	Samples arrived at ESL-QEHL outside holding temperature (≤4.0°C).
TIT	Titrimetry
TPH	Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
TSB	
	Tryptic Soy Broth
TSA + YE	Tryptic Soy Agar + Yeast Extract
TTC	2,3,5 Triphenyl-2H-Tetrazolium Chloride
UMR	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference within the sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745 E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24042430-33 & 35-38 Rev

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number: 24042430-38

SPN: -

Date of Report: 25/06/2024

Revision Date: 15/07/2024

Sample(s) Collected: 24/04/2024

Sample(s) Submitted: 24/04/2024

Temperature on Arrival: 0.4°C

Number of Samples: 9

Analysis Started: 24/04/2024

Analysis Completed: 06/06/2024

Prepared By: Rushell Hart, Technical Assistant

Revision Notice

As per the client's request, the matrix for samples "3 (Groundwater)", "4 (Surface Water)", and "PW2 (Surface Water)" were adjusted to (Surface Water); (Groundwater); and (Groundwater) respectively.

Verified By ______

Travis Garnett, Senior Analyst Approved By

Jaidene Webster Jones, Quality Control Officer

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #1 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	261 @ 23.5°C	-	120.0 – 300
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	0.03	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	5.7	P(P)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	11-8039	1.3		-
Chloride (mg Cl ⁻ /L)	H-8206	40.3	P(1)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	23	E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	2.6	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	12	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	3.4	E(M3)	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	1969	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #2 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	28800 @ 23.0°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.02	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	11 0020	7.5	E(M1) D(D)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	1.7	E(M1), P(P)	-
Chloride (mg Cl ⁻ /L)	H-8206	16080.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	2000	D(C), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	11.2	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	65	D(C), P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.2	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	277977	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #3 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	34300 @ 24.0°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.02	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	10.6	E(M1) D(D)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	2.4	E(M1). P(P)	-
Chloride (mg Cl ⁻ /L)	H-8206	15760.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	2800	D(C), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	7.5	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	90	D(C), P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.1	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	393368	P(), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #4 (Groundwater) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	1244 @ 23.9°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.13	-	0.01 - 0.8
Nitrate (mg NO ₃ -/L)	11 2020	17.5	P(P), D(I), E(M1) P(1), D(C)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	4.0		-
Chloride (mg Cl ⁻ /L)	H-8206	438.0		5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	80	D(C), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	1.7	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	7	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.1	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	4042	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: PW2 (Groundwater)

- $\square C(B) \boxtimes C(C) \square C(L)$

				. , . , . ,
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	7.21 @ 24.9°C	b(1)	7.00 - 8.40
Conductivity (µS/cm)	DR	1901 @ 23.5°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1241 @ 23.8°C	-	120.0 - 300
Nitrate (mg NO ₃ -/L)	11 0020	14.5	E(M1),	0.1 – 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	3.3	D(I), P(P)	-
Total Coliform (MPN/100mL)	SM-9221	6.1	-	-
Faecal Coliform (MPN/100mL)	SM-9221	2.0	-	-
Sulfate (mg SO4 ² -/L)	H-8051	34	D(C), E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	346.0	D(C)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	518.5	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.5	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	163599	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	31.0	P(P), P(1)	-
Magnesium (µg Mg/L)	EPA 200.7	19484	P(P), P(1), D(C)	3600 – 27000
Calcium (µg Ca/L)	EPA 200.7	136543	P(P), P(1), D(C)	40000 - 101000
Potassium (μg K/L)	EPA 200.7	3658	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent)

- □C(B)	$\boxtimes C(C)$	$\Box C(L)$
---------	------------------	-------------

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	3.76 @ 23.9°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	33.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	3200.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	76750	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	8219	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	4.24	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D2 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

-				
Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	3.67 @ 23.3°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	34.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	2100.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	91125	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	9054	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	4.71	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D3 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

		<u> </u>		. , . , ,
Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	3.81 @ 23.4°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	33.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	2400.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	65500	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	4257	D(C), P(1), E(M3)	<30
Potassium (g K/L)	EPA 200.7	3.28	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Parameter: pH (DR)

QEHL Personnel: S. Crooks Date of Analysis: 24/04/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	4.03	23.9
6.90 - 7.10	7.06	23.3
9.96 – 10.04	10.03	23.6

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: R. Brown Date of Analysis: 29/04/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		38.0	2.7
вр		37.0	2.7
SRS	68.7-85.9	81.5	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: R. Stephens Date of Analysis: 25/04/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		0.03	
RB		< 0.02	
BD		13.40	0.0
BD		13.40	0.0
SRS	1.91-2.01	2.00	

Parameter: Sulfate (H-8051)

QEHL Personnel: R. BrownDate of Analysis: 09/05/2024

	Standard Concentration (mg SO ₄ ² -/L)	Determined Concentration (mg SO ₄ ² -/L)	RPD (%)
MB		<1	
DD.		220	0.0
BD		220	0.0
SRS	49-59	56	

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Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 27/04/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
BD		31	0.0
ВD		31	0.0
SRS	121-129	125	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 27/04/2024

•	•	•	
	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<11	
DD		91250	0.2
BD		91000	0.3
SRS	488-512	498	

Parameter: Chloride (H-8206)

QEHL Personnel: A. St. Marie Date of Analysis: 26/04/2024

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
BD		<3.0	
שם		<3.0	_
SRS	87.1-112.9	99.2	

Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: T. Thompson, J. Webster-Jones, S. Crooks Date of Analysis: 25/04/2024

Parameter: Total Hardness (SM-2340 C)

QEHL Personnel: N. McCalla Date of Analysis: 15/05/2024

	Standard Concentration (mg CaCO ₃ /L)	Determined Concentration (mg CaCO ₃ /L)	RPD (%)
BD		171.9	0.2
ΒD		171.5	0.2
SRS	0.91 - 1.09	0.97	

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Date of Analysis: 24/04/2024



Parameter: Conductivity (DR) QEHL Personnel: S. Crooks

Standard (µS/cm)	Instrument Reading (µS/cm)	Temperature (°C)
1399-1427	1415	24.6

Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Ford Date of Analysis: 25/04/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.7	
RB		0.7	
BD		1.8	0.0
ВД		1.8	0.0
SRS	8.6-11.4	9.3	

Standard Additions

QEHL Personnel: R. Ford Date of Analysis: 25/04/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
	Standard		2.5	2.1	84
addition checks*	1.4	5.0	4.2	84	
	checks*		7.5	6.2	83

^{*}Equation of the line y = 0.828x + 1.42

Standard Additions

QEHL Personnel: R. Ford Date of Analysis: 25/04/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
	Standard		2.5	1.5	60
addition checks*	1.5	5.0	3.0	60	
	checks*		7.5	4.6	61

^{*}Equation of the line y = 0.612x + 1.48

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Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Crooks Date of Analysis: 24/04/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909 - 928	919	24.5

Parameter: Faecal and Total Coliform (SM-9221)

QEHL Personnel: R. Dawkins Date of Analysis: 24/04/2024

Media/Test Item (Batch #)	DS LTB (23/04/2024)	SS LTB (23/04/2024)	BGB (16/04/2024)	EC (24/04/2024)
Sterile (Yes/No)	Yes	Yes	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical	Typical	Typical

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 06/06/2024

*Additional Quality Control Information can be provided upon request.

Parameter: Fats, Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 15/05/2024

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 07/06/2024

*Additional Quality Control Information can be provided upon request.

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Glossary

%	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA	Bile Esculin Azide Agar
BG	Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BSA	Bismuth Sulfite Agar
C(B)	parameter analysed in the field
C(B)	Samples collected by the client and picked up by an ESL bearer
C(C)	Samples collected by the client and delivered to ESL
C(H)	Analytical sample submitted in incorrect container. This may affect data quality.
C(L)	Samples collected by ESL
C(S)	Sample collected by the client then sub-sampled and delivered by ESL.
CFU	Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
Col CVAAS	Cold Venova Atomio Absorption Spectroscopy
	Cold Vapour Atomic Absorption Spectroscopy
D(I)	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D(C) DR	Sample diluted due to high concentration of target analyte Direct Reading
DS ADB	Double Strength Azide Dextrose Broth
DS LTB	Double Strength Lauryl Tryptose Broth
DS PAB	Double Strength Pseudomonas Asparagine Broth
EB	Equipment Blank
E(E1)	Estimated Value. Data acquisition affected by equipment malfunction.
	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this
E(L1)	may be affected by same bias.
E(L2)	Estimated Value due to the nature of the sample matrix.
E(M1)	Estimated Value. Result calculated using calibration curve.
	Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
E(M2)	recovery.
E(M3)	Estimated Value. Sample performance indicate presence of interference
E(R)	Estimated Value. RPD value was outside control limits.
EC	E. coli Media
E(V)	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EC-MUG	E. coli Media with 4-methylumbelliferyl-β-D-glucuronide
EHU	Environmental Health Unit
EPA	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy
FAES	Flame Atomic Emission Spectroscopy
FB	Field Blank
FD	Field Duplicate
FL-PRO	Florida Petroleum Range Organic Method
GC-MS	Gas Chromatography Mass Spectrometry
H	Hach Water Analysis Workbook
$\mathbf{H}(\mathbf{A})$	Off-scale high data obtained. Actual value may be greater than value given.

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LCD	
ICP	Inductively Coupled Plasma
ISE	Ion Selective Electrode
LCA	Listeria Chromogenic Agar
LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23 rd Edition
SRS	Standard Reference Solution
SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
T(H) TIT	Samples arrived at ESL-QEHL outside holding temperature (≤4.0°C).
	Titrimetry Total Potentianum Hydrogorthan
TPH TSA	Total Petroleum Hydrocarbon Tryptic Soy Agar
TSB	
	Tryptic Soy Agar Veest Extract
TSA + YE TTC	Tryptic Soy Agar + Yeast Extract 2,3,5 Triphenyl-2H-Tetrazolium Chloride
110	
UMR	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference
WHO	within the sample.
XLD	World Health Organization Yylogo Lyging Dogwycholato
ALD	Xylose Lysine Deoxycholate

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745 E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24052819-23 & 25-27

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number: 24052819-27

SPN: -

Date of Report: 24/09/2024

Revision Date: Not Applicable

Sample(s) Collected: 28/05/2024

Sample(s) Submitted: 28/05/2024

Temperature on Arrival: 1.0°C

Number of Samples: 8

Analysis Started: 28/05/2024

Analysis Completed: 26/06/2024

Prepared By: Rushell Hart, Technical Assistant

Senior Analyst

Approved By

Jaidene Webster Jones, Quality Control Officer

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #3 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	142 @ 24.2°C	-	120.0 – 300
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	0.04	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	0.9	P(P)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	0.2		-
Chloride (mg Cl ⁻ /L)	H-8206	18.3	P(1)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	26	P(1), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	8.0	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	14	P(P), D(C), P(1)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.3	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	1598	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #2 (Surface Water) -

 $- \square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	30100 @ 24.4°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.02	-	0.01 - 0.8
Nitrate (mg NO ₃ -/L)	11 2020	10.6	E(M1), P(P)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	2.4		-
Chloride (mg Cl ⁻ /L)	H-8206	15100	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	2550	D(C), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	5.6	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	15	P(P), D(C), P(1)	•
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.2	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	311448	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

CDL 24052819-23 & 25-27

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Sample ID (Matrix) - Qualifier: #4 (Groundwater) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	34600 @ 24.5°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.13	P(P)	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	11.4	E(M1), P(P)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-6039	2.6		-
Chloride (mg Cl ⁻ /L)	H-8206	17200	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	2950	D(C), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	8.4	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	165	P(P), D(C), P(1)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	6.5	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	364525	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #1 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

				` ` `
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	1233 @ 23.9°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.13	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	Н 8030	10.1	E(M1), D(I), P(P)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	2.3		-
Chloride (mg Cl ⁻ /L)	H-8206	260.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	90	D(C), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	<1.6	BDL	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	11	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.0	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	3847	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: AH (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	7.13 @ 23.7°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	2080 @ 23.8°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1349 @ 23.6°C	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	H-8039	22.5	E(M1),	0.1 – 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	5.1	D(I), P(P)	-
Total Coliform (MPN/100mL)	SM-9221	>1600	-	-
Faecal Coliform (MPN/100mL)	SM-9221	430	-	-
Sulfate (mg SO4 ² -/L)	H-8051	62	P(1), E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	426.0	D(C), P(1)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	772.2	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.2	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	95626	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	912	P(P), P(1), D(C)	-
Magnesium (μg Mg/L)	EPA 200.7	36509	P(P), P(1), D(C)	3600 – 27000
Potassium (μg K/L)	EPA 200.7	3570	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	3.84 @ 23.8°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	33.50	D(C), P(P)	5
Total Suspended Solids (mg/L)	SM-2540 D	4125.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	96000	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	9610	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	5.55	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D2 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.13 @ 23.6°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	18.00	D(C), P(P)	5
Total Suspended Solids (mg/L)	SM-2540 D	5050.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	93750	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	5471	D(C), P(1), E(M3)	<30
Potassium (g K/L)	EPA 200.7	6.17	P(1), P(P), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D3 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.14 @ 24.2°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	18.00	D(C), P(P)	5
Total Suspended Solids (mg/L)	SM-2540 D	4850.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	90750	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	12965	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	4.90	P(1), P(P), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: T. Thompson, J. Webster-Jones, S. Crooks, S. Williams

