Appendix E, Attachment I – Greenhouse Gases – Assessment of Alternatives

Environmental Statement

East-West Arterial Extension:

Section 2 (Woodland Drive – Lookout Road)

Section 3 (Lookout Road – Frank Sound Road)

Greenhouse Gases FINAL

Assessment of Alternatives Grand Cayman East-West Arterial Extension

NATIONAL ROADS AUTHORITY

April 23, 2024

Table of Contents

List of Tables ii
List of Figures iv
List of Terms v
1 Introduction 1
2 Shortlist Evaluation 1
3 Baseline Conditions 3
3.1 Applicable Standards 4
3.2 Incorporated Traffic Data Methodology 5
4 Anticipated Project Impacts and Methodology 5
4.1 Quantitative 5
4.1.1 Construction Tailpipe Methodology 5
4.1.2 Construction Tailpipe Emissions 7
4.1.3 Commuter and Delivery Tailpipe Emissions 12
4.1.4 Traffic Emissions Methodology 13
4.1.5 Traffic Emissions Discussion 18
4.1.6 Habitat and Peat Methodology 32
4.1.7 Habitat and Peat Emissions 37
4.1.8 Bulk Material Methodology 39
4.1.9 Bulk Material Emissions 39
4.2 Qualitative 45
4.3 Monetary 45
5 Shortlist Evaluation Summary 45
6 References 47

Attachments

Attachment A – Traffic Segment Data by Alternative

Attachment B – Habitat by Alternative

Attachment C – Material Quantities

List of Tables

Table 1: Typical Construction Equipment List ... 6
Table 2: Construction Equipment Emission Factors (g/hr) ... 8
Table 3: Construction Tailpipe GHG Emissions by Alternative ... 9
Table 4: Commuting and Delivery Vehicles ... 13
Table 5: Vehicle Tailpipe GHG Emissions by Alternative ... 13
Table 6: Fuel Distribution by Model Year and Vehicle Type ... 14
Table 7: Segment Data – Morning AM Baseline 2021 ... 17
Table 8: Segment Data Vehicle Type Distribution – Baseline 2021 ... 17
Table 9: Daily Hourly Traffic Volumes and Distribution ... 19
Table 10: Baseline (2021) Annual Emissions (CO_2e) ... 20
Table 11: 2026 No-Build Annual Emissions (CO_2e) ... 22
Table 12: 2026 Alternative B1 Annual Emissions (CO_2e) ... 23
Table 13: 2026 Alternative B2 Annual Emissions(CO_2e) ... 24
Table 14: 2026 Alternative B3 Annual Emissions (CO_2e) ... 25
Table 15: 2026 Alternative Annual Emissions Summary Table (CO_2e) ... 25
Table 16: 2074 No-Build Annual Emissions ... 27
Table 17: 2074 Alternative B1 Annual Emissions ... 28
Table 18: 2074 Alternative B2 Annual Emissions ... 29
Table 19: 2074 Alternative B3 Annual Emissions ... 30
Table 20: 2074 Alternative Annual Emissions Summary Table (CO_2e) ... 30
Table 21: Alternative GHG Emissions ... 31
Table 22: Habitat Biomass Parameters ... 34
Table 23: Habitat Classifications ... 35
Table 24: Habitat Biomass and Impact Area per Alternative ... 36
Table 25: Peat Volume Excavated per Alternative ... 36
Table 26: GHG Emissions from Biomass Removal Across Habitat Types per Alternative ... 37
Table 27: GHG Emissions from Habitat and Peat Impacts per Alternative ... 38
Table 28: Emission Factor/Density by Material Breakdown ... 40
Table 29: Will T Connector Material GHG Emissions ... 41
Table 30a: Alternative B1 Material GHG Emissions ... 42
Table 30b: Alternative B1 Material GHG Emissions ... 42

Table 31a: Alternative B2 Material GHG Emissions 43
Table 31b: Alternative B2 Material GHG Emissions 43
Table 32a: Alternative B3 Material GHG Emissions 44
Table 32b: Alternative B3 Material GHG Emissions 44
Table 33: GHG One-Time Emissions (2024-2026) 45
Table 34: GHG Annual Operational Traffic Emissions (2026 through 2074) 45
Table 35: Overall GHG Expected Emissions by Alternative 46

List of Figures

Figure 1: Shortlist of Build Alternatives.. 2

Figure 2: Annual Greenhouse Gas Emissions by Sector in the Cayman Islands (1990-2022) ((Szanto, 2024)) 4

List of Terms

CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
Cu yd	Cubic Yards
DoE	Department of Environment
EPA	United States Environmental Protection Agency
ESO	Economics and Statistics Office
g/gal	grams per gallons
g/hr	grams per hour
g/veh-mi	grams per vehicle mile
GCM	Grand Cayman Travel Demand Model
GHG	Greenhouse gas
hr/day	hours per day
IPCC	Intergovernmental Panel on Climate Change
m^3	Cubic Metres
MOVES	Motor Vehicle Emission Simulator
MT	Metric tonnes
N_2O	Nitrous Oxide
NEP	National Energy Policy Unit
NRA	National Roads Authority
Ton/yr	Tons per year
ToR	Terms of Reference
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
U.S.	United States

1 Introduction

The East-West Arterial (EWA) Extension Environmental Impact Assessment (EIA) is proposed to evaluate an alternative east-west travel route on Grand Cayman. The Terms of Reference (ToR) for the proposed EWA Extension EIA was finalized on April 4, 2023. Since then, five Build alternatives (B1, B2, B3, B4, and C1), in addition to the No-Build scenario, were developed and assessed as part of the Longlist Alternatives Evaluation. A separate Longlist Alternatives Evaluation Document has been prepared to document this analysis.

As a result of the Longlist Evaluation four Build alternatives (B1, B2, B3, and B4) and the No-Build scenario were advanced to the shortlist evaluation process and Alternative C1 was dismissed. Based on the technical discipline studies, it was determined that Alternative B4 would not meet a number of the identified Critical Success Factors without resulting in significant impacts to properties and resource features along this route. Additional information regarding elimination of Alternative B4 can be found in the Shortlist Alternatives Evaluation Document. Due to these considerations Alternative B4 was not further evaluated and therefore it is not included in this Greenhouse Gases Report.

This report focuses on the assessment of greenhouse gases (GHG) for these shortlisted alternatives (B1, B2, and B3) and the No-Build scenario. Information from this report will be incorporated within the Shortlist Alternatives Evaluation Document and Environmental Statement.

2 Shortlist Evaluation

The following report outlines the procedures to calculate GHG emissions for each alternative and the critical assumptions applied for the analysis.

According to the 2022 United Kingdom (UK) Green Book, which is the Central Government Guidance on Appraisal and Evaluation, "Costs and benefits should be calculated over the lifetime of an intervention. As a guideline, a time horizon of 10 years is a suitable working assumption for many interventions. In some cases, up to 60 years may be suitable, for example for buildings and infrastructure." For this analysis a 50-year time horizon, with a horizon year of 2074, that would represent the life-cycle year for construction was used for the evaluations.

The GHG emissions were established for the following main project components:

- Construction vehicle tailpipe emissions from diesel equipment
- Tailpipe emissions from projected traffic volumes
- Habitat/peat removal
- Bulk building materials

For this analysis the baseline year is defined as year 2021 and representative of existing conditions. This baseline year was established based on the latest available census data. The initial construction phase is anticipated to be 2024-2026. The construction vehicular fleet used in the analysis was set to 2023 to ensure the most conservative emission factor distributions were predicted. The opening year was anticipated as year 2026 and the horizon year is set to 2074. Additional assumptions and methodology are included within **Section 4**.

The Shortlist of Alternatives contained in this GHG report includes the No-Build scenario and three Build alternatives B1, B2, and B3 as shown in **Figure 1.** As shown in **Figure 1,** the three Build alternatives all share the same common section beginning at the western terminus, near Woodland Drive, and continuing east to near Lookout Road. They also share the same common improvements to the local roadway network referred to as the Will T Connector. Additional details describing the Shortlist of Alternatives including full descriptions of each alternative along with typical design sections can be found in the Engineering Evaluation Document.