Date of Analysis: 29/05/2024

Parameter: pH (DR)

QEHL Personnel: S. Williams Date of Analysis: 28/05/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	4.01	23.3
6.90 - 7.10	7.00	23.6
9.96 – 10.04	10.03	23.4

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: R. Brown Date of Analysis: 31/05/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		5050.0	0.0
DD		5050.0	0.0
SRS	68.7-85.9	76.7	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: R. Stephens Date of Analysis: 29/05/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		0.02	
RB		< 0.02	
BD		18.00	0.0
BD		18.00	0.0
SRS	1.91-2.01	1.98	

Parameter: Sulfate (H-8051) QEHL Personnel: R. Brown

 Standard Concentration (mg SO4²-/L)
 Determined Concentration (mg SO4²-/L)
 RPD (%)

 MB
 <1</td>
 2550

 BD
 2550
 0.0

 SRS
 49-59
 53

Date of Analysis: 13/06/2024

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Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 04/06/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
PD.		11	0.0
BD		11	0.0
SRS	121-129	124	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 04/06/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)	
MB		<11		
BD		127	0.0	
		127	0.0	
SRS	488-512	502		

Parameter: Chloride (H-8206)

QEHL Personnel: A. St. Marie, S. Robinson Date of Analysis: 30/05/2024

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)	
MB		<3.0		
RB		<3.0		
BD		3.5	0.0	
		3.5		
SRS	87.1-112.9	98.0		

Parameter: Total Hardness (SM-2340 C)

QEHL Personnel: A. St. Marie Date of Analysis: 19/06/2024

	Standard Concentration (mg CaCO ₃ /L)	Determined Concentration (mg CaCO ₃ /L)	RPD (%)
Duplicates		765.3	1 0
		779.1	1.8
SRS	0.91 - 1.09	1.01	

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 26/06/2024

*Additional Quality Control Information can be provided upon request.

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Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Ford, T. Clarke

Date of Analysis: 29/05/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.9	
RB		0.7	
PD		1.8	5.4*
BD		1.9	3.4*
SRS	8.7-11.3	10.8	

^{*}Duplicates accepted based on the sensitivity of the analytical method used.

Standard Additions

QEHL Personnel: R. Ford, T. Clarke

Date of Analysis: 29/05/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
7,	Standard addition	1.8	2.5	1.9	76
			5.0	3.8	76
	checks*		7.5	5.7	76

^{*}Equation of the line y = 0.76x + 1.8

Standard Additions

QEHL Personnel: R. Ford, T. Clarke

Date of Analysis: 29/05/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
Standard addition checks*		2.5	1.7	68	
	addition	lition 1.9	5.0	3.5	70
	checks*		7.5	5.3	71

^{*}Equation of the line y = 0.708x + 1.87

Parameter: Conductivity (DR)

QEHL Personnel: S. Williams Date of Analysis: 28/05/2024

Standard (µS /cm)	Instrument Reading (μS/cm)	Temperature (°C)
1399-1427	1415	24.2

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Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Williams Date of Analysis: 28/05/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909 - 928	919	24.2

Parameter: Faecal and Total Coliform (SM-9221)

QEHL Personnel: T. Russell Date of Analysis: 28/05/2024

Media/Test Item	DS LTB	SS LTB	BGB	EC
(Batch #)	(21/05/2024)	(21/05/2024)	(29/05/2024)	(27/05/2024)
Sterile (Yes/No)	Yes	Yes	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical	Typical	Typical

Parameter: Fats, Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 05/06/2024

Parameter: Fats, Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 06/06/2024

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Glossary

%	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA	Bile Esculin Azide Agar
BG	Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BSA	Bismuth Sulfite Agar
C(B)	parameter analysed in the field
C(B)	Samples collected by the client and picked up by an ESL bearer Samples collected by the client and delivered to ESL
C(C) C(H)	Analytical sample submitted in incorrect container. This may affect data quality.
C(L)	Samples collected by ESL
$C(\mathbf{L})$	Sample collected by the client then sub-sampled and delivered by ESL.
CFU	Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
Col	Colourimetry
CVAAS	Cold Vapour Atomic Absorption Spectroscopy
D(I)	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D(C)	Sample diluted due to high concentration of target analyte
DR	Direct Reading
DS ADB	Double Strength Azide Dextrose Broth
DS LTB	Double Strength Lauryl Tryptose Broth
DS PAB	Double Strength Pseudomonas Asparagine Broth
EB	Equipment Blank
E(E1)	Estimated Value. Data acquisition affected by equipment malfunction.
E (L 1)	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this
	may be affected by same bias.
E(L2)	Estimated Value due to the nature of the sample matrix.
E (M 1)	Estimated Value. Result calculated using calibration curve.
E(M2)	Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
E(M3)	recovery. Estimated Value. Sample performance indicate presence of interference
E(R)	Estimated Value. RPD value was outside control limits.
EC	E. coli Media
E(V)	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EC-MUG	E. coli Media with 4- m ethyl u mbelliferyl-β-D- g lucuronide
EHU	Environmental Health Unit
EPA	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy
FAES	Flame Atomic Emission Spectroscopy
FB	Field Blank
FD	Field Duplicate
FL-PRO	Florida Petroleum Range Organic Method
GC-MS	Gas Chromatography Mass Spectrometry
H	Hach Water Analysis Workbook
H(A)	Off-scale high data obtained. Actual value may be greater than value given.

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LCD	
ICP	Inductively Coupled Plasma
ISE	Ion Selective Electrode
LCA	Listeria Chromogenic Agar
LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation Standard Methods for the Examination of Water and Wastewater 23 rd Edition
SM SRS	Standard Methods for the Examination of Water and Wastewater 23 th Edition Standard Reference Solution
SS	Sample Submerged upon receival at the laboratory
SS ADB SS LTB	Single Strength Azide Dextrose Broth Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
	Samples arrived at ESL-QEHL outside holding temperature (≤4.0°C).
T(H) TIT	
TPH	Titrimetry Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Agai Tryptic Soy Broth
TSA + YE	Tryptic Soy Agar + Yeast Extract
TTC	2,3,5 Triphenyl-2H-Tetrazolium Chloride
	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference
UMR	within the sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate
	Tylobe Lyonic Deoxyenolace

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745

E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24062608-15

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job	Number:	24062608-15

SPN:

Date of Report: 11/09/2024

Revision Date: Not Applicable

Sample(s) Collected: 26/06/2024

Sample(s) Submitted: 26/06/2024

Temperature on Arrival: 0.9°C

Number of Samples: 8

Analysis Started: 26/06/2024

Analysis Completed: 31/07/2024

Prepared By: Rushell Hart, Technical Assistant

Verified By Approved By Approved By

Travis Garnett, Jaidene Webster-Jones, Senior Analyst Quality Control Officer

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #1 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
Total Dissolved Solids (mg/L)	DR	187 @ 23.6°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.03	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	<1.3	D/D) DDI	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	<0.3	P(P), BDL	-
Chloride (mg Cl ⁻ /L)	H-8206	25.9	P(1)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	23	E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	4.4	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	14	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	4.6	E(M3)	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (µg K/L)	EPA 200.7	1976	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: #2 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
Total Dissolved Solids (mg/L)	DR	30600 @ 23.6°C	-	120.0 – 300
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	0.02	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	10.1	E(M1),	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	11-8039	2.3	P(1)	-
Chloride (mg Cl ⁻ /L)	H-8206	18100.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	2350	D(C), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	14.0	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	30	D(C), P(P), P(1)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.5	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (µg K/L)	EPA 200.7	327684	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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A division of



Sample ID (Matrix) - Qualifier: #3 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
Total Dissolved Solids (mg/L)	DR	34400 @ 23.5°C	-	120.0 – 300
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	<0.02	BDL	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	10.6	P(P),	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	11-8039	2.4	E(M1)	-
Chloride (mg Cl ⁻ /L)	H-8206	18600.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ²⁻ /L)	H-8051	2600	D(C), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	7.5	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	85	P(1), D(C), P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.5	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (µg K/L)	EPA 200.7	388537	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: PW3 (Groundwater) - \Box C(B) \boxtimes C(C) \Box C(L)

Sample 1D (Matrix) - Qu	(_ = (3) _	
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	7.75 @ 23.6°C	b(1)	7.00 - 8.40
Conductivity (µS/cm)	DR	1904 @ 23.8°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1229 @ 23.5°C	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	** 0000	7.4	E(M1),	0.1 – 7.5
Nitrate as Nitrogen (mg NO3 ⁻ -N/L)	H-8039	1.7	D(I), P(P)	-
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.11	-	0.01 – 0.8
Total Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Faecal Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Sulfate (mg SO4 ²⁻ /L)	H-8051	75	D(C), E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	285.0	D(C), P(1)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	491.1	P(1), P(P)	127.0 – 381.0
Total Suspended Solids (mg/L)	SM-2540 D	<1.6	BDL	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	6	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.2	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Sodium (µg Na/L)	EPA 200.7	184736	P(P), P(1)	4500 - 12000
Iron (µg Fe/L)	EPA 200.7	361	P(P), P(1)	-
Magnesium (μg Mg/L)	EPA 200.7	21890	P(P), P(1)	3600 – 27000
Potassium (µg K/L)	EPA 200.7	4396	P(P), P(1)	740 – 5000
L	l		1	l

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: CH (Groundwater)

 $- \square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	6.98 @ 23.8°C	b(1)	7.00 - 8.40
Conductivity (µS/cm)	DR	2280 @ 24.4°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1469 @ 24.5°C	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	H-8039	9.7	E(M1),	0.2 – 7.5
Nitrate as Nitrogen (mg NO ₃ N/L)	П-8039	2.2	D(I), P(P)	-
Total Coliform (MPN/100mL)	SM-9221	49	-	-
Faecal Coliform (MPN/100mL)	SM-9221	4.5	-	-
Sulfate (mg SO4 ²⁻ /L)	H-8051	70	D(C), E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	500.0	D(C)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	687.9	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.2	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	172096	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	194	P(P), P(1), D(I)	-
Magnesium (μg Mg/L)	EPA 200.7	55281	P(P), P(1), D(C)	3600 – 27000
Potassium (μg K/L)	EPA 200.7	2739	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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A division of



Sample ID (Matrix) - Qualifier: PW2 (Groundwater)

- $\square C(B) \boxtimes C(C) \square C(L)$

	Dample 1D (Matrix) - Quamier: 1 W2 (Ground water)			C(C) LC(L)
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	7.33 @ 23.7°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	2100 @ 24.0°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1354 @ 23.9°C	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	H-8039	12.0	E(M1),	0.3 – 7.5
Nitrate as Nitrogen (mg NO ₃ - N/L)	П-8039	2.7	D(I), P(P)	-
Total Coliform (MPN/100mL)	SM-9221	170	-	-
Faecal Coliform (MPN/100mL)	SM-9221	3.7	-	-
Sulfate (mg SO4 ²⁻ /L)	H-8051	67	E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	392.0	D(C), P(1)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	628.4	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.1	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	146796	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	27.0	P(P), P(1), D(I)	-
Magnesium (μg Mg/L)	EPA 200.7	36992	P(P), P(1), D(C)	3600 – 27000
Potassium (μg K/L)	EPA 200.7	2945	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent)

$-\Box C(B)$	$\boxtimes C(C)$	$\Box C(L)$
--------------	------------------	-------------

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.20 @ 23.8°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	55.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	4425.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	70500	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	13897	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	4.65	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

Sample ID (Matrix) - Qualifier: D3 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.02 @ 23.8°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	69.50	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	7400.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	98000	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	18634	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	5.32	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Parameter: pH (DR)

QEHL Personnel: S. Williams Date of Analysis: 26/06/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	4.03	23.2
6.90 - 7.10	7.05	23.3
9.96 – 10.04	10.03	23.2

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: R. Brown Date of Analysis: 01/07/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		4450.0	1 1
ВD		4400.0	1.1
SRS	68.7-85.9	76.7	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: R. Stephens Date of Analysis: 26/06/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		0.09	
RB		< 0.02	
BD		10.40	0.0
БО		10.40	0.0
SRS	1.93-2.07	2.05	

Parameter: Sulfate (H-8051)

QEHL Personnel: R. Brown Date of Analysis: 01/07/2024

	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ²⁻ /L)	RPD (%)
MB		<1	
BD		10	0.0
DD		10	0.0
SRS	46-62	60	

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Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 30/06/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<11	
BD		384	0.3
DD		385	0.5
SRS	488-512	499	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 30/06/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
DD.		9	0.0
BD		9	0.0
SRS	121-129	124	

Parameter: Chloride (H-8206)

QEHL Personnel: A. St. Marie Date of Analysis: 01/07/2024

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
BD		392.0	0.0
ВD		392.0	0.0
SRS	97.9-102.1	100.8	

Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: J. Webster-Jones, S. Williams, T. Thompson Date of Analysis: 27/06/2024

Parameter: Total Hardness (SM-2340 C)

QEHL Personnel: N. McCalla Date of Analysis: 01/07/2024

	Standard Concentration (mg CaCO ₃ /L)	Determined Concentration (mg CaCO ₃ /L)	RPD (%)
Dunligatos		687.5	0.1
Duplicates		688.3	0.1
SRS	0.91 - 1.09	0.97	

 $\label{eq:parameter:Conductivity} \textbf{(DR)}$

QEHL Personnel: S. Williams Date of Analysis: 26/06/2024

Standard (µS/cm)	Instrument Reading (µS/cm)	Temperature (°C)
1399-1427	1412	24.8

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Parameter: HR Nitrate (H-8039)

QEHL Personnel: T. Clarke, T. Thompson Date of Analysis: 27/06/2024

	Standard Concentration (mg NO ₃ N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.5	
RB		0.6	
BD		2.7	0.0
BD		2.7	0.0
SRS	8.7-11.3	10.2	

Standard Additions

QEHL Personnel: T. Clarke Date of Analysis: 27/06/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
Standard addition checks*	1.4	2.50	2.8	56	
		5.00	4.3	58	
	checks*		7.50	5.9	60

^{*}Equation of the line y = 0.6x + 1.35

Standard Additions

QEHL Personnel: T. Clarke Date of Analysis: 27/06/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
Standard addition checks*		2.50	2.9	56	
	1.5	5.00	4.4	58	
	checks*		7.50	6.0	60

^{*}Equation of the line y = 0.6x + 1.45

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Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Williams Date of Analysis: 26/06/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909-928	918	24.7

Parameter: Fats, Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 02/07/2024

Parameter: Faecal and Total Coliform (SM-9221)

QEHL Personnel: R. Dawkins Date of Analysis: 26/06/2024

Media/Test Item	DS LTB	SS LTB	EC	BG
(Batch #)	(24/06/2024)	(25/06/2024)	(01/07/2024)	(07/06/2024)
Sterile (Yes/No)	Yes	Yes	Yes	Yes
Media performance	7D 1	7F 1	7D 1	Tr. 1
(Typical, not typical)	Typical	Typical	Typical	Typical

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. M^cCalla Date of Analysis: 17/07/2024

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. M^cCalla Date of Analysis: 31/07/2024

*Additional Quality Control Information can be provided upon request.

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^{*}Additional Quality Control Information can be provided upon request.

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Glossary

%	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA	Bile Esculin Azide Agar
BG	Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BSA	Bismuth Sulfite Agar
C(B)	parameter analysed in the field
C(B)	Samples collected by the client and picked up by an ESL bearer Samples collected by the client and delivered to ESL
C(C)	Analytical sample submitted in incorrect container. This may affect data quality.
C(H)	
C(L) C(S)	Samples collected by ESL Sample collected by the client then sub-sampled and delivered by ESL.
CFU	Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
Col	Compendation of Methods for the Microbiological Examination of Poods Colourimetry
CVAAS	Cold Vapour Atomic Absorption Spectroscopy
D(I)	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D (C)	Sample diluted due to high concentration of target analyte
DR	Direct Reading
DS ADB	Double Strength Azide Dextrose Broth
DS LTB	Double Strength Lauryl Tryptose Broth
DS PAB	Double Strength Pseudomonas Asparagine Broth
EB	Equipment Blank
E (E 1)	Estimated Value. Data acquisition affected by equipment malfunction.
E (L1)	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this
	may be affected by same bias.
E(L2)	Estimated Value due to the nature of the sample matrix.
E (M 1)	Estimated Value. Result calculated using calibration curve.
E(M2)	Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
	recovery.
E(M3)	Estimated Value. Sample performance indicate presence of interference
E(R)	Estimated Value. RPD value was outside control limits.
EC	E. coli Media
E(V) EC-MUG	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EHU	E. coli Media with 4- m ethyl u mbelliferyl-β-D- g lucuronide Environmental Health Unit
EPA	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy
FAES	Flame Atomic Emission Spectroscopy
FB	Field Blank
FD	Field Duplicate
FL-PRO	Florida Petroleum Range Organic Method
GC-MS	Gas Chromatography Mass Spectrometry
Н	Hach Water Analysis Workbook
H(A)	Off-scale high data obtained. Actual value may be greater than value given.
ICP	Inductively Coupled Plasma

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ISE	Ion Selective Electrode
LCA	Listeria Chromogenic Agar
LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23 rd Edition
SRS	Standard Reference Solution
SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
T(H)	Samples arrived at ESL-QEHL outside holding temperature ($\leq 4.0^{\circ}$ C).
TIT	Titrimetry
ТРН	Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Broth
TSA + YE	Tryptic Soy Agar + Yeast Extract
TTC	2,3,5 Triphenyl-2H-Tetrazolium Chloride
UMR	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference
	within the sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745

E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24072560-63

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number: 24072560-63

SPN:

Date of Report: 23/12/2024

Revision Date: Not Applicable

Sample(s) Collected: 25/07/2024

Sample(s) Submitted: 25/07/2024

Temperature on Arrival: 2.2°C

Number of Samples: 4

Analysis Started: 25/07/2024

Analysis Completed: 28/08/2024

Prepared By: Rushell Hart, Technical Assistant

Verified By Reena McKenzie,

QMS Manager

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #4 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Dampie ID (Matrix) - Qua	miler. #4 (Bur	iace water)) LC(L)
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	274 @ 24.3°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.03	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	2.2	D(1)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-0039	0.5	P(1)	-
Chloride (mg Cl ⁻ /L)	H-8206	16.7	P(1)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	21	E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	3.7	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	11	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	5.4	E(M3)	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	2390	P(P), P(1)	740 – 5000
Iron (μg Fe/L)	EPA 200.7	84.2	P(P), P(1)	-
Zinc (μg Zn/L)	EPA 200.7	16.0	P(P), P(1)	-
Lead (μg Pb/L)	EPA 200.7	<4.2	P(P), P(1), BDL	-
Copper (µg Cu/L)	EPA 200.7	11.1	P(P), P(1)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: #1 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

1 , , ,		,		
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	3393 @ 23.8°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.03	-	0.01 - 0.8
Nitrate (mg NO ₃ -/L)	H-8039	22.7	P(1), D(I),	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ N/L)	П-8039	5.1	E(M1)	-
Chloride (mg Cl ⁻ /L)	H-8206	1456.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ²⁻ /L)	H-8051	220	D(C), E(M1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	4.0	1	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	16	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.6	1	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664 B	8.4	P(P)	-
Potassium (μg K/L)	EPA 200.7	28097	P(P), P(1)	740 – 5000
Zinc (μg Zn/L)	EPA 200.7	15.0	P(P), P(1)	-
Iron (μg Fe/L)	EPA 200.7	79.6	P(P), P(1)	-
Lead (μg Pb/L)	EPA 200.7	4.6	P(P), P(1)	-
Copper (µg Cu/L)	EPA 200.7	13.6	P(P), P(1)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #2 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

• '	`	,	. , , , ,	
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	18980 @ 24.5°C	-	120.0 - 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.02	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	9.2	D(1) E(M1)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-0039	2.1	P(1), E(M1)	-
Chloride (mg Cl ⁻ /L)	H-8206	9280.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ²⁻ /L)	H-8051	1440	E(M1), D(C)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	8.9	-	•
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	30	P(P), D(C), P(1)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	4.3	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664 B	7.4	P(P), E(M3)	-
Potassium (μg K/L)	EPA 200.7	198158	P(P), P(1), D(C)	740 – 5000
Zinc (µg Zn/L)	EPA 200.7	<295	P(P), P(1), D(I), BDL	-
Iron (μg Fe/L)	EPA 200.7	<322	P(P), P(1), D(I), BDL	-
Lead (μg Pb/L)	EPA 200.7	<105	P(P), P(1), D(I), BDL	-
Copper (µg Cu/L)	EPA 200.7	<132	P(P), P(1), D(I), BDL	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: #3 (Groundwater) - \Box C(B) \boxtimes C(C) \Box C(L)

				NRCA
Parameters (Unit)	Test Method	Results	Qualifier	AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	1207 @ 23.4°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.13	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	11 0020	7.7	P(1),	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	1.7	E(M1), D(1)	-
Chloride (mg Cl ⁻ /L)	H-8206	337.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	94	E(M1), D(C)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	3.3	1	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	8	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.2	1	0.8 – 1.7
Fats, Oil & Grease (mg/L)	EPA 1664 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	3654	P(P), P(1)	740 – 5000
Zinc (µg Zn/L)	EPA 200.7	<11.8	P(P), P(1), BDL	-
Iron (μg Fe/L)	EPA 200.7	96.5	P(P), P(1)	-
Lead (μg Pb/L)	EPA 200.7	<4.2	P(P), P(1) BDL	-
Copper (µg Cu/L)	EPA 200.7	14.0	P(P), P(1)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: R. Brown Date of Analysis: 31/07/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		6.0	0.0
DD		6.0	0.0
SRS	68.7-85.9	76.7	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: J. Webster-Jones Date of Analysis: 25/07/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		< 0.02	
RB		< 0.02	
BD		14.60	0.0
БD		14.60	0.0
SRS	1.93-2.07	2.04	

Parameter: Sulfate (H-8051)

OEHL Personnel: R. Brown Date of Analysis: 08/082024

<u> </u>		_ 5000 5 = 1 = 1 = 1000 5	
	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ²⁻ /L)	RPD (%)
MB		<1	
BD		220	0.0
ВD		220	0.0
SRS	46-62	57	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 26/07/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
DD.		10	0.5*
BD		11	9.5*
SRS	121-129	123	

^{*}Duplicates are selected based on the sensitivity of the analytical method.

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Date of Analysis: 26/07/2024



Parameter: Chloride (H-8206) OEHL Personnel: A. St. Marie

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
BD		18960.0	0.8
BD		19120.0	0.8
SRS	92.2 - 107.8	99.6	

Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: T. Thompson, J. Webster-Jones, S. Williams Date of Analysis: 26/07/2024

Parameter: HR Nitrate (H-8039)

QEHL Personnel: T. Clarke Date of Analysis: 26/07/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.7	
RB		0.6	
DD.		3.2	0.0
BD		3.2	0.0
SRS	8.5 – 11.4	9.3	

Standard Additions

QEHL Personnel: T. Clarke Date of Analysis: 26/07/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
	Standard	Standard	2.5	1.6	64
#3	addition	1.4	5.0	3.3	66
	checks*		7.5	4.9	65

^{*}Equation of the line y = 0.656 + 1.39

Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Crooks Date of Analysis: 25/07/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909 - 928	918	24.7

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Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 28/08/2024

*Additional Quality Control Information can be provided upon request.

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 22/08/2024

*Additional Quality Control Information can be provided upon request.