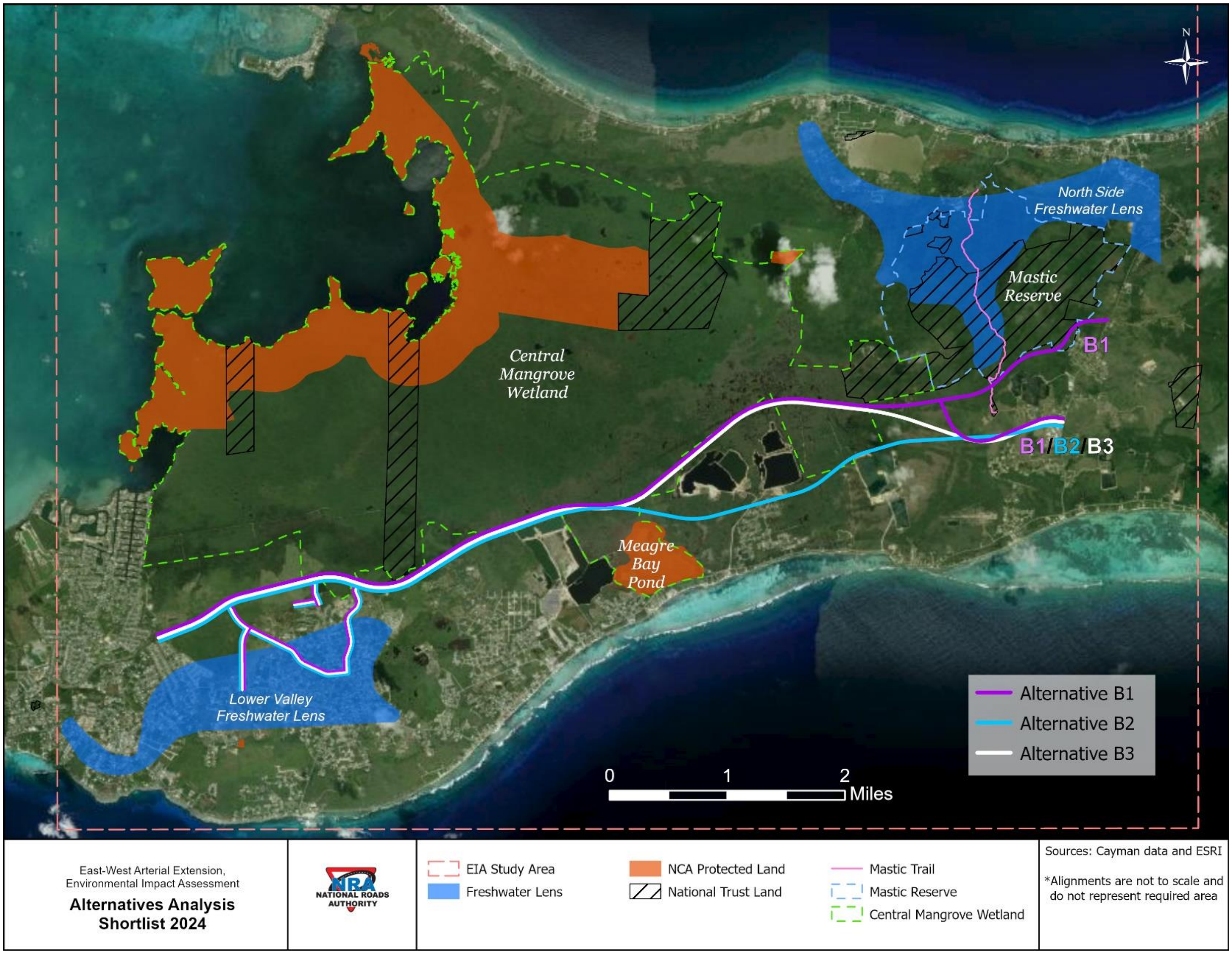

Figure 1: Shortlist of Build Alternatives

3 Baseline Conditions

In the framework of the United Nations Framework Convention on Climate Change (UNFCCC), countries are developing national emissions inventories and propose/implement actions to mitigate GHG emissions. CO_2 emissions, which are connected to global warming, are continuing to increase at world levels despite numerous climate change mitigation agreements. Reporting on GHG emissions for the Cayman Islands is undertaken by the UK as part of its GHG emissions inventory obligations under the UNFCCC and the Kyoto Protocol. As part of this agreement, GHG emissions are reported annually by the DoE to Aether Consulting in the UK for electricity generation and fuel consumption. Data is also collected and submitted to Aether Consulting in the UK on solvent use, waste management, mobile machinery, aircraft and air transport, shipping, and agriculture and forestry.

The Aether Consulting data are broken down into eight general categories including residential, industrial processes, agriculture, land use/land use change and forestry, water management, business, transportation, and energy supply which are shown in **Figure 2** from the years 1990-2022 (Szanto, 2024). GHG emissions do not have as much of a direct effect on individual body pathways (i.e. respiratory, cardiovascular systems) in the short term because the body can handle limited exposures, although they have been found to influence the body through chronic exposure (Naiyer and Abbas 2022). Additionally, GHG will create overall changes in climate over a prolonged period.

In May 2023, the Cayman Islands National Climate Change Committee issued a draft Climate Change Policy (Ministry of Sustainability and Climate Resiliency 2023), which is undergoing revisions and updates. The updated policy's goals will be incorporated into the EIA process, if available. The 2023 draft policy outlines a series of goals and objectives which include:

- Reduce vulnerability and enhance resiliency to climate change
- Promote sustainable, low or zero carbon economic activity
- Establish a governance framework for climate action which is future-focused, fair to all, accountable and transparent
- Resilient Infrastructure Networks

Additionally, the Cayman Islands National Energy Policy Unit (NEP) developed the National Energy Policy 2017-2037 (NEP, 2021). The focus is to utilise more renewable energy, promote energy efficiency/conservation measures, and reduce reliance of imported fossil fuels. As of 2014, the Cayman Islands produced 12.3 metric tons of CO_2e (Carbon dioxide equivalent)[1] per capita. The 2030 goal is to reduce that to 4.8 metric tons of CO_2e per capita. Ultimately, the policy is geared toward 62% utility solar, 3% wind, 3% waste to energy and 2% distributed solar by 2037 (NEP, 2021).

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[1] Note that CO_2e is a mathematical approach that applies global warming potential values for each GHG, which were developed to allow for direct comparisons of global warming impacts of varying gases. For example, CO_2 has a multiplier or potential of 1 while methane has a potential of 25, meaning methane is 25 times more impactful from a warming perspective.

A new draft policy has been updated in late 2023 for 2030-2050 by the NEP as part of their 5-year review process. Twelve key recommendations were developed from private, public, and no-profit stakeholders. Some of which include emphasise of social equity, energy efficiency measures, public awareness campaigns and initiatives to promote electric vehicles (NEP 2023).