Parameter: Fats, Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 08/08/2024

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Glossary

μg/L Micro sciences per centimetre μg/S/m Micro sciences per centimetre ADB	%	Percentage
ADB ADB Aride Devtroes Broth AIM ANC Anerican Organization of Analytical Chemists b (1) Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time b (2) Parameter analysed outside of hold-time; analysis authorised by Client BAM BAM BBD BAGE Analyte Concentration below laboratory determined limit of detection BBL Analyte detected below method detection limit (MDL), MDL greater than standard value. BBC BGA BGSA BRIlliam Green Bile Broth BHH BRIX Benzen, Toluene, Ethylbenzene, Xylene BIRX BEAA BEAA BEAA BEAA BEAA BEAA BEAA BEA	μg/L	
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E(V) Estimated Value. Count(s) obtained is/are outside of the method counting range. EC-MUG E. coli Media with 4-methylumbelliferyl-β-D-glucuronide EHU Environmental Health Unit	$\mathbf{E}(\mathbf{R})$	Estimated Value. RPD value was outside control limits.
EC-MUG E. coli Media with 4-methylumbelliferyl-β-D-glucuronide EHU Environmental Health Unit	EC	E. coli Media
EHU Environmental Health Unit	E(V)	
	EC-MUG	
TDA (LIC) E ' LID (L' A	EHU	Environmental Health Unit
· /	EPA	(US) Environmental Protection Agency
FAAS Flame Atomic Absorption Spectroscopy		
FAES Flame Atomic Emission Spectroscopy		
FB Field Blank		
FD Field Duplicate		
FL-PRO Florida Petroleum Range Organic Method		
GC-MS Gas Chromatography Mass Spectrometry		
H Hach Water Analysis Workbook		
H(A) Off-scale high data obtained. Actual value may be greater than value given.		
ICP Inductively Coupled Plasma	ICP	Inductively Coupled Plasma

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ISE	Ion Selective Electrode
LCA	Listeria Chromogenic Agar
LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA NB	Nutrient Agar
NB	Nutrient Broth
NEPA NRCA	National Environment and Planning Agency Natural Resources Conservation Authority
NTU	·
NWC	Nephelometric Turbidity Units National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23rd Edition
SRS	Standard Reference Solution
SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
T(H)	Samples arrived at ESL-QEHL outside holding temperature (≤4.0°C).
TIT	Titrimetry
TPH	Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
$\begin{array}{c} \textbf{TSB} \\ \textbf{TSA} + \textbf{YE} \end{array}$	Tryptic Soy Agar Veest Extract
TTC	Tryptic Soy Agar + Yeast Extract 2,3,5 Triphenyl-2H-Tetrazolium Chloride
	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference
UMR	within the sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate
43242	Tylose Lysine Deoxyenolae

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745 E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24082816-20 & 22-24

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number: 24082816-24

SPN: -

Date of Report: 29/11/2024

Revision Date: Not Applicable

Sample(s) Collected: 28/08/2024

Sample(s) Submitted: 28/08/2024

Temperature on Arrival: 1.7°C

Number of Samples: 8

Analysis Started: 28/08/2024

Analysis Completed: 17/09/2024

Prepared By: Rushell Hart, Technical Assistant

Travis Garnett,

Senior Analyst

Approved By

Jaidene Webster Jones, Quality Control Officer

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #4 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	298 @ 24.4°C	-	120.0 – 300
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	0.03	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	1.3	D/D)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	0.3	P(P)	-
Chloride (mg Cl ⁻ /L)	H-8206	29.7	P(1)	5.0 – 20.0
Sulfate (mg SO ₄ ²⁻ /L)	H-8051	27	E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	14.4	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	15	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.3	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	2442	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #3 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

	Test	D 14	01:6:	NRCA AMBIENT
Parameters (Unit)	Method Results		Qualifier	FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	5040 @ 23.9°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.05	-	0.01 – 0.8
Nitrate and Nitrite (mg NO ₃ -& NO ₂ -/L)		41.2	D(1) D(C)	0.1 - 7.5
Nitrate and Nitrite as Nitrogen (mg NO ₃ -& NO ₂ -N/L)	H-8039	9.4	P(1), D(C), E(M1), P(P)	-
Chloride (mg Cl ⁻ /L)	H-8206	2180.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO4 ² -/L)	H-8051	350	D(C), E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	5.5	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	36	P(P) D(C)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.2	E(M3)	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	11.1	P(P)	-
Potassium (μg K/L)	EPA 200.7	39077	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #2 (Surface Water)

 $- \square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	15820 @ 23.3°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.03	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	1.3	P(P), E(M3)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	0.3	F(F), E(M3)	-
Chloride (mg Cl ⁻ /L)	H-8206	7840.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	1050	E(M1), P(1), D(C)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	7.0	-	•
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	60	P(P), D(C), E(M1)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.8	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	10.2	P(P)	-
Potassium (μg K/L)	EPA 200.7	141352	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #1 (Groundwater) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	1216 @ 23.7°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.14	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	8.3	P(P), E(M1), D(1)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	1.9		-
Chloride (mg Cl ⁻ /L)	H-8206	286.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	70	E(M1), P(1), D(C)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	<1.6	BDL	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	8	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.8	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	3728	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: AH (Groundwater)

- $\square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	6.97 @ 22.8°C	b(1)	7.00 - 8.40
Conductivity (µS/cm)	DR	2260 @ 24.8°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1464 @ 24.5°C	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	H-8039	17.7	E(M1), D(C), P(P)	0.1 – 7.5
Nitrate as Nitrogen (mg NO ₃ - N/L)	П-8039	4.0		-
Total Coliform (MPN/100mL)	SM-9221	79	-	-
Faecal Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Sulfate (mg SO4 ²⁻ /L)	H-8051	55	D(C), E(M1), P(1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	584.0	D(C)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	834.3	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	0.2	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	112336	P(P), P(1) D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	134	P(P), P(1) D(I)	-
Magnesium (μg Mg/L)	EPA 200.7	40914	P(P), P(1) D(C)	3600 – 27000
Potassium (μg K/L)	EPA 200.7	3556	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent)

- \square C(B) \boxtimes C(C) \square C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.20 @ 24.3°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	62.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	1442.8	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	40500	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	8283	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	1.94	P(P), D(C), P(1)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D2 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	4.08 @ 23.7°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	61.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	2480.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	90250	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	14321	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	5.50	P(P), D(C), P(1)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D3 (Trade Effluent)

- $\square C(B) \boxtimes C(C) \square C(L)$

Parameters (Units)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH Units)	DR	3.94 @ 23.7°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	58.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	2950.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	98000	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	14375	D(C), P(1)	<30
Potassium (g K/L)	EPA 200.7	5.93	P(P), D(C), P(1)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Parameter: pH (DR)

QEHL Personnel: S. Crooks Date of Analysis: 28/08/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	4.04	24.1
6.90 - 7.10	7.02	24.1
9.96 - 10.04	10.02	24.2

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: J. Webster Jones Date of Analysis: 03/09/2024

•		· ·	
	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		3000.0	3.4
ВИ		2900.0	3.4
SRS	358-465	417.5	

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: J. Webster Jones Date of Analysis: 04/09/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		4266.7	4.8
БЪ		4066.7	4.0
SRS	358-465	417.5	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: R. Stephens Date of Analysis:28/08/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		< 0.02	
RB		< 0.02	
DD		0.91	2.2
BD		0.89	2.2
SRS	1.93-2.07	1.99	

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Parameter: Sulfate (H-8051)

QEHL Personnel: R. Ford, S. Robinson Date of Analysis: 12/09/2024

	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ²⁻ /L)	RPD (%)
MB		<1	
BD		150	0.0
БD		150	0.0
SRS	46 - 62	54	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 03/09/2024

	-	<u> </u>	
	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<11	
BD		90000	0.6
ъD		90500	0.6
SRS	490-510	498	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 03/09/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
DD		530	0.0
BD		530	0.0
SRS	121-129	127	

Parameter: Chloride (H-8206)

QEHL Personnel: A. St. Marie Date of Analysis: 03/09/2024

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
DD.		5.5	0.0
BD		5.5	0.0
SRS	92.2- 107.8	100.4	

Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: T. Thompson, J. Webster-Jones, S. Crooks Date of Analysis: 29/08/2024

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Parameter: Total Hardness (SM-2340 C)

QEHL Personnel: A. St. Marie Date of Analysis: 09/09/2024

	Standard Concentration (mg CaCO ₃ /L)	Determined Concentration (mg CaCO ₃ /L)	RPD (%)
BD		302.6	2.5
БD		292.0	3.5
SRS	0.91 - 1.09	1.01	

Parameter: Conductivity (DR)

QEHL Personnel: S. Crooks Date of Analysis: 28/08/2024

Standard (µS/cm)	Instrument Reading (µS/cm)	Temperature (°C)
1399-1427	1413	24.9

Parameter: HR Nitrate (H-8039)

QEHL Personnel: T. Clarke Date of Analysis: 29/08/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.8	
RB		0.7	
BD		160.6	4.2
ВО		154.0	4.2
SRS	8.5-11.4	9.2	

Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Stephens & S. Robinson Date of Analysis: 17/09/2024

	Standard Concentration (mg NO3 ⁻ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.7	
RB		0.7	
DD.		20.5	2.4
BD		21.0	2.4
SRS	8.5-11.4	8.7	

Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Crooks Date of Analysis: 28/08/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909-928	918	24.4

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Standard Additions

QEHL Personnel: R. Stephens Date of Analysis: 29/08/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)	
	Standard addition	Standard		2.50	1.60	64
#2		1.3	5.00	3.20	64	
	checks*		7.50	5.00	67	

^{*}Equation of the line y = 0.664x + 1.26

Parameter: Faecal and Total Coliform (SM-9221)

QEHL Personnel: L. Wilson Date of Analysis: 28/08/2024

Media/Test Item (Batch #)	DS LTB (27/08/2024)	SS LTB (27/08/2024)	BG Broth (06/09/2024)	EC Broth (03/09/2024)
Sterile (Yes/No)	Yes	Yes	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical	Typical	Typical

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 12/09/2024

*Additional Quality Control Information can be provided upon request.

Parameter: Fats, Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 11/09/2024

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 13/09/2024

*Additional Quality Control Information can be provided upon request.

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Glossary

%	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA BG	Bile Esculin Azide Agar Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BSA	Bismuth Sulfite Agar
C	parameter analysed in the field
C(B)	Samples collected by the client and picked up by an ESL bearer
C(C)	Samples collected by the client and delivered to ESL
C(H)	Analytical sample submitted in incorrect container. This may affect data quality.
C(L)	Samples collected by ESL
C(S)	Sample collected by the client then sub-sampled and delivered by ESL.
CFU	Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
Col	Colourimetry
CVAAS	Cold Vapour Atomic Absorption Spectroscopy
D(I)	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D(C)	Sample diluted due to high concentration of target analyte
DR	Direct Reading
DS ADB	Double Strength Azide Dextrose Broth
DS LTB	Double Strength Lauryl Tryptose Broth
DS PAB	Double Strength Pseudomonas Asparagine Broth
EB	Equipment Blank
E(E1)	Estimated Value. Data acquisition affected by equipment malfunction.
E (L 1)	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this
	may be affected by same bias.
E(L2)	Estimated Value due to the nature of the sample matrix.
E (M1)	Estimated Value. Result calculated using calibration curve.
E (M2)	Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
E(M3)	recovery. Estimated Value. Sample performance indicate presence of interference
E(R)	Estimated Value. RPD value was outside control limits.
EC	E. coli Media
E(V)	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EC-MUG	E. coli Media with 4- m ethyl u mbelliferyl- β - D-g lucuronide
EHU	Environmental Health Unit
EPA	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy
FAES	Flame Atomic Emission Spectroscopy
FB	Field Blank
FD	Field Duplicate
FL-PRO	Florida Petroleum Range Organic Method
GC-MS	Gas Chromatography Mass Spectrometry
H	Hach Water Analysis Workbook
$\mathbf{H}(\mathbf{A})$	Off-scale high data obtained. Actual value may be greater than value given.

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ICP	Inductively Coupled Plasma
ISE	Ion Selective Electrode
LCA	Listeria Chromogenic Agar
LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23 rd Edition
SRS	Standard Reference Solution
SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
T(H)	Samples arrived at ESL-QEHL outside holding temperature (≤4.0°C).
TIT	Titrimetry
TPH	Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Agai Tryptic Soy Broth
TSA + YE	Tryptic Soy Agar + Yeast Extract
TTC	2,3,5 Triphenyl-2H-Tetrazolium Chloride
110	
UMR	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference
WITO	within the sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745 E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24092517-22

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number: 24092517-23

SPN:

Date of Report: 29/11/2024

Revision Date: Not Applicable

Sample(s) Collected: 25/09/2024

Sample(s) Submitted: 25/09/2024

Temperature on Arrival: 1.4°C

Number of Samples: 7

Analysis Started: 25/09/2024

Analysis Completed: 31/10/2024

Prepared By: Rushell Hart, Technical Assistant

Verified By Shanice Robinson,

Senior Analyst

Approved By

Jaidene Webster Jones, Quality Control Officer

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #2 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	161 @ 23.8°C	-	120.0 – 300
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	0.31	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	Н 9020	<1.3	D(D) LIMB	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	<0.3	P(P), UMR	-
Chloride (mg Cl ⁻ /L)	H-8206	8.2	P(1)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	14	E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	66.0	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	56	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	3.4	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	2697	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: #3 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	192 @ 23.4°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.25	-	0.01 - 0.8
Nitrate (mg NO ₃ -/L)	H-8039	<1.3	D/D) LIMD	0.1 - 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	<0.3	P(P), UMR	-
Chloride (mg Cl ⁻ /L)	H-8206	21.4	P(1)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	11	E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	124.0	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	40	P(P), D(C)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	3.4	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	12.2	P(P)	-
Potassium (μg K/L)	EPA 200.7	2260	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: #1 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	279 @ 23.1°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.34	-	0.01 - 0.8
Nitrate (mg NO ₃ -/L)	H-8039	<1.3	D/D) IIMD	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-8039	<0.3	P(P), UMR	-
Chloride (mg Cl ⁻ /L)	H-8206	55.6	P(1)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	18	E(M1), D(C)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	35.1	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	59	P(P) D(C) E(M1)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.1	-	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	2943	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: PW3 (Groundwater)