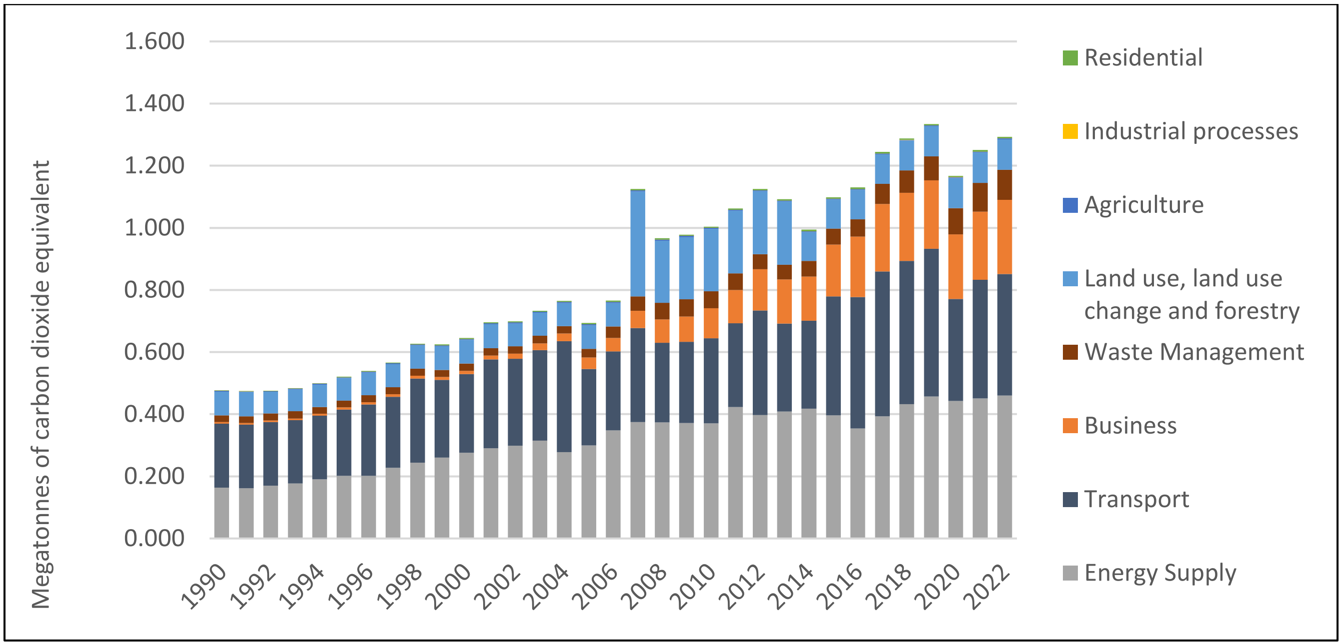

Figure 2: Annual Greenhouse Gas Emissions by Sector in the Cayman Islands (1990-2022) ((Szanto, 2024))

3.1 Applicable Standards

Standards, guidance and draft documentation related to GHG emissions include:

- Cayman Public Health Law, 2002 Revision
- International Finance Corporation Guidance Note 3, 2006
- Draft Cayman Islands' Climate Change Policy, 2023
- UK National Highways: Introduction and General Requirements for Sustainable Development and Design (GG103), Revision 0, 2019
- Cayman Islands National Energy Policy 2017-2037
- Draft Cayman Islands National Energy Policy 2023-2050
- UK National Highways Carbon Tool Guidance Version 2.5, 2022

While there is no Cayman Islands-specific GHG reporting threshold, for context, the United States (U.S.) Environmental Protection Agency (EPA) and the State of Florida determines that 25,000 MT of GHG emissions requires reporting to the agency, and 100,000 MT equates to a large or major source. For the purposes of this analysis, the GHG project significance threshold will be equivalent to the large source threshold (100,000 MT). This threshold provides a numerical comparison for potential project traffic emissions and their general impact.

3.2 Incorporated Traffic Data Methodology

Traffic data utilized within this report was developed for the EWA EIA project as part of the Traffic Evaluation. The traffic data contributed to multiple components within the EWA EIA studies including this GHG evaluation **(Attachment A)**. Additional information regarding the traffic volumes and analysis is contained in the Traffic Evaluation Technical Report. The traffic data was developed using a travel demand model, which is a program used to forecast future traffic flows in a transportation system based on demographic and land use data, available travel modes, the transportation network (number of lanes, traffic control, operating speed), and the most up-to-date estimate of travel costs. These models are typically used to evaluate the impact of planned transportation improvements or changes in land use by forecasting future traffic conditions. The Grand Cayman Travel Demand Model (GCM) was originally developed in 2019 by the National Roads Authority (NRA) using a comprehensive dataset including census socioeconomic data, cruise passenger surveys, long-term visitor surveys, and traffic counts collected across the island to accurately reflect observed travel patterns across the island. The GCM underwent a calibration process where model parameters were adjusted to ensure the model would accurately reflect observed travel patterns; this process was documented and reviewed by outside experts as part of an independent modelling task.

For the EWA EIA, the GCM was updated using the 2021 Economics and Statistics Office (ESO) census data as well as travel time runs and traffic count data collected by the NRA in 2023 within the districts of Bodden Town, North Side, and East End. Within the EWA EIA study area, the GCM was calibrated to this travel time and count data to ensure the model accurately reflects observed existing conditions and can ultimately forecast realistic results under future year conditions.

Population growth for future years 2026 and 2074 was determined based on historical district growth trends from the 2021 ESO census data, and land use inputs were updated based on planned residential and commercial development projects that the NRA identified for the next 30 years. For year 2074, three land use scenarios of low, medium, and high growth were developed based on input from stakeholders and various agencies in Grand Cayman, as detailed in the Land Use Planning Charrette Summary memorandum dated September 8, 2023. Of these three 2074 land use scenarios, the medium growth scenario was carried forward as the “core scenario” for the Shortlist Evaluation, assuming a population of 135,000 people.

4 Anticipated Project Impacts and Methodology

4.1 Quantitative

4.1.1 Construction Tailpipe Methodology

The construction equipment emissions factors were established using the U.S. EPA mobile source Motor Vehicle Emission Simulator (MOVES) model version 4.0. The NONROAD component of the model was applied for diesel fuel construction equipment. For the Shortlist Evaluation, construction information was estimated based off a review of similar road projects where construction emissions were previously determined. A general list of equipment likely to be used for road construction was developed as shown in **Table 1** and applied for this analysis.

Additionally, it was also anticipated that delivery vehicles and worker commuter vehicles would be occurring during the construction phase.

Table 1: Typical Construction Equipment List

Road Construction Equipment Type	Commuter/Delivery Vehicles
Pavers	Gasoline Passenger Car
Rollers	Gasoline Passenger Truck
Excavators	Diesel Short haul Truck
Scrapers	
Graders	
Loaders	
Dozers	
Off-Highway Trucks	
Cranes	
Drill Rigs	
Forklifts	
Trenches	
Surfacing Equipment	

For the purposes of this analysis, the construction vehicular fleet was assumed to be a 2023 mix, with the years of anticipated construction being 2024-2026 for the initial phase. This means that the age distribution of construction vehicles has a small percentage of 2023 models included and scaled back over 30 years. This approach ensures the most conservative emission factor distribution within MOVES as the earlier the year the higher the general emission factors are predicted by the model. To account for any potential seasonal variability and to limit computational run time, four representative months (January, April, July, and October) were selected. The average of the four MOVES factors was then applied. Additionally, the model requires a U.S. based county domain. The Florida county of Monroe was selected for two reasons. First, the 2023 population is 85,808 (USCB 2023), which is relatively close to the 2023 population (69,473) of Cayman (Worldmeter 2023). Secondly, it is the most southern Florida county nearest to the Cayman Islands, which is the most geographically similar U.S. County available. Note that this domain selection has very little effect on the MOVES NONROAD construction emission factors, but it is required as an input parameter.

Emission factors can be derived in a multitude of ways whether that be from the horsepower of the equipment, hours of operations of the equipment, or number of vehicle miles travelled. The hours of operation factor were selected for this analysis.

Roadway segments within MOVES were used to estimate the full length of each of the Build alternatives (B1, B2, and B3). This was completed to determine whether GHG emissions from any alternative were significantly greater than others. Alternative B1 has an estimated overall largest length of approximately 12.4 miles (19.9 km). Alternatives B2 and B3 ranged from 10.5 to 11.4 miles (16.8 to 18.4 km) (approximately 85% to 92% of Alternative B1's length) respectively.

The estimated minimum number of workdays for the road construction was set to 150 for Alternative B1 and was reduced proportional to length for Alternatives B2 and B3. This value assumes a 50-person crew and does not account for weekends, holidays, weather, etc. Additionally, all workdays are assumed to operate all equipment for 10 hours per day (hr/day).

Electrical work, which incorporates utilities and highway lighting, assumed another minimum of 100 total workdays for Alternative B1 and was scaled accordingly for Alternatives B2 and B3. This value assumes a 150-person crew and does not account for weekends, holidays, weather, etc. The anticipated speciality equipment used for this work including cranes, drill rigs, forklifts, and trenchers, are different than the equipment typically used for general road construction and also assumed to operate 10 hr/day as a conservative measure.

Overall, the project is anticipated to require a minimum of 250 working days to complete, dependent on workforce availability, hours worked per day, and additional variables. Estimation of the construction timeline will be further refined as the design proceeds but anticipated to span a minimum of 2 years to construct.

4.1.2 Construction Tailpipe Emissions

For the anticipated road construction equipment, diesel emissions associated with running exhaust and crankcase exhaust were evaluated to establish the GHG emissions. The NONROAD component of the MOVES model directly outputs CO_2 and methane (CH_4) emissions in grams per hour (g/hr). Nitrous oxide (N_2O) emissions are not directly outputted. Instead, EPA non-road vehicle emission factors from the EPA GHG Emission Factor Hub (EPA 2024a) were used to determine N_2O emissions. A ratio of the N_2O and CH_4 emission factors were applied as defined in Table 5 of the EPA GHG Emission Factor Hub. For example, diesel equipment in the Construction/Mining Equipment section of **Table 5** of the EPA GHG Emission Factor Hub has a CH_4 factor of 1.01 grams/gallon (g/gal) and an N_2O factor of 0.94 g/gal (diesel off-highway trucks is 0.91 and 0.56 g/gal for CH_4 and N_2O, respectively). The CH_4 MOVES result for the equipment, besides trucks, was multiplied by the ratio, 0.94/1.01 g/gal, (0.56/0.91 g/gal for diesel off-highway trucks) to establish the N_2O equivalent results. **Table 2** illustrates the g/hr emission factors by each equipment type.

Table 2: Construction Equipment Emission Factors (g/hr)

Activity	MOVES Output Name	CO_2	CH_4	N_2O
Road Construction	Pavers	40,388	0.14	0.13
	Rollers	30,459	0.15	0.14
	Excavators	54,728	0.11	0.10
	Scrapers	129,636	0.37	0.34
	Graders	64,845	0.11	0.10
	Loaders	13,052	0.13	0.12
	Dozers	82,747	0.23	0.21
	Off-Highway Trucks	247,923	0.70	0.43
	Surfacing Equipment	36,151	0.24	0.23
Electrical Work	Loaders	13,052	0.13	0.12
	Cranes	52,945	0.17	0.16
	Drill Rigs	40,750	0.28	0.26
	Graders	64,845	0.11	0.10
	Forklifts	32,530	0.14	0.13
	Off-Highway Trucks	247,923	0.70	0.43
	Trenchers	25,851	0.20	0.18

All CO_2 and CH_4 emission factors were from MOVES 4.0 for a 2023 vehicular fleet as a representative worst-case scenario.

Potential GHG emissions were calculated from an assumed number of each equipment type (1 for each type other than Off-Highway Trucks [2] by activity), daily construction schedule and total workdays by activity.

The assumed values affect the overall GHG emissions. The overall GHG emissions may vary from what is presented in this report once the actual construction schedule and specific equipment needed is determined. However, the variation amongst the three Build alternatives B1, B2, and B3 will remain constant, and it is projected that the construction operations would be a small portion of the overall potential GHG emissions.

Table 3 outlines the projected construction emissions by Build alternative. The No-Build scenario is assumed to include no construction related emissions, and therefore not included within **Table 3.** Additionally, CO_2e is calculated in both short tons and metric tonnes (MT)[2] by applying standard EPA global warming potential values by pollutant. CO_2 has a multiplier of 1, the CH_4 multiplier is 25, and the N_2O multiplier is 298. (EPA 2024b).

Amongst all of Build alternatives, Alternative B1 is anticipated to result in the highest construction tailpipe emissions due to the length of the road and subsequent more total workdays.

[2] Note that a metric tonne corresponds to approximately 1.10231 short tons.

Table 3: Construction Tailpipe GHG Emissions by Alternative

Alternative	Activity	Equipment				Emissions Short Tons (MT)			
		Type	Number	Daily Schedule (hr/day)	Total Work Days	CO_2	CH_4	N_2O	CO_2e
B1	Road Construction	Pavers	1	10	150	66.8 (60.6)	2.4E-04 (2.1E-04)	2.2E-04 (2.0E-04)	66.9 (60.7)
		Rollers	1	10	150	50.4 (45.7)	2.4E-04 (2.2E-04)	2.3E-04 (2.1E-04)	50.4 (45.8)
		Excavators	1	10	150	90.5 (82.1)	1.8E-04 (1.6E-04)	1.7E-04 (1.5E-04)	90.6 (82.1)
		Scrapers	1	10	150	214.4 (194.5)	6.0E-04 (5.5E-04)	5.6E-04 (5.1E-04)	214.5 (194.6)
		Graders	1	10	150	107.2 (97.3)	1.8E-04 (1.7E-04)	1.7E-04 (1.6E-04)	107.3 (97.3)
		Loaders	1	10	150	21.6 (19.6)	2.2E-04 (2.0E-04)	2.0E-04 (1.8E-04)	21.7 (19.6)
		Dozers	1	10	150	136.8 (124.1)	3.7E-04 (3.4E-04)	3.5E-04 (3.2E-04)	136.9 (124.2)
		Off-Highway Trucks	2	10	150	819.9 (743.8)	2.3E-03 (2.1E-03)	1.4E-03 (1.3E-03)	820.4 (744.2)
		Surfacing Equipment	1	10	150	59.8 (54.2)	4.0E-04 (3.7E-04)	3.7E-04 (3.4E-04)	59.9 (54.3)
	Electrical Work	Loaders	1	10	100	14.4 (13.1)	1.5E-04 (1.3E-04)	1.4E-04 (1.2E-04)	14.4 (13.1)
		Cranes	1	10	100	58.4 (52.9)	1.9E-04 (1.7E-04)	1.7E-04 (1.6E-04)	58.4 (53.0)
		Drill Rigs	1	10	100	44.9 (40.8)	3.1E-04 (2.8E-04)	2.9E-04 (2.6E-04)	45.0 (40.8)
		Graders	1	10	100	71.5 (64.8)	1.2E-04 (1.1E-04)	1.1E-04 (1.0E-04)	71.5 (64.9)
		Forklifts	1	10	100	35.9 (32.5)	1.6E-04 (1.4E-04)	1.5E-04 (1.3E-04)	35.9 (32.6)
		Off-Highway Trucks	1	10	100	273.3 (247.9)	7.7E-04 (7.0E-04)	4.8E-04 (4.3E-04)	273.5 (248.1)
		Trenchers	1	10	100	28.5 (25.9)	2.2E-04 (2.0E-04)	2.0E-04 (1.8E-04)	28.6 (25.9)
	Total CO_2e Short Tons (Metric Tonnes)								**2,095.7 (1,901.2)**