- $\square C(B) \boxtimes C(C) \square C(L)$

Sample 1D (Matrix) - Quamier, 1 W3 (Groundwater)				
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	7.49 @ 23.0°C	b(1)	7.00 - 8.40
Conductivity (µS/cm)	DR	1893 @ 23.7°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1234 @ 23.7°C	-	120.0 – 300
Total Suspended Solids (mg/L)	SM-2540 D	2.7	-	-
Nitrate (mg NO ₃ -/L)		8.5	E(M1), D(I),	0.1 - 7.5
Nitrate as Nitrogen (mg NO3 ⁻ -N/L)	Н-8039	1.9	P(P)	-
Total Coliform (MPN/100mL)	SM-9221	49	-	-
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	0.12	-	0.01 – 0.8
Faecal Coliform (MPN/100mL)	SM-9221	2.0	-	-
Sulfate (mg SO ₄ ² -/L)	H-8051	88	D(C), E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	318.0	D(C), P(1)	5.0 - 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	505.2	P(1), P(P)	127.0 – 381.0
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	11	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	4.8	E(M3)	0.8 – 1.7
Fats, Oil & Grease (mg/L)	SM-5520 B	6.0	P(P)	-
Sodium (µg Na/L)	EPA 200.7	161354	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	585	P(P), P(1) D(I)	-
Magnesium (µg Mg/L)	EPA 200.7	19341	P(P), P(1), D(C)	3600 – 27000
Potassium (μg K/L)	EPA 200.7	3878	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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.Sample ID (Matrix) - Qualifier: CH (Groundwater)

- $\square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	6.70 @ 23.4°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	2290 @ 24.8°C	-	150.0 - 600
Total Dissolved Solids (mg/L)	DR	1488 @ 24.8°C	-	120.0 - 300
Nitrate (mg NO ₃ -/L)	H-8039	15.9	E(M1),	0.1 – 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	Н-8039	3.6	D(I), P(P)	-
Total Coliform (MPN/100mL)	SM-9221	9.3	-	-
Faecal Coliform (MPN/100mL)	SM-9221	1.8	-	-
Sulfate (mg SO4 ² -/L)	H-8051	96	D(C), E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	440.0	D(C)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	721.0	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	4.1	E(M3)	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	158377	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	60.4	P(P), P(1) D(I)	-
Magnesium (μg Mg/L)	EPA 200.7	49288	P(P), P(1), D(C)	3600 – 27000
Potassium (µg K/L)	EPA 200.7	2571	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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A division of



Sample ID (Matrix) - Qualifier: PW2 (Groundwater)

- $\square C(B) \boxtimes C(C) \square C(L)$

				. , , , , , , , , , , , , , , , , , , ,
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	6.67 @ 24.4°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	1902 @ 24.5°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1232 @ 24.4°C	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	H-8039	10.6	E(M1),	0.1 – 7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-0039	2.4	D(C), P(P)	-
Total Coliform (MPN/100mL)	SM-9221	49	-	-
Faecal Coliform (MPN/100mL)	SM-9221	49	-	-
Sulfate (mg SO4 ² -/L)	H-8051	88	D(C), E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	348.0	D(C)	5.0 – 20.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	458.9	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.7	E(M3)	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	179832	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	59.0	P(P) P1) D(I)	-
Magnesium (μg Mg/L)	EPA 200.7	26996	P(P), P(1), D(C)	3600 – 27000
Potassium (μg K/L)	EPA 200.7	3051	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Sample ID (Matrix) - Qualifier: P (Potable Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
pH (pH units)	DR	5.14 @ 24.1°C	b(1)	7.00 – 8.40
Turbidity (NTU)	EPA 180.1	<0.41	BDL	-
Nitrate (mg NO ₃ -/L)	11 0020	<1.3	BDL, P(P),	0.1 – 7.5
Nitrate as Nitrogen (mg NO3 - N/L)	H-8039	<0.3	P(1)	-
Total Coliform (MPN/100mL)	SM-9221	12	-	-
Total Aerobic Plate Count (CFU/mL)	SM-9215 B	7.8×10^3	-	-
E. coli (MPN/100mL)	SM-9221	<1.1	-	-
Pseudomonas aeruginosa (MPN/100ml)	SM-9213 F	2.0	-	-
Sulfate (mg SO4 ² -/L)	H-8051	3	E(M1)	3.0 – 10.0
Chloride (mg Cl ⁻ /L)	H-8206	408.0	D(C), P(1)	5.0 – 20.0

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

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Parameter: Turbidity (EPA 180.1)

QEHL Personnel: R. Stephens, T. Clarke

Date of Analysis: 26/09/2024

	Standard Concentration (NTU)	Determined Concentration (NTU)	RPD (%)
BD		< 0.41	
DD		< 0.41	_
SRS	9.00- 11.00	9.70	

Parameter: Fats, Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 09/10/2024

Parameter: Total Aerobic Plate Count (SM-9215 B)

QEHL Personnel: T. Garnett Date of Analysis: 25/09/2024

Media/Test Item	PCA	0.1% 9ml Pep Water	
(Batch#)	(19/09/2024)	(20/09/2024)	
Sterile	Yes	Yes	
(Yes/No)	Tes	1 68	
Media performance	Typical	Typical	
(Typical, not typical)	Typical	Typical	

Parameter: pH (DR)

QEHL Personnel: S. Crooks Date of Analysis: 25/09/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	3.97	23.6
6.90 - 7.10	7.05	24.1
9.96 - 10.04	10.02	24.7

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: A. St. Marie, S. Robinson Date of Analysis: 30/09/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		66.4	1.0
ВО		65.7	1.0
SRS	358-465	417.5	

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 10/11/2024

*Additional Quality Control Information can be provided upon request.

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Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 31/10/2024

*Additional Quality Control Information can be provided upon request.

Parameter: Orthophosphates (H-8048)

QEHL Personnel: T. Clarke, R. Stephens Date of Analysis: 25/09/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		< 0.02	
RB		< 0.02	
PD		1.13	2.6
BD		1.09	3.6
SRS	1.96-2.04	2.01	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: T. Clarke Date of Analysis: 26/09/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		< 0.02	
RB		< 0.02	
PD.		65.50	0.0
BD		65.50	0.0
SRS	1.96-2.04	2.01	

Parameter: Sulfate (H-8051)

QEHL Personnel: R. Ford, S. Robinson Date of Analysis: 27/09/2024

	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ² -/L)	RPD (%)
MB		<1	
BD		14	0.0
БЪ		14	0.0
SRS	46-62	61	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 08/10/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
BD		45	0.0
DD		45	0.0
SRS	121-129	122	

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Parameter: Chloride (H-8206)

QEHL Personnel: B. Davis, R. Ford Date of Analysis: 27/09/2024

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
BD		320.0	1.2
BD		316.0	1.2
SRS	95.3- 104.7	103.6	

Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: T. Thompson, J. Webster-Jones, S. Williams Date of Analysis:26/09/2024

Parameter: Total Hardness (SM-2340 C)

OEHL Personnel: R. PryceDate of Analysis: 15/10/2024

	Standard Concentration (mg CaCO ₃ /L)	Determined Concentration (mg CaCO ₃ /L)	RPD (%)
BD		184.4	0.4
ВD		185.2	0.4
SRS	0.91 - 1.09	1.03	

Parameter: Total Hardness (SM-2340 C)

QEHL Personnel: R. Pryce Date of Analysis: 26/10/2024

	Standard Concentration (mg CaCO ₃ /L)	Determined Concentration (mg CaCO ₃ /L)	RPD (%)
BD		102.3	0.4
BD		103.2	0.4
SRS	0.91 – 1.09	1.05	

Parameter: Conductivity (DR)

QEHL Personnel: S. Crooks Date of Analysis: 25/09/2024

Standard (µS/cm)	Instrument Reading (µS/cm)	Temperature (°C)
1399-1427	1413	24.9

Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Crooks Date of Analysis: 25/09/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909-928	918	24.9

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Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Stephens, T. Clarke

Date of Analysis: 26/09/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.7	
RB		0.7	
BD		15.9	0.0
BD		15.9	0.0
SRS	8.5-11.4	9.2	

Parameter: Pseudomonas aeruginosa (SM-9213 F)

QEHL Personnel: T. Garnett Date of Analysis: 25/09/2024

Media/Test Item (Batch #)	SS Asparagine Broth (19/09/2024)	DS Asparagine Broth (12/09/2024)	Acetamide Agar (24/09/2024)
Sterile (Yes/No)	Yes	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical	Typical

Parameter: E. Coli (SM-9221)

QEHL Personnel: T. Garnett Date of Analysis: 25/09/2024

Media/Test Item	DS LTB	EC MUG	
(Batch #)	(24/09/2024) (27/09/2024)		
Sterile	Yes	Yes	
(Yes/No)	Tes	Tes	
Media performance	T1	Transita al	
(Typical, not typical)	Typical	Typical	

Parameter: Faecal and Total Coliform (SM-9221)

QEHL Personnel: T. Garnett Date of Analysis: 25/09/2024

Media/Test Item (Batch #)	DS LTB (24/09/2024)	SS LTB (24/09/2024)	BG (27/09/2024)	EC (04/10/2024)
Sterile (Yes/No)	Yes	Yes	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical	Typical	Typical

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Glossary

%	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA	Bile Esculin Azide Agar
BG	Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BSA	Bismuth Sulfite Agar
C(P)	parameter analysed in the field
C(B)	Samples collected by the client and picked up by an ESL bearer
C(C)	Samples collected by the client and delivered to ESL
C(H)	Analytical sample submitted in incorrect container. This may affect data quality.
C(L)	Samples collected by ESL
C(S)	Sample collected by the client then sub-sampled and delivered by ESL.
CFU	Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
Col	Colourimetry
CPD	Cold Venezuia Absorption Spectroscopy
CVAAS	Cold Vapour Atomic Absorption Spectroscopy
D(I)	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D(C) DR	Sample diluted due to high concentration of target analyte Direct Reading
DS ADB	Double Strength Azide Dextrose Broth
DS LTB	Double Strength Lauryl Tryptose Broth
DS PAB	Double Strength Pseudomonas Asparagine Broth
EA	Enterococcosel Agar
EB	Equipment Blank
E(E1)	Estimated Value. Data acquisition affected by equipment malfunction.
	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this may be
E(L1)	affected by same bias.
E(L2)	Estimated Value due to the nature of the sample matrix.
E (M 1)	Estimated Value. Result calculated using calibration curve.
	Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
E(M2)	recovery.
E(M3)	Estimated Value. Sample performance indicate presence of interference
E(R)	Estimated Value. RPD value was outside control limits.
EC	EC Broth
E(V)	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EC-MUG	E. coli Media with 4-methylumbelliferyl-β-D-glucuronide
EHU	Environmental Health Unit
EPA	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy
FAES	Flame Atomic Emission Spectroscopy
FB	Field Blank
FD	Field Duplicate
FL-PRO	Florida Petroleum Range Organic Method
GC-MS	Gas Chromatography Mass Spectrometry
H	Hach Water Analysis Workbook
H(A)	Off-scale high data obtained. Actual value may be greater than value given.
ICP	Inductively Coupled Plasma
ISE	Ion Selective Electrode
LCA	Listeria Chromogenic Agar

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LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23 rd Edition
SRS	Standard Reference Solution
SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
T(H)	Samples arrived at ESL-QEHL outside holding temperature ($\leq 4.0^{\circ}$ C).
TIT	Titrimetry
TPH	Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Agai
TSA + YE	Tryptic Soy Agar + Yeast Extract
TTC	2,3,5 Triphenyl-2H-Tetrazolium Chloride
	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference within the
UMR	sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate
ALD	Aylose Lysine Deoxycholate

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745 E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24103107-10 & 12-14

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number: 24103107-14

SPN: -

Date of Report: 23/12/2024

Revision Date: Not Applicable

Sample(s) Collected: 31/10/2024

Sample(s) Submitted: 31/10/2024

Temperature on Arrival: 2.2°C

Number of Samples: 7

Analysis Started: 01/11/2024

Analysis Completed: 13/11/2024

Prepared By: Rushell Hart, Technical Assistant

Verified By Reena Mckenzie,

QMS Manager

Approved By ...