Alternative	Activity	Equipment				Emissions Short Tons (MT)			
		Type	Number	Daily Schedule (hr/day)	Total Work Days	CO_2	CH_4	N_2O	CO_2e
B2	Road Construction	Pavers	1	10	127	56.4 (51.2)	2.0E-04 (1.8E-04)	1.9E-04 (1.7E-04)	56.5 (51.3)
		Rollers	1	10	127	42.6 (38.6)	2.1E-04 (1.9E-04)	1.9E-04 (1.7E-04)	42.6 (38.7)
		Excavators	1	10	127	76.5 (69.4)	1.5E-04 (1.4E-04)	1.4E-04 (1.3E-04)	76.5 (69.4)
		Scrapers	1	10	127	181.1 (164.3)	5.1E-04 (4.6E-04)	4.8E-04 (4.3E-04)	181.3 (164.5)
		Graders	1	10	127	90.6 (82.2)	1.6E-04 (1.4E-04)	1.5E-04 (1.3E-04)	90.6 (82.2)
		Loaders	1	10	127	18.2 (16.5)	1.9E-04 (1.7E-04)	1.7E-04 (1.6E-04)	18.3 (16.6)
		Dozers	1	10	127	115.6 (104.9)	3.2E-04 (2.9E-04)	2.9E-04 (2.7E-04)	115.7 (105.0)
		Off-Highway Trucks	2	10	127	692.8 (628.5)	2.0E-03 (1.8E-03)	1.2E-03 (1.1E-03)	693.2 (628.9)
		Surfacing Equipment	1	10	127	50.5 (45.8)	3.4E-04 (3.1E-04)	3.2E-04 (2.9E-04)	50.6 (45.9)
	Electrical Work	Loaders	1	10	85	12.2 (11.0)	1.2E-04 (1.1E-04)	1.2E-04 (1.0E-04)	12.2 (11.1)
		Cranes	1	10	85	49.3 (44.7)	1.6E-04 (1.4E-04)	1.6E-04 (1.3E-04)	49.4 (44.8)
		Drill Rigs	1	10	85	38.0 (34.4)	2.6E-04 (2.4E-04)	2.4E-04 (2.2E-04)	38.0 (34.5)
		Graders	1	10	85	60.4 (54.8)	1.0E-04 (9.4E-05)	9.6E-05 (8.7E-05)	60.4 (54.8)
		Forklifts	1	10	85	30.3 (27.5)	1.3E-04 (1.1E-04)	1.2E-04 (1.1E-04)	30.3 (27.5)
		Off-Highway Trucks	1	10	85	230.9 (209.5)	6.5E-04 (5.9E-04)	4.0E-04 (3.6E-04)	231.1 (209.6)
		Trenchers	1	10	85	24.1 (21.8)	1.8E-04 (1.6E-04)	1.7E-04 (1.5E-04)	24.1 (21.9)
	Total CO_2e Short Tons (MT)								**1,771.0 (1,606.6)**

Alternative	Activity	Equipment				Emissions Short Tons (MT)			
		Type	Number	Daily Schedule (hr/day)	Total Work Days	CO_2	CH_4	N_2O	CO_2e
B3	Road Construction	Pavers	1	10	132	58.6 (53.2)	2.1E-04 (1.9E-04)	1.9E-04 (1.8E-04)	58.7 (53.3)
		Rollers	1	10	132	44.2 (40.1)	2.1E-04 (1.9E-04)	2.0E-04 (1.8E-04)	44.3 (40.2)
		Excavators	1	10	132	79.5 (72.1)	1.6E-04 (1.4E-04)	1.5E-04 (1.3E-04)	79.5 (72.1)
		Scrapers	1	10	132	188.2 (170.7)	5.3E-04 (4.8E-04)	4.9E-04 (4.5E-04)	188.4 (170.9)
		Graders	1	10	132	94.1 (85.4)	1.6E-04 (1.5E-04)	1.5E-04 (1.4E-04)	94.2 (85.4)
		Loaders	1	10	132	19.0 (17.2)	1.9E-04 (1.7E-04)	1.8E-04 (1.6E-04)	19.0 (17.2)
		Dozers	1	10	132	120.1 (109.0)	3.3E-04 (3.0E-04)	3.1E-04 (2.8E-04)	120.2 (109.0)
		Off-Highway Trucks	2	10	132	719.8 (653.0)	2.0E-03 (1.9E-03)	1.3E-03 (1.1E-03)	720.3 (653.4)
		Surfacing Equipment	1	10	132	52.5 (47.6)	3.5E-04 (3.2E-04)	3.2E-04 (3.0E-04)	52.6 (47.7)
	Electrical Work	Loaders	1	10	88	12.6 (11.5)	1.3E-04 (1.2E-04)	1.2E-04 (1.1E-04)	12.7 (11.5)
		Cranes	1	10	88	51.2 (46.5)	1.6E-04 (1.5E-04)	1.5E-04 (1.4E-04)	51.3 (46.5)
		Drill Rigs	1	10	88	39.4 (35.8)	2.7E-04 (2.5E-04)	2.5E-04 (2.3E-04)	39.5 (35.9)
		Graders	1	10	88	62.7 (56.9)	1.1E-04 (9.8E-05)	1.0E-04 (9.1E-05)	62.8 (57.0)
		Forklifts	1	10	88	31.5 (28.6)	1.4E-04 (1.3E-04)	1.3E-04 (1.2E-04)	31.5 (28.6)
		Off-Highway Trucks	1	10	88	240.0 (217.7)	6.8E-04 (6.2E-04)	4.2E-04 (3.8E-04)	240.1 (217.8)
		Trenchers	1	10	88	25.0 (22.7)	1.9E-04 (1.7E-04)	1.7E-04 (1.6E-04)	25.1 (22.8)
	Total CO_2e Short Tons (MT)								**1,840.1 (1,669.3)**

4.1.3 Commuter and Delivery Tailpipe Emissions

In addition to the construction equipment, there would be GHG tailpipe emissions from workers commuting and material delivery trucks. Based on the size of Grand Cayman it was determined that the likely average distance a worker may travel one-way is about 6 miles (9.6 km) with a daily round trip of about 12 miles (19.3 km) per vehicle. For the purposes of this evaluation, it was determined that each alternative will comprise the same number of daily workers. The number of daily workers by activity was based on similar projects and was anticipated at 50 workers for road construction and 150 workers for electrical work. This value will be re-evaluated as part of the Preferred Alternative based on anticipated workforce availability on Grand Cayman. It was also anticipated that each worker was allocated one personal vehicle to travel to and from the work site.

Material delivery operations were assumed to use 10 trucks for road construction and 20 trucks for electrical work. Additionally, daily truck trips were set at two per day per truck for electrical work and three per day per truck for road construction. As most of the material would be coming from the port along the western portion of the island, 20 miles (32.2 km) was applied for each round-trip delivery. For emission calculations, the number of workdays by Build alternative remained consistent as shown in **Table 3**.

The EPA MOVES model also consists of an "on-road" component. The model outputs a CO_2e emission factor in grams per vehicle mile travelled (g/veh-mi). Due to the high likelihood of vehicles on Grand Cayman being older, the analysis assumed that all on-road vehicles would be equivalent to 20 years behind present day on average[3]. Therefore, for a construction 2023 vehicular fleet, MOVES applied emission characteristics from Monroe County, Florida for the year 2003.

The commuter vehicle fleet assumed 80% gasoline passenger cars, 15% gasoline passenger trucks and 5% diesel-fuelled trucks. The delivery trucks were assumed to be heavy duty diesel short haul combination trucks. As noted for the construction equipment, that actual schedule, worker numbers, and vehicle fleet may deviate from the assumptions described, but that the differences amongst the three Build alternatives would remain the same. **Table 4** illustrates the general information and calculated emission factor in g/veh-mi for commuting and delivery. **Table 5** provides the projected GHG emissions by alternative. The No-Build scenario is assumed to include no construction related emissions, and therefore not included within **Table 4** or **Table 5.** Emissions provided in **Table 5** are based on the g/veh-mi factors outlined in **Table 4**. Build Alternatives B2 and B3 emissions are scaled based on the overall length differences compared to Alternative B1.

[3] The Final ToR for the EWA assumed the vehicles to be 15-20 years behind standard values. An assumption of 20 years was utilized as a conservative measure within this report.

Table 4: Commuting and Delivery Vehicles

Activity	Work Days[1]	Crew Member	No. Personal Vehicles	Personal Vehicle Days	Personal Vehicle Miles	CO_2e (g/veh-mi)
Commuter Vehicles						
Road Construction	150	50	50	7,500	90,000	477.5
Electrical Work	100	150	150	15,000	180,000	
Activity	**Work Days**	**No. Trucks**	**Truck Trips**	**Truck Miles**	**CO_2e (g/veh-mi)**	
Delivery Vehicles						
Road Construction	150	10	4,500	90,000	1,966.8	
Electrical Work	100	20	4,000	80,000		

1. The workdays shown are for Alternative B1 only. Alternative B2 is 127 days for road construction and 85 days for electrical work, Alternative B3 is 132 days for road construction and 88 days for electrical work based on the proportional roadway length as compared to Alternative B1.