Rashidah Khan-Haqq,

Manager, EHAS

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #2 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	273 @ 24.5°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.22	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	VI 0000	<1.3	D(1) DDI	0.1-7.5
Nitrate as Nitrogen (mg NO3 ⁻ -N/L)	H-8039	<0.3	P(1), BDL	-
Chloride (mg Cl ⁻ /L)	H-8206	12.0	P(1)	5.0 – 20.0
Sulfate (mg SO ₄ ²⁻ /L)	H-8051	20	E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	13.7	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	23	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	4.9	E(M3)	0.8 – 1.7
Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (µg K/L)	EPA 200.7	2302	P(P), P(1),	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #4 (Surface Water)

 $- \square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	364 @ 24.1°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.27	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	Y 0000	<1.3	D(1) LIMD	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	<0.3	P(1), UMR	-
Chloride (mg Cl ⁻ /L)	H-8206	47.4	P(1)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	29	E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	10.1	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	13	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.7	E(M3)	0.8 – 1.7
Oil & Grease (mg/L)	SM-5520 B	<5.0	P(P), BDL	-
Potassium (µg K/L)	EPA 200.7	2819	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #1 (Surface Water)

- \square C(B) \boxtimes C(C) \square C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	4660 @ 23.8°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.24	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	7.5	D(1) E(M1)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)		1.7	P(1), E(M1)	-
Chloride (mg Cl ⁻ /L)	H-8206	2360.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	320	E(M1), P(1), D(C)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	18.7	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	20	P(P), D(C)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	3.1	E(M3)	0.8 – 1.7
Oil & Grease (mg/L)	SM-5520 B	5.7	P(P)	-
Potassium (µg K/L)	EPA 200.7	202552	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #3 (Groundwater)

- \square C(B) \boxtimes C(C) \square C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	1244 @ 24.3°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.14	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	7.2	P(1), D(C),	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)		1.6	E(M1)	-
Chloride (mg Cl ⁻ /L)	H-8206	328.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ²⁻ /L)	H-8051	83	E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	<1.6	BDL	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	43	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.2	-	0.8 – 1.7
Oil & Grease (mg/L)	SM-5520 B	5.2	P(P)	-
Potassium (µg K/L)	EPA 200.7	809	P(P), P(1), D(C)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent)

$-\Box C(B) \boxtimes C(C)$	\mathbf{C}) $\square \mathbf{C}(\mathbf{L})$
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Parameters (Unit)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH units)	DR	4.05 @ 23.5°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	42.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	5500.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	101000	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	16139	P(1), D(C)	<30
Potassium (g K/L)	EPA 200.7	5.89	P(P), P(1),D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

Sample ID (Matrix) - Qualifier: D2 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH units)	DR	4.06 @ 24.1°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	23.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	6150.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	105000	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	13268	P(1), D(C)	<30
Potassium (g K/L)	EPA 200.7	5.45	P(P), P(1),D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D3 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH units)	DR	4.08 @ 23.5°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	16.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	1266.7	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	87000	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	8098	P(1), D(C)	<30
Potassium (g K/L)	EPA 200.7	4.29	P(P), P(1),D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 03/11/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		3	
BD		10	0.0
БО		10	0.0
SRS	123-137	129	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 03/11/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<11	
DD		428	0.2
BD		427	0.2
SRS	490-510	508	

Parameter: Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 13/11/2024

Parameter: pH (DR)

QEHL Personnel: S. Williams Date of Analysis: 01/11/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	4.03	23.3
6.90 - 7.10	7.05	23.5
9.96 - 10.04	10.04	23.4

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: A. St. Marie Date of Analysis: 04/11/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		6300.0	4.9
БD		6000.0	4.9
SRS	358-465	417.5	

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Parameter: Orthophosphates (H-8048)

QEHL Personnel: T. Clarke Date of Analysis: 01/11/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		< 0.02	
RB		< 0.02	
BD		16.60	1.2
BD		16.40	1.2
SRS	1.96-2.04	1.99	

Parameter: Sulfate (H-8051)

QEHL Personnel: J. Webster-Jones Date of Analysis: 04/11/2024

	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ²⁻ /L)	RPD (%)
MB		<1	
BD		80	0.0
שם		80	0.0
SRS	51-67	58	

Parameter: Chloride (H-8206)

OEHL Personnel: B. DavisDate of Analysis: 01/11/2024

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
DD.		608.0	1.2
BD		600.0	1.3
SRS	95.4- 104.7	98.4	

Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: J. Webster- Jones, S. Williams, T. Thompson Date of Analysis: 01/11/2024

Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Stephens Date of Analysis: 31/10/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.7	
RB		0.7	
BD		1.5	12.5*
BD		1.7	12.5
SRS	8.5-11.4	8.8	

^{*}Duplicates are selected based on the sensitivity of the analytical method.

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Standard Additions

QEHL Personnel: R. Stephens Date of Analysis: 31/10/2024

Sample ID		Unspiked Sample Concentration (mg/L)	Spike Concentration Added (mg/L)	Spike Concentration Recovered (mg/L)	Recovery (%R)
	Standard		2.50	1.00	40
#1	addition	0.7	5.00	2.00	40
	checks*		7.50	3.10	41

^{*}Equation of the line y = 0.412x + 0.68

Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Willimas Date of Analysis: 01/11/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909-928	919	24.8

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 08/11/2024

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 13/11/2024

^{*}Additional Quality Control Information can be provided upon request.

^{*}Additional Quality Control Information can be provided upon request.

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Glossary

μg/L μS/cm Alm Micro siemens per centimetre a Parameter subcontracted ADB Azide Dextrose Broth AIM The Aquaculture, Inland & Marine Products & By-Products Act (Regul AOAC American Organization of Analytical Chemists b (1) Parameter analysed outside of hold-time; samples submitted outside of the anal b (2) Parameter analysed outside of hold-time; analysis authorised by Cli BAM Bacteriological Analytical Manual BD Batch Duplicate BDL Analyte concentration below laboratory determined limit of detecti BDLS Analyte detected below method detection limit (MDL). MDL greater than sta BEA Bile Esculin Azide Agar BG Brilliant Green Bile Broth BGSA Brilliant Green Bulfa Agar BHI Brain Heart Infusion Broth BTEX Benzene, Toluene, Ethylbenzene, Xylene BSA Bismuth Sulfite Agar c parameter analysed in the field C(B) Samples collected by the client and delivered to ESL C(H) Analytical sample submitted in incorrect container. This may affect data C(L) Samples collected by ESL	
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C(H) Analytical sample submitted in incorrect container. This may affect data C(L) Samples collected by ESL	
C(L) Samples collected by ESL	quality.
	1 5
C(S) Sample collected by the client then sub-sampled and delivered by E	ESL.
CFU Colony Forming Units	
CMMEF Compendium of Methods for the Microbiological Examination of Fo	oods
Colourimetry	
CPD Client provided data	
CVAAS Cold Vapour Atomic Absorption Spectroscopy	
D(I) Sample was diluted due to the presence of high levels of non-target analytes or other	r matrix interference
D(C) Sample diluted due to high concentration of target analyte	
DR Direct Reading	
DS ADB Double Strength Azide Dextrose Broth	
DS LTB Double Strength Lauryl Tryptose Broth	
DS PAB Double Strength Pseudomonas Asparagine Broth	
EA Enterococcosel Agar	
EB Equipment Blank	
E(E1) Estimated Value. Data acquisition affected by equipment malfuncti	ion
E(L1) Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC	
affected by same bias.	mines. Results for this may be
E(L2) Estimated Value due to the nature of the sample matrix.	
E(M1) Estimated Value. Result calculated using calibration curve.	
Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on labor	ratory control sample (LCS)
recovery.	amor, control sumple (LCS)
E(M3) Estimated Value. Sample performance indicate presence of interfere	ence
E(R) Estimated Value. RPD value was outside control limits.	
EC EC Broth	
E(V) Estimated Value. Count(s) obtained is/are outside of the method countin	ig range
EC-MUG Estimated value. Countly) obtained is/are outside of the method counting $E. coli$ Media with 4-methylumbelliferyl- β -D-glucuronide	ig range.
Et. con Media with 4-methylumoeinteryi-p-D-glucuronide EHU Environmental Health Unit	
EPA (US) Environmental Protection Agency	
FAAS Flame Atomic Absorption Spectroscopy Flame Atomic Emission Spectroscopy	
FAES Flame Atomic Emission Spectroscopy	
FB Field Blank	
FD Field Duplicate	
FL-PRO Florida Petroleum Range Organic Method	
GC-MS Gas Chromatography Mass Spectrometry	
H Hach Water Analysis Workbook	
H(A) Off-scale high data obtained. Actual value may be greater than value g	given.
ICP Inductively Coupled Plasma	_

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LCA Itsistrica Chromogenic Agar It Data not available date to inhoratory error It A MAC MAC MAC MAC MAC MAC MAC M	ISE	Ion Selective Electrode
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XLD Xvlose Lysine Deoxycholate		
	XLD	Xylose Lysine Deoxycholate

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745 E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24112845 & 47-50

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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The ISO/IEC 17025 accreditation only applies to the tests identified in the Results of Sample Analysis.

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Sample(s) Information

Job Number: 24112845-50

SPN:

Date of Report: 28/12/2024

Revision Date: Not Applicable

Sample(s) Collected: 28/11/2024

Sample(s) Submitted: 28/11/2024

Temperature on Arrival: 3.4°C

Number of Samples: 5

Analysis Started: 28/11/2024

Analysis Completed: 16/12/2024

Prepared By: Rushell Hart, Technical Assistant

u

Travis Garnett,

Client Manager

Approved By

Jaidene Webster-Jones, Quality Control Officer

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #2 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
Total Dissolved Solids (mg/L)	DR	224 @ 23.5°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.32	-	0.01 - 0.8
Nitrate (mg NO ₃ -/L)	11 2020	<1.3	D(1) DDI	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ N/L)	H-8039	<0.3	P(1), BDL	-
Chloride (mg Cl ⁻ /L)	H-8206	11.0	P(1)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	12	E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	87.7	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	9	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	7.8	E(M3)	0.8 – 1.7
Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	2273	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: PW2 (Groundwater)

- $\square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESHWATER STANDARD
Total Dissolved Solids (mg/L)	DR	1327 @ 24.3°C	-	120.0 – 300
pH (pH units)	DR	6.93 @ 24.3°C	b(1)	7.00 – 8.00
Total Coliform (MPN/100mL)	SM-9221	>1600	-	-
Faecal Coliform (MPN/100mL)	SWI-9221	130	-	-
Nitrate (mg NO ₃ -/L)	H-8039	4.4	D(C)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	1.0	D(C)	-
Chloride (mg Cl ⁻ /L)	H-8206	416.0	D(C)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	75	E(M1)	3.0-10.0
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	676.6	P(P), P(1)	127.0 – 381.0
Conductivity (uS/cm)	DR	2040 @ 24.2°C	-	150.0-600
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	0.6	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	150057	P(P), P(1)	4500 – 12000
Magnesium (μg Mg/L)	EPA 200.7	36035	P(P), P(1)	3600 - 27000
Iron (μg Fe/L)	EPA 200.7	32.4	P(P), P(1)	-
Calcium (μg Ca/L)	EPA 200.7	178263	P(P), P(1)	40000 – 101000
Potassium (μg K/L)	EPA 200.7	3228	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent)

- \square C(B) \boxtimes C(C) \square C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH units)	DR	4.07 @ 23.6°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	44.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	3380.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	81400	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	18412	P(1), D(C)	<30
Potassium (g K/L)	EPA 200.7	4.52	P(P), P(1),D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

Please note that the data presented in the table above are determined to be compliant or non-compliant based on the value provided without the incorporation of the measurement uncertainty.