Table 5: Vehicle Tailpipe GHG Emissions by Alternative

Alternative	Vehicle Type	Activity	CO_2e Short Tons (MT)
B1	Commuter	Road Construction	47.4 (43.0)
		Electrical Work	94.8 (86.0)
	Delivery	Road Construction	195.1 (177.0)
		Electrical Work	173.4 (157.3)
		Total	**510.7 (463.3)**
B2	Commuter	Road Construction	40.0 (36.3)
		Electrical Work	80.1 (72.6)
	Delivery	Road Construction	164.9 (149.6)
		Electrical Work	146.6 (133.0)
		Total	**431.5 (391.5)**
B3	Commuter	Road Construction	41.6 (37.7)
		Electrical Work	83.2 (75.5)
	Delivery	Road Construction	171.3 (155.4)
		Electrical Work	152.3 (138.1)
		Total	**448.4 (406.8)**

4.1.4 Traffic Emissions Methodology

The Traffic Evaluation presents a baseline year of 2021, opening year of 2026, and horizon year of 2074. Both the opening year and the horizon year consisted of the No-Build scenario, and three Build alternatives.

EPA MOVES 4.0 was implemented to establish potential GHG emissions by year and alternative. MOVES requires several input parameters which include vehicle age distribution, fuel type, road segments (length, vehicle volume, average speed), vehicle type, distribution of vehicle type by segment, representative meteorological data and time span (i.e., weekdays, months of the year and hr/day). The data were applied using a combination of known project information and most representative default values.

The analysis included five vehicle types and assumed the use of all fuel types available within MOVES for each of the modelled years. Because MOVES is a U.S. model and numerous vehicles imported to Grand Cayman may not meet U.S. emission standards, the MOVES model assumed a vehicle age distribution equivalent to 20 years behind the analysis year. Therefore, in assessments of the baseline year 2021 and anticipated opening year 2026, MOVES applied emission characteristics from Monroe County, Florida across the five vehicle types for years 2001 and 2006, respectively. The expectation for horizon year 2074 is that Grand Cayman's fuel type distribution is anticipated to be equivalent to the U.S.; however, MOVES only allows evaluation out to year 2060. To accurately represent 2074 emissions, MOVES default values were evaluated for 2046 and 2060; the 15-year fuel type differentials by vehicle type from 2046 to 2060 were assumed to be equivalent to the fuel type differentials between 2060 and 2074. Specifically, the distribution of gasoline passenger cars was anticipated to decrease by 5.8%, while electric vehicles increase by 10.9% from 2046 to 2060. Thus, 2074 distribution of gas, electric, and all other vehicles are assumed to shift by that same amount from the 2060 percentages. **Table 6** provides the estimated fuel distribution for each vehicle type by modelled year.

Table 6: Fuel Distribution by Model Year and Vehicle Type

Scenario Year	MOVES Year	Vehicle Type	Fuel Type	Fuel Distribution
2021	2001	Motorcycle	Gasoline	100%
		Passenger Car	Gasoline	98.68%
			Diesel	0.34%
			Ethanol 85	0.94%
			Electric	0.04%
		Transit Buses	Gasoline	9.70%
			Diesel	80.98%
			CNG	9.14%
			Electric	0.18%
		Short Haul Truck	Gasoline	23.15%
			Diesel	76.77%
			CNG	0.08%
			Electric	0%
		Combo Haul Truck	Gasoline	0.02%
			Diesel	99.98%
			CNG	0%
			Electric	0%

Scenario Year	MOVES Year	Vehicle Type	Fuel Type	Fuel Distribution
2026	2006	Motorcycle	Gasoline	100%
		Passenger Car	Gasoline	95.74%
			Diesel	0.69%
			Ethanol 85	3.55%
			Electric	0.012%
		Transit Buses	Gasoline	17.32%
			Diesel	80.36%
			CNG	2.32%
			Electric	0%
		Short Haul Truck	Gasoline	20.47%
			Diesel	79.50%
			CNG	0.03%
			Electric	0%
		Combo Haul Truck	Gasoline	0%
			Diesel	100.00%
			CNG	0%
			Electric	0%
2074	2060	Motorcycle	Gasoline	100%
		Passenger Car	Gasoline	55.85%
			Diesel	0.01%
			Ethanol 85	1.32%
			Electric	42.82%
		Transit Buses	Gasoline	34.75%
			Diesel	27.34%
			CNG	21.37%
			Electric	16.55%
		Short Haul Truck	Gasoline	26.27%
			Diesel	59.31%
			CNG	0.61%
			Electric	13.82%
		Combo Haul Truck	Gasoline	0%
			Diesel	95.00%
			CNG	0.45%
			Electric	4.55%

4.1.4.1 Road Segment Traffic Data

Traffic data was broken out by road segments, road type, and length for the baseline and future years. The 2021 baseline includes five segments: two along Shamrock Road (segments Woodland Drive, Woodland to Condor Road, and Condor Road to Bodden Town Bypass), one along Bodden

Town Road from the Bypass to Frank Sound, one along Hirst Road from East-West Arterial to Shamrock Road, and one along Frank Sound Road from North Side Road to Bodden Town Road (**Figure 3**). The traffic evaluation used site day hourly data from June 2023 to establish a baseline of traffic volumes. A peak morning hour (6:00AM to 7:00AM) and a peak afternoon/evening hour (5:00PM to 6:00PM) was established. Volumes by vehicle type were determined for both AM and PM hours in two directions (northbound/southbound and eastbound/westbound) via the GCM. Traffic data incorporated into this evaluation can be found in **Attachment A**. Methodology of the incorporated traffic data can be found in **Section 3.2** and in the separate Traffic Evaluation document.

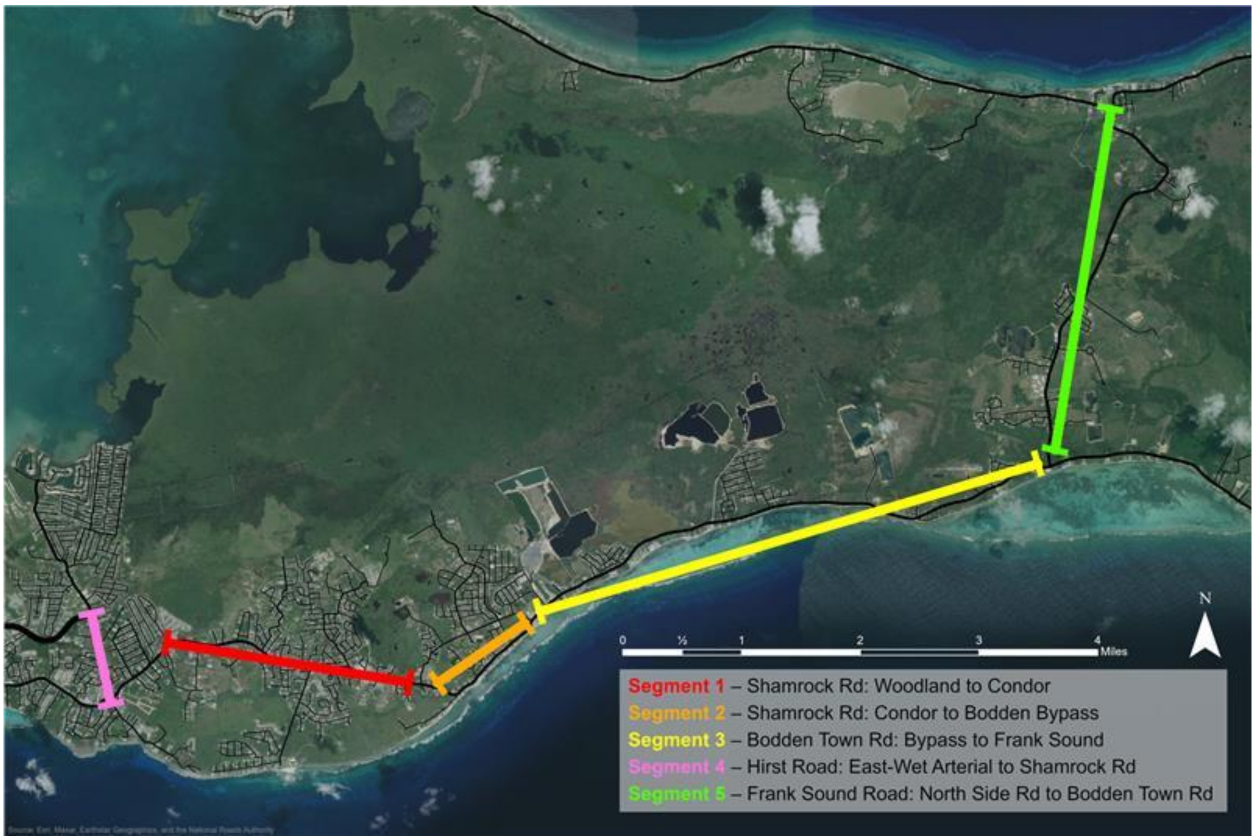

Figure 3: Roadway Segments – 2021 Baseline

For each road segment and peak hour, the MOVES model inputs included the aggregated total hourly volume, the segment length, and the average speed travelled along each segment. **Table 7** shows an example of the segment data from the 2021 baseline scenario. Following completion of the segment data, the distribution of each vehicle type by segment was calculated (See **Table 8**). These same data were determined for the No-Build scenario and the three Build alternatives. **Attachment A** provides information on the road segments by Build alternative.

Table 7: Segment Data – Morning AM Baseline 2021

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (mi/km)	Segment Average Speed (mph/kmh)	Segment Description
1	Urban	1,388	2.09 (3.36)	34.7 (21.6)	Shamrock Rd: Woodland to Condor
2	Urban	656	1.17 (1.88)	27.8 (17.3)	Shamrock Rd: Condor to Bodden Bypass
3	Urban	624	4.54 (7.31)	35.9 (22.3	Bodden Town Rd: Bypass to Frank Sound
4	Urban	360	0.71 (1.14)	29.6 (18.4)	Hirst Road: East-West Arterial to Shamrock Rd
5	Urban	262	3.60 (5.79)	40.7 (25.3)	Frank Sound Road: North Side Rd to Bodden Town Rd

Table 8: Segment Data Vehicle Type Distribution – Baseline 2021

Vehicle Type	1	2	3	4	5
	Morning 6:00AM to 7:00 AM				
Motorcycles	0.87%	2.17%	0.21%	1.80%	3.12%
Passenger Cars	92.34%	91.32%	93.25%	95.05%	87.31%
Transit Buses	1.65%	0.39%	0.78%	0.63%	1.27%
Short Haul Truck	4.20%	4.84%	5.45%	1.57%	7.45%
Combo Haul Truck	0.94%	1.28%	0.32%	0.95%	0.85%
Total	100.00%	100.00%	100.00%	100.00%	100.00%
	1	2	3	4	5
	Afternoon/Evening 5:00PM to 6:00PM				
Motorcycles	1.47%	1.02%	1.59%	4.52%	1.28%
Passenger Cars	92.43%	90.87%	92.47%	91.55%	92.50%
Transit Buses	1.78%	1.15%	0.22%	1.47%	1.51%
Short Haul Truck	3.34%	6.37%	4.79%	1.52%	4.71%
Combo Haul Truck	0.98%	0.58%	0.93%	0.95%	0.00%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

4.1.4.2 Intersection Traffic Data

In addition to the general road segments, the traffic analysis included potential emissions from four intersections. Approach volumes were determined for each cardinal direction (north, east, south, and west) and each possible movement manoeuvre (U-turn, left turn, right turn and through). This analysis generated 16 volume determination per intersection or 64 in total for the four intersections. The intersections selected varied by year and alternative. The four selected for the 2021 Baseline were all along Shamrock Road at Woodland Drive, Agricola Drive, Brightview Drive/Calla Lilly Drive and Beach Bay Road as they were projected to have the highest traffic volumes. The AM/PM peak hour volumes and approach speeds were determined for these intersections and movement manoeuvres via the GCM. Each potential intersection/manoeuvre combination was input into MOVES as an individual segment such as those shown in **Tables 7 and 8.** In addition, the vehicle distribution percentages were applied uniformly for the intersections/manoeuvre combinations based on the average value of the road segments by type for the year evaluated. As an example, the average distribution for anticipated motorcycles amongst the segments in **Table 8** between 6:00AM and 7:00AM is 1.19%; therefore all 64 intersections/manoeuvres were allocated 1.19% motorcycles for the AM peak hour during baseline year 2021.

The approach length of the intersection segments was defined uniformly as well to maintain consistency. The U-turn segments were set to 100 feet (30.5 m); both left and right turns were set to 200 feet (61.0 m), and the through lanes were set to 400 feet (121.9 m). Overall, the 2021 Baseline and No-Build scenario consider a total of 13 intersections while Build alternatives B1, B2, and B3 contain 21 intersections.

4.1.5 Traffic Emissions Discussion

The project-level MOVES model outputs emissions on an hourly basis to best represent daily and annual potential emissions. Model output was calculated for the 2021 Baseline during the peak morning AM and peak afternoon/evening PM hours for both the road segments and intersections.

Consistent with the construction emissions discussed in **Sections 4.11** and **4.12**, traffic GHG emissions of CO_2, CH_4, and N_2O were determined along with CO_2e. CO_2e emissions were calculated by MOVES but are based on U.S. EPA global warming potential multipliers. CO_2e is calculated by applying standard EPA global warming potential values by pollutant. CO_2 has a multiplier of 1, the CH_4 multiplier is 25, and the N_2O multiplier is 298. (EPA 2024b).

Traffic on the various road segments included running exhaust and crankcase exhaust emissions. Intersection segments calculated the emissions from the same vehicle processes. Extended idling was not included as the MOVES output corresponds specifically to overnight idling of long-haul trucks and terminals, which would not apply to the EWA project. Normal operation for all vehicle types such as stopping at traffic signals and truck loading and unloading are accounted for within the running exhaust calculations (EPA 2023).

Baseline 2021 road segment emissions are estimated to be 6.43 MT (7.09 short tons) CO_2e for the morning AM peak hour and 9.29 MT (10.24 short tons) for the afternoon PM peak hour. The four intersections with the projected highest traffic volumes generate an average of between 0.33 (0.37) and 0.43 (0.47) MT (short tons) per hour for the peak AM and PM hours, respectively.

To establish daily emission totals, all non-peak hour emissions were calculated using percentages of volumes relative to the peak hours (AM peak hour from 6-7 AM; PM peak hour from 5-6 PM) (see **Table 9**). **Table 9** shows the emission percentage per hour throughout the day. The volume count data applied the AM peak hour from 6-7 AM since that was the estimated time period when most people begin the commute westward; however, as vehicles move westward throughout the morning, counts increase at other Automated Traffic Recorder sites. The result suggests that overall vehicle totals from 7-9 AM exceed 100% of the initial peak volume along the Build alternatives B1, B2, and B3. For consistency, emission ratios in **Table 9** were applied for the Baseline to the No-Build scenario and the three Build alternatives.