Sample ID (Matrix) - Qualifier: D2 (Trade Effluent) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH units)	DR	3.75 @ 24.2°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	77.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	2820.0	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	123900	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	31000	P(1), D(C), E(M3)	<30
Potassium (g K/L)	EPA 200.7	6.59	P(P), P(1),D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D3 (Trade Effluent)

$-\Box C(B)$	$\boxtimes C(C)$	$\Box C(L)$
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Parameters (Unit)	Test Method	Results	Qualifier	NRCA RADE EFFLUENT STANDARD
pH (pH units)	DR	4.04 @ 24.3°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	62.00	D(C)	5
Total Suspended Solids (mg/L)	SM-2540 D	3637.5	-	All times <150 Monthly average 50
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	74700	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	15367	P(1), D(C)	<30
Potassium (g K/L)	EPA 200.7	3.92	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 03/12/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		3	
PD		24	0.0
BD		24	0.0
SRS	123-137	129	

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 03/12/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<11	
DD.		123800	0.2
BD		124000	0.2
SRS	490-510	500	

Parameter: Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 05/12/2024

Parameter: E. Coli (SM-9221)

QEHL Personnel: T. Russell Date of Analysis: 28/11/2024

Media/Test Item (Batch #)	DS LTB (28/11/2024)	SS LTB (28/11/2024)	EC (09/12/2024)	BGB (03/12/2024)
Sterile (Yes/No)	Yes	Yes	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical	Typical	Typical

Parameter: Total Coliform (SM-9221)

QEHL Personnel: T. Russell Date of Analysis: 28/11/2024

Media/Test Item (Batch #)	DS LTB (28/11/2024)	SS LTB (28/11/2024)	EC (09/12/2024)	BGB (03/12/2024)
Sterile (Yes/No)	Yes	Yes	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical	Typical	Typical

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Parameter: Total Hardness (SM-2340 C)

QEHL Personnel: R. Pryce Date of Analysis: 16/12/2024

	Standard Concentration (mg CaCO ₃ /L)	Determined Concentration (mg CaCO ₃ /L)	RPD (%)
Dunlington		679.1	0.7
Duplicates		674.2	0.7
SRS	0.91 - 1.09	1.01	

Parameter: Conductivity (DR)
OFHI Parameter S Williams

QEHL Personnel: S. Williams Date of Analysis: 29/11/2024

Standard (µS /cm)	Instrument Reading (µS/cm)	Temperature (°C)
1399-1427	1416	24.8

Parameter: Chloride (H-8206)

OEHL Personnel: D. Gavle; R. Ford

Date of Analysis: 02/12/2024

Quite 1 ersonmen 21 Guyle, 10 1 oru		3150 02,12,202	
	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
PΠ		14.5	0.7
BD		14.4	0.7
SRS	95.0-105.0	96.8	

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 11/12/2024

Parameter: Sulfate (H-8051)

QEHL Personnel: A. St. Marie Date of Analysis: 10/12/2024

	Standard Concentration (mg SO ₄ ²⁻ /L)	Determined Concentration (mg SO ₄ ²⁻ /L)	RPD (%)
MB		<1	
PΠ		36	0.0
BD		36	0.0
SRS	55-63	58	

Parameter: pH (DR)

QEHL Personnel: S. Williams Date of Analysis: 29/11/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	4.02	23.4
6.90 - 7.10	7.05	23.7
9.96-10.04	10.04	24.0

^{*}Additional Quality Control Information can be provided upon request.

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Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: A. St. Marie Date of Analysis: 03/12/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		13.3	0.0
שם		13.3	0.0
SRS	358-465	394.5	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: T. Clarke Date of Analysis: 29/11/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		0.02	
RB		< 0.02	
PD		44.00	0.0
BD		44.00	0.0
SRS	1.87-2.13	1.98	

Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: J. Webster-Jones, T. Thompson, S. Williams Date of Analysis: 29/11/2024

Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Stephens Date of Analysis: 29/11/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.6	
RB		0.6	
BD		3.2	0.0
PD		3.2	0.0
SRS	8.5-11.4	10.5	

Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Williams Date of Analysis: 29/11/2024

Standard (mg/L)	Instrument Reading (mg/L)	Temperature (°C)
909 - 928	919	24.8

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla

*Additional Quality Control Information can be provided upon request.

CDL 24112845 & 47-50

Date of Analysis: 12/12/2024

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Glossary

%	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA	Bile Esculin Azide Agar
BG	Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BSA	Bismuth Sulfite Agar
c	parameter analysed in the field
C(B)	Samples collected by the client and picked up by an ESL bearer
C(C)	Samples collected by the client and delivered to ESL
C(H)	Analytical sample submitted in incorrect container. This may affect data quality.
C(L)	Samples collected by ESL
C(S)	Sample collected by the client then sub-sampled and delivered by ESL.
CFU	Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
Col	Colourimetry
CPD	Client provided data
CVAAS	Cold Vapour Atomic Absorption Spectroscopy
D(I)	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D(C)	Sample diluted due to high concentration of target analyte
DR	Direct Reading
DS ADB	Double Strength Azide Dextrose Broth
DS LTB	Double Strength Lauryl Tryptose Broth
DS PAB	Double Strength Pseudomonas Asparagine Broth
EA	Enterococcosel Agar
EB	Equipment Blank
E(E1)	Estimated Value. Data acquisition affected by equipment malfunction.
E(L1)	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this
	may be affected by same bias.
E(L2)	Estimated Value due to the nature of the sample matrix.
E(M1)	Estimated Value. Result calculated using calibration curve.
E(M2)	Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
E(M2)	recovery.
E(M3)	Estimated Value. Sample performance indicate presence of interference
E(R)	Estimated Value. RPD value was outside control limits.
EC	EC Broth
E(V)	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EC-MUG	E. coli Media with 4-methylumbelliferyl-β-D-glucuronide
EHU	Environmental Health Unit
EPA	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy
FAES	Flame Atomic Emission Spectroscopy
FB	Field Blank
FD	Field Duplicate
FL-PRO	Florida Petroleum Range Organic Method
GC-MS	Gas Chromatography Mass Spectrometry
H	Hach Water Analysis Workbook

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H(A)	Off-scale high data obtained. Actual value may be greater than value given.
ICP	Inductively Coupled Plasma
ISE	Ion Selective Electrode
LCA	Listeria Chromogenic Agar
LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per knogram
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	
	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23 rd Edition
	Standard Methods for the Examination of Water and Wastewater 25 Edition
SRS SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth Single Strength Pseudomonas Asparagine Broth
SS PAB	
T(H)	Samples arrived at ESL-QEHL outside holding temperature (≤4.0°C).
TIT	Titrimetry
TPH	Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Broth
TSA + YE	Tryptic Soy Agar + Yeast Extract
TTC	2,3,5 Triphenyl-2H-Tetrazolium Chloride
UMR	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference
	within the sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate

End of Report

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7 Hillview Avenue, Kingston 10, Jamaica Tel: (876) 978-9519, 978-6297, 978-5902 Fax: (876) 946-3745

E-mail: envirsol@cwjamaica.com

Certificate of Sample Analysis

CSA#: CDL 24121138-43 & 45-47

Attention:

Ms. Flovia Riley Clarendon Distillers Limited 10th Floor, The Towers 25 Dominica Drive Kingston 5

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Sample(s) Information

Job Number: 24121138-47

SPN: -

Date of Report: 12/03/2025

Revision Date: Not Applicable

Sample(s) Collected: 11/12/2024

Sample(s) Submitted: 11/12/2024

Temperature on Arrival: 3.7°C

Number of Samples: 9

Analysis Started: 11/12/2024

Analysis Completed: 23/12/2024

Prepared By: Rushell Hart, Technical Assistant

Travis Garnett, Senior Analyst

Verified By

Quality Control Officer

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Results of Sample Analysis

Sample ID (Matrix) - Qualifier: #2 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	304 @ 23.7°C	-	120.0 – 300
Orthophosphate (mg PO4 ³⁻ /L)	H-8048	0.12	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	H-8039	<1.3	P(1), BDL	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	П-6039	<0.3		-
Chloride (mg Cl ⁻ /L)	H-8206	16.9	P(1)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	19	E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	18.0	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	12	P(P)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	0.7	-	0.8 – 1.7
Oil & Grease (mg/L)	SM-5520 B	<5.0	BDL, P(P)	-
Potassium (μg K/L)	EPA 200.7	1002	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #3 (Surface Water) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	368 @ 23.4°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	0.13	-	0.01 – 0.8
Nitrate (mg NO ₃ -/L)	11 9020	<1.3	P(1), BDL	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	<0.3		-
Chloride (mg Cl ⁻ /L)	H-8206	38.1	P(1)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	26	E(M1), P(1)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	14.0	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	150	P(P), D(I) E(M1)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	2.4	-	0.8 – 1.7
Oil & Grease (mg/L)	SM-5520 B	<5.0	P(P), BDL	-
Potassium (μg K/L)	EPA 200.7	1526	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: #1 (Surface Water)

 $- \Box C(B) \boxtimes C(C) \Box C(L)$

1 , ,		- () — - (-) —	()	
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Dissolved Solids (mg/L)	DR	4220 @ 23.6°C	-	120.0 – 300
Orthophosphate (mg PO ₄ ³⁻ /L)	H-8048	0.11	-	0.01 – 0.8
Nitrate & Nitrite (mg NO ₃ -&NO ₂ -/L)	Н-8039	34.4	P(1), E(M1),	0.1-7.5
Nitrate & Nitrite as Nitrogen (mg NO ₃ -&NO ₂ -N/L)		7.8	P(P), D(I)	-
Chloride (mg Cl ⁻ /L)	H-8206	1840.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO ₄ ² -/L)	H-8051	290	E(M1), P(1), D(C)	3.0 - 10.0
Total Suspended Solids (mg/L)	SM-2540 D	9.6	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	115	P(P), D(I), E(M1)	-
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.0	-	0.8 – 1.7
Oil & Grease (mg/L)	SM-5520 B	<5.0	P(P), BDL	-
Potassium (μg K/L)	EPA 200.7	40890	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: PW3 (Groundwater) - \Box C(B) \boxtimes C(C) \Box C(L)

Sample ID (Matrix) - Qualit	ier: r w 3 (Gr	oundwater) - 🗆	$C(\mathbf{R}) \boxtimes C(C) \Gamma$	
Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
pH (pH units)	DR	7.60 @ 24.0°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	1908 @ 24.2°C	-	150.0 - 600
Total Dissolved Solids (mg/L)	DR	1238 @ 24.3°C	-	120.0 - 300
Orthophosphate (mg PO4 ³ -/L)	H-8048	0.13	-	0.01 - 0.8
Nitrate (mg NO ₃ -/L)	11 0020	8.6	P(1), D(I),	0.1-7.5
Nitrate as Nitrogen (mg NO3 ⁻ -N/L)	H-8039	1.9	E(M1)	-
Chloride (mg Cl ⁻ /L)	H-8206	328.0	P(1), D(C)	5.0 – 20.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	55	E(M1), P(1) D(C)	3.0-10.0
Total Suspended Solids (mg/L)	SM-2540 D	2.8	-	-
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	10	P(P)	-
Total Coliform (MPN/100mL)	SM-9221	49	-	-
Faecal Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	507.1	P(1), P(P)	127.0 – 381.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.2	-	0.8 – 1.7
Oil & Grease (mg/L)	SM-5520 B	<5.0	P(P), BDL	-
Potassium (µg K/L)	EPA 200.7	3673	P(P), P(1)	740 – 5000
Sodium (µg Na/L)	EPA 200.7	177587	P(P), P(1)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	387	P(P), P(1)	-
Magnesium (μg Mg/L)	EPA 200.7	19999	P(P), P(1)	3600 – 27000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: CH (Groundwater)

- $\square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
pH (pH units)	DR	7.61 @ 24.2°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	2280 @ 24.3°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1480 @ 24.2°C	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	H-8039	10.3	D(I) E(MI)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	Н-8039	2.3	D(I), E(M1)	-
Chloride (mg Cl ⁻ /L)	H-8206	436.0	P(1), D(C)	5.0 – 20.0
Total Coliform (MPN/100mL)	SM-9221	33	-	-
Faecal Coliform (MPN/100mL)	SM-9221	2.0	-	-
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	673.1	P(1), P(P)	127.0 – 381.0
Sulfate (mg SO4 ²⁻ /L)	H-8051	80	E(M1), D(C)	3.0-10.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.1	-	0.8 – 1.7
Potassium (μg K/L)	EPA 200.7	1966	P(P), P(1)	740 – 5000
Sodium (μg Na/L)	EPA 200.7	173731	P(P), P(1), D(C)	4500 - 12000
Iron (μg Fe/L)	EPA 200.7	149	P(P), P(1)	-
Magnesium (μg Mg/L)	EPA 200.7	49414	P(P), P(1)	3600 – 27000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: PW2 (Groundwater) - \Box C(B) \boxtimes C(C) \Box C(L)

Parameters (Unit)	Test Method	Results	Qualifier	NRCA AMBIENT FRESH WATER STANDARD
Total Hardness (mg CaCO ₃ /L)	SM-2340 C	651.4	P(1), P(P)	127.0 – 381.0
pH (pH units)	DR	7.14 @ 23.6°C	b(1)	7.00 – 8.40
Conductivity (µS/cm)	DR	2100 @ 24.2°C	-	150.0 – 600
Total Dissolved Solids (mg/L)	DR	1361 @ 24.3°C	-	120.0 – 300
Nitrate (mg NO ₃ -/L)	11 0020	13.2	D. (1)	0.1-7.5
Nitrate as Nitrogen (mg NO ₃ -N/L)	H-8039	3.0	D(I), E(M1)	-
Chloride (mg Cl ⁻ /L)	H-8206	420.0	P(1), D(C)	5.0 – 20.0
Total Coliform (MPN/100mL)	SM-9221	240	-	-
Faecal Coliform (MPN/100mL)	SM-9221	<1.8	-	-
Sulfate (mg SO4 ² -/L)	H-8051	55	E(M1), D(C)	3.0-10.0
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	1.7	-	0.8 – 1.7
Sodium (µg Na/L)	EPA 200.7	149087	P(P), P(1)	4500 - 12000
Iron (µg Fe/L)	EPA 200.7	17.2	P(P), P(1)	-
Magnesium (μg Mg/L)	EPA 200.7	36068	P(P), P(1)	3600 – 27000
Potassium (µg K/L)	EPA 200.7	2672	P(P), P(1)	740 – 5000

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D1 (Trade Effluent)

- $\square C(B) \boxtimes C(C) \square C(L)$

Parameters (Unit)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH units)	DR	4.05 @ 24.0°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	49.00	D(C)	5.0
Total Suspended Solids (mg/L)	SM-2540 D	3615.0	-	All Times <150 mg/l Monthly average 50 mg/l
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	82000	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	7785	P(1), D(C), E(M3)	<30
Potassium (g K/L)	EPA 200.7	2.73	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D2 (Trade Effluent)

- UC	$(\mathbf{B}) \boxtimes \mathbf{C}(\mathbf{C}) \sqcup \mathbf{C}(\mathbf{L})$
	NRCA TRADE

Parameters (Unit)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH units)	DR	4.12 @ 23.9°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO ₄ ³ -/L)	H-8048	61.00	D(C)	5.0
Total Suspended Solids (mg/L)	SM-2540 D	9020.0	-	All Times <150 mg/l Monthly average 50 mg/l
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	64750	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	7368	P(1), D(C), E(M3)	<30
Potassium (g K/L)	EPA 200.7	4.65	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Sample ID (Matrix) - Qualifier: D3 (Trade Effluent)

-	$\Box \mathbf{C}$	(B)	$\boxtimes C$	(\mathbf{C})	$\Box C(L)$)
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Parameters (Unit)	Test Method	Results	Qualifier	NRCA TRADE EFFLUENT STANDARD
pH (pH units)	DR	3.99 @ 23.4°C	b(1)	6.5 – 8.5
Orthophosphate (mg PO4 ³ -/L)	H-8048	44.00	D(C)	5.0
Total Suspended Solids (mg/L)	SM-2540 D	10670.0	-	All Times <150 mg/l Monthly average 50 mg/l
Chemical Oxygen Demand (mg O ₂ /L)	H-8000	86750	P(P), D(C)	<100
Biochemical Oxygen Demand (mg O ₂ /L)	H-8043	10596	P(1), D(C), E(M3)	<30
Potassium (µg K/L)	EPA 200.7	4.28	P(P), P(1), D(C)	-

^{*}Blue shaded parameters are ISO/IEC 17025:2017 accredited.

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Certificate of Quality

Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 17/12/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<11	
BD		304	0.0
ви		304	0.0
SRS	490-510	498	

Parameter: Oil and Grease (EPA 1664 B)

QEHL Personnel: S. Robinson Date of Analysis: 17/12/2024

Parameter: pH (DR)

QEHL Personnel: S. Williams Date of Analysis: 11/12/2024

Standard (Buffer)	pH After Calibration	Temperature (°C)
3.96 - 4.04	4.04	24.0
6.90 - 7.10	7.04	23.7
9.96 - 10.04	10.01	23.8

Parameter: Total Suspended Solids (SM-2540 D)

QEHL Personnel: A. St. Marie Date of Analysis: 17/12/2024

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	RPD (%)
MB		<1.6	
BD		24.5	2.1
ВД		24.0	2.1
SRS	358 - 465	394.5	

Parameter: Orthophosphates (H-8048)

QEHL Personnel: T. Clarke Date of Analysis: 12/12/2024

	Standard Concentration (mg PO ₄ ³⁻ /L)	Determined Concentration (mg PO ₄ ³⁻ /L)	RPD (%)
MB		< 0.02	
RB		< 0.02	
BD		13.00	1.6
BD		12.80	1.0
SRS	1.87-2.13	1.94	

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Date of Analysis: 17/12/2024

Date of Analysis: 23/12/2024



Parameter: Sulfate (H-8051) QEHL Personnel: A. St. Marie

	Standard Concentration (mg SO4 ² -/L)	Determined Concentration (mg SO ₄ ² -/L)	RPD (%)
MB		<1	
BD		1	0.0
БD		1	0.0
SRS	55-63	60	

Parameter: Chloride (H-8206)

QEHL Personnel: D. Gayle, R. Ford Date of Analysis: 17/12/2024

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
DD.		4620.0	0.0
BD		4620.0	0.0
SRS	94.2- 105.8	96.0	

Parameter: Biochemical Oxygen Demand (H-8043)

QEHL Personnel: R. Khan-Haqq, S. Williams, N. Finlay Date of Analysis: 12/12/2024

Parameter: HR Nitrate (H-8039) QEHL Personnel: R. Stephens

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ - N/L)	RPD (%)
MB		0.7	
RB		0.7	
BD		7.8	0.0
В		7.8	0.0
SRS	8.5-11.4	10.2	

Parameter: Total Dissolved Solids (DR)

QEHL Personnel: S. Williams Date of Analysis: 12/12/2024

Standard (mg/L) Instrument Reading (mg/L)		Temperature (°C)	
909-928	915	24.8	

Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 18/12/2024

*Additional Quality Control Information can be provided upon request.

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Parameter: Metals via EPA 200.7 (EPA 200.7)

QEHL Personnel: N. McCalla Date of Analysis: 19/12/2024

*Additional Quality Control Information can be provided upon request.

Parameter: Total Hardness (SM-2340 C)

QEHL Personnel: R. PryceDate of Analysis: 17/12/2024

	Standard Concentration (mg CaCO ₃ /L)	Determined Concentration (mg CaCO ₃ /L)	RPD (%)
Duplicates		<18.3	
		<18.3] -
SRS	0.91 - 1.09	1.01	

Parameter: HR Nitrate (H-8039)

QEHL Personnel: R. Stephens Date of Analysis: 12/12/2024

	Standard Concentration (mg NO ₃ -N/L)	Determined Concentration (mg NO ₃ -N/L)	RPD (%)
MB		0.6	
RB		0.7	
BD		26.0	0.0
BD		26.0	0.0
SRS	8.5-11.4	10.7	

Parameter: Chloride (H-8206)

QEHL Personnel: D. Gayle; R. Ford Date of Analysis: 16/12/2024

	Standard Concentration (mg Cl ⁻ /L)	Determined Concentration (mg Cl ⁻ /L)	RPD (%)
MB		<3.0	
RB		<3.0	
BD		158.4	0.5
BD		157.6	0.5
SRS	94.2-105.8	97.2	

Parameter: Faecal and Total Coliform (SM-9221)

OEHL Personnel: T. Russell Date of Analysis: 12/12/2024

				v
Media/Test Item	DS LTB	SS LTB	BG	EC Broth
(Batch #)	(11/12/2024)	(11/12/2024)	(18/12/2024)	(18/12/2024)
Sterile	Yes	Yes	Yes	Yes
(Yes/No)	168	168	168	1 68
Media performance	Typical	Typical	Typical	Typical
(Typical, not typical)	1 ypicai	Typical	Typical	Typical

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Parameter: Chemical Oxygen Demand (H-8000)

QEHL Personnel: T. Thompson Date of Analysis: 17/12/2024

	Standard Concentration (mg O ₂ /L)	Determined Concentration (mg O ₂ /L)	RPD (%)
MB		<3	
DD		7	0.0
BD		7	0.0
SRS	123-137	132	

Parameter: Conductivity (DR) QEHL Personnel: S. Williams

Date of Analysis: 11/12/2024

Standard (µS /cm)	Instrument Reading (µS/cm)	Temperature (°C)
1399-1427	1414	24.8

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Glossary

%	Percentage
μg/L	microgram per litre
μS/cm	Micro siemens per centimetre
a	Parameter subcontracted
ADB	Azide Dextrose Broth
AIM	The Aquaculture, Inland & Marine Products & By-Products Act (Regulations)
AOAC	American Organization of Analytical Chemists
b (1)	Parameter analysed outside of hold-time; samples submitted outside of the analysis hold-time
b (2)	Parameter analysed outside of hold-time; analysis authorised by Client
BAM	Bacteriological Analytical Manual
BD	Batch Duplicate
BDL	Analyte concentration below laboratory determined limit of detection
BDLS	Analyte detected below method detection limit (MDL). MDL greater than standard value.
BEA	Bile Esculin Azide Agar
BG	Brilliant Green Bile Broth
BGSA	Brilliant Green Sulfa Agar
BHI	Brain Heart Infusion Broth
BTEX	
	Benzene, Toluene, Ethylbenzene, Xylene
BSA	Bismuth Sulfite Agar
C(D)	parameter analysed in the field
C(B)	Samples collected by the client and picked up by an ESL bearer
C(C)	Samples collected by the client and delivered to ESL
C(H)	Analytical sample submitted in incorrect container. This may affect data quality.
C(L)	Samples collected by ESL
C(S)	Sample collected by the client then sub-sampled and delivered by ESL.
CFU	Colony Forming Units
CMMEF	Compendium of Methods for the Microbiological Examination of Foods
Col	Colourimetry
CPD	Client provided data
CVAAS	Cold Vapour Atomic Absorption Spectroscopy
D(I)	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference
D(C)	Sample diluted due to high concentration of target analyte
DR	Direct Reading
DS ADB	Double Strength Azide Dextrose Broth
DS LTB	Double Strength Lauryl Tryptose Broth
DS PAB	Double Strength Pseudomonas Asparagine Broth
EA	Enterococcosel Agar
EB	
	Equipment Blank
E(E1)	Estimated Value. Data acquisition affected by equipment malfunction.
E(L1)	Estimated Value. Analyte recovery in the laboratory control sample (LCS) was outside of QC limits. Results for this may be
	affected by same bias.
E(L2)	Estimated Value due to the nature of the sample matrix.
E(M1)	Estimated Value. Result calculated using calibration curve.
E(M2)	Estimated Value. Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS)
	recovery.
E(M3)	Estimated Value. Sample performance indicate presence of interference
E(R)	Estimated Value. RPD value was outside control limits.
EC	EC Broth
E(V)	Estimated Value. Count(s) obtained is/are outside of the method counting range.
EC-MUG	E. coli Media with 4-methylumbelliferyl-β-D-glucuronide
EHU	Environmental Health Unit
EPA	(US) Environmental Protection Agency
FAAS	Flame Atomic Absorption Spectroscopy
FAES	Flame Atomic Emission Spectroscopy
FB	Field Blank
FD	Field Duplicate
FL-PRO	Florida Petroleum Range Organic Method
GC-MS	Gas Chromatography Mass Spectrometry
H	Hach Water Analysis Workbook
H(A)	Off-scale high data obtained. Actual value may be greater than value given.
ICP	Inductively Coupled Plasma
	A = = = = = = = = = = = = = = = = = = =
ISE	Ion Selective Electrode

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LE	Data not available due to laboratory error
LIA	Lysine Iron Agar
MAC	MacConkey Agar
MB	Method Blank
mEndo	mEndo Agar/Broth
MFHPB	Microbiology Food Health Protection Branch, Government of Canada
mmhos/cm	Millimhos per centimetre
mg/kg	milligram per kilogram
mg/L	milligrams per litre
MPN	Most Probable Number
mS/cm	millisiemens per centimetre
N/A (1)	Data not yet Available. Analysis not complete.
N/A (2)	Data not Available. Sample matrix interferences prevented data acquisition.
N/A (3)	Data not Available. Insufficient sample submitted.
N/A (4)	Data not Available. Equipment malfunction prevented data acquisition.
N/A (5)	Data not Available. Analysis not complete due to force majeure.
N/A (6)	Data not available due to issues with the shipment of the sample(s).
N/A (7)	Data not available. Technical difficulties experienced by subcontractor.
NA	Nutrient Agar
NB	Nutrient Broth
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NTU	Nephelometric Turbidity Units
NWC	National Water Commission (Jamaica)
NST	No Time given for collection of samples
P(P)	Sample preserved prior to analysis
P(1)	Non-routine sample pre-treatment required
PAB	Pseudomonas Asparagine Broth
PCA	Plate Count Agar
PDA + C	Potato Dextrose Agar with Chloramphenicol
Pep Water	Peptone Water
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RED	Parameter Non-compliant
RPD	Relative Percentage Difference
RSD	Relative Standard Deviation
SM	Standard Methods for the Examination of Water and Wastewater 23 rd Edition
SRS	Standard Reference Solution
SS	Sample Submerged upon receival at the laboratory
SS ADB	Single Strength Azide Dextrose Broth
SS LTB	Single Strength Lauryl Tryptose Broth
SS PAB	Single Strength Pseudomonas Asparagine Broth
T(H)	Samples arrived at ESL-QEHL outside holding temperature ($\leq 4.0^{\circ}$ C).
TIT	Titrimetry
TPH	Total Petroleum Hydrocarbon
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Broth
TSA + YE	Tryptic Soy Agar + Yeast Extract
TTC	2,3,5 Triphenyl-2H-Tetrazolium Chloride
UMR	Analyte detection was below the measuring range of instrument. This is indicative of possible matrix interference within the
Civilia	sample.
WHO	World Health Organization
XLD	Xylose Lysine Deoxycholate
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End of Report