Table 9: Daily Hourly Traffic Volumes and Distribution

Hour[1]	Shamrock Rd: West of Little Red Road	Shamrock Rd: East of Midnight Road	Shamrock Rd: West of Arrow Road	Bodden Town Rd, east of Anton Bodden Rd	Bodden Town Rd, west of Frank Sound Rd	Condor Rd: North of Shamrock Road	Total of All Road Segments	% of Daily Total	% of Peak Emission Rate (6:00 AM and 5:00 PM)
AM Hours									
12:00 AM	138	124	101	102	53	31	**548**	0.64%	11.97%
01:00	69	66	90	57	35	11	**326**	0.38%	7.11%
02:00	51	46	58	36	18	12	**220**	0.26%	4.80%
03:00	43	41	58	27	16	8	**192**	0.22%	4.18%
04:00	109	107	103	53	57	24	**453**	0.53%	9.90%
05:00	878	836	793	398	425	200	**3,529**	4.10%	77.05%
06:00	1,385	1,047	945	564	370	269	**4,580**	5.32%	100.00%
07:00	1,420	1,185	881	700	596	317	**5,099**	5.93%	111.33%
08:00	1,322	1,223	1,069	776	660	343	**5,393**	6.27%	117.76%
09:00	1,166	1,076	924	650	495	213	**4,524**	5.26%	98.79%
10:00	1,089	1,002	862	641	459	194	**4,247**	4.94%	92.73%
11:00	1,086	1,006	897	643	446	168	**4,246**	4.94%	92.70%
PM Hours									
12:00 PM	1,027	939	824	653	457	193	**4,092**	4.76%	67.18%
01:00	1,100	1,016	957	674	497	180	**4,423**	5.14%	72.61%
02:00	1,148	1,077	978	710	546	247	**4,706**	5.47%	77.26%
03:00	1,365	1,253	1,115	803	549	328	**5,412**	6.29%	88.85%
04:00	1,531	1,399	1,162	874	557	302	**5,823**	6.77%	95.60%
05:00	1,597	1,471	1,228	899	586	310	**6,091**	7.08%	100.00%
06:00	1,578	1,416	1,159	832	563	329	**5,877**	6.83%	96.49%
07:00	1,492	1,366	1,073	757	501	333	**5,522**	6.42%	90.65%
08:00	1,077	997	900	622	360	214	**4,167**	4.84%	68.42%
09:00	841	772	704	472	301	197	**3,285**	3.82%	53.93%
10:00	540	490	481	319	204	112	**2,144**	2.49%	35.20%
11:00	272	259	253	170	120	57	**1,130**	1.31%	18.54%
Day Total	22,321	20,211	17,611	12,428	8,867	4,590	**86,027**	100.0%	

1. The highlighted areas refer to the peak AM/PM hours.

Hourly emissions factors were then applied for all road segments and intersections. As a worst-case approach, the annual emissions assumed daily totals for 365 days. To account for all intersections, a static multiplier was applied to the modelled hourly output based on the scenario. The No-Build scenario and the Baseline used a multiplier of 3.25 (13 intersections); while Build alternatives B1, B2, and B3, used a multiplier of 5.25 (21 intersections). This is another part of the worst-case approach since there are four main modelled intersections that are projected to have the highest traffic volumes, while the remaining are not likely to experience nearly the same volumes. However, the multiplier approach assumes that all groups of four intersections are equivalent.

4.1.5.1 Baseline Emissions

Baseline emissions were determined for 2021 using MOVES 4.0 based on the five primary road segments referenced in **Section 4.1.4.1** and the intersection locations referenced in **Section 4.1.4.2.** As a worst-case approach, the annual GHG emissions were based on 365 days. The maximum modelled AM hour (6:00-7:00AM) produced 7.09 ton/hr (6.43 MT/hr), and the PM hour (5:00-6:00 PM) produced 10.24 ton/hr (9.29 MT/hr). **Table 10** shows the projected annual totals as 58,976.10 ton/yr (53,502.28 MT/yr.).

Table 10: Baseline (2021) Annual Emissions (CO_2e)

Road Segments (Combined)				Intersections (Combined)			
AM Hours	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**	**AM Hours**	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**
12:00 AM	0.85 (0.77)	12:00 PM	6.88 (6.24)	12:00 AM	0.14 (0.13)	12:00 PM	1.03 (0.93)
01:00	0.50 (0.46)	01:00	7.44 (6.75)	01:00	0.08 (0.08)	01:00	1.11 (1.01)
02:00	0.34 (0.31)	02:00	7.91 (7.18)	02:00	0.06 (0.05)	02:00	1.18 (1.07)
03:00	0.30 (0.27)	03:00	9.10 (8.26)	03:00	0.05 (0.05)	03:00	1.36 (1.23)
04:00	0.70 (0.64)	04:00	9.79 (8.88)	04:00	0.12 (0.11)	04:00	1.46 (1.32)
05:00	5.46 (4.96)	05:00	10.24 (9.29)	05:00	0.92 (0.83)	05:00	1.53 (1.38)
06:00	7.09 (6.43)	06:00	9.88 (8.97)	06:00	1.19 (1.08)	06:00	1.47 (1.34)
07:00	7.90 (7.16)	07:00	9.29 (8.42)	07:00	1.32 (1.20)	07:00	1.38 (1.26)
08:00	7.93 (7.19)	08:00	7.01 (6.36)	08:00	1.33 (1.20)	08:00	1.04 (0.95)
09:00	7.01 (6.36)	09:00	5.52 (5.01)	09:00	1.17 (1.06)	09:00	0.82 (0.75)
10:00	5.97 (6.58)	10:00	3.61 (3.27)	10:00	1.10 (1.00)	10:00	0.54 (0.49)
11:00	6.57 (5.96)	11:00	1.90 (1.72)	11:00	1.10 (1.00)	11:00	0.28 (0.26)
Total	**51.23 (46.47)**		**88.57 (80.35)**		**8.58 (7.78)**		**13.20 (11.98)**
Annual	**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**
	18,697.56 (16,962.16)		**32,328.81 (29,328.24)**		**3,131.45 (2,840.81)**		**4,818.27 (4,371.06)**
Annual Combined Total	**58,976.10 (53,502.28)**						

Results are rounded where appropriate.

4.1.5.2 2026 Emissions

The 2026 opening year emissions were evaluated for the shortlist of alternatives including the No-Build scenario and three Build alternatives B1, B2, and B3 using MOVES 4.0. **Attachment A** provides information on the road segments by Build alternative.

Emissions for 2026 were calculated using the same methodology as baseline emissions, except with the vehicle age and corresponding fuel distribution equivalent to 2006 U.S. values. Additionally, the total number of projected vehicle maximum hourly volumes increased between the baseline year (2021) and opening year (2026). The 2026 No-Build scenario had 9,170 daily vehicles, while the Build alternatives ranges from 10,318 to 10,483 daily vehicles. The increase of daily vehicles from the Baseline year 2021 ranges from 19.2% for the No-Build to 36.3% for Alternative B1. Additionally, the average speeds vary by alternative, with the No-Build scenario at approximately 33.2 mph (53.4 kmh), Alternative B1 at 37.4 mph (60.2 kmh), Alternative B2 at 37.3 mph (60.0 kmh), and Alternative B3 at 37.4 mph (60.2 kmh). Refer to **Tables A-4** through **A-11** in **Attachment A** for specific details of 2026 No Build and Build Alternative information. The combined miles travelled amongst all segments within 2026 scenarios during those hours is greater because the Build Alternatives have additional road segments not included in the Baseline year or No-Build. The Baseline and the No-Build scenario are 12.11 miles (19.5 km), respectively. Conversely, Build Alternatives B1, B2, and B3 are 17.0 to 23.0 miles (27.4 to 37.0 km). Fuel distribution/vehicle type changes also increased the projected emissions. For example, the percentage of transit buses increased, and diesel usage of single unit haul trucks increased from the Baseline, contributing to a projected increase of GHG emissions for 2026 as shown in **Tables 11 through 14**. As illustrated in **Table 15**, the summary of potential GHG traffic emissions by alternative shows that Alternative B2 is the highest at 77,210 short tons (70,044 MT); followed by Alternative B3 with 74,999 short tons (68,038 MT). Alternative B1 is slightly lower than Alternative B3 at 74,991 short tons (68,031 MT). The No-Build Scenario is the lowest with 70,696 short tons (64,134 MT), which primarily due to fewer vehicles and road segments.

Table 11: 2026 No-Build Annual Emissions (CO_2e)

Road Segments (Combined)				Intersections (Combined)			
AM Hours	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**	**AM Hours**	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**
12:00 AM	1.12 (1.01)	12:00 PM	8.27 (10.36)	12:00 AM	0.15 (0.13)	12:00 PM	0.85 (0.77)
01:00	0.66 (0.60)	01:00	8.94 (11.19)	01:00	0.09 (0.08)	01:00	0.92 (0.83)
02:00	0.45 (0.41)	02:00	9.51 (11.91)	02:00	0.06 (0.05)	02:00	0.98 (0.89)
03:00	0.39 (0.35)	03:00	10.94 (13.70)	03:00	0.05 (0.05)	03:00	1.13 (1.02)
04:00	0.92 (0.84)	04:00	11.77 (14.74)	04:00	0.12 (0.11)	04:00	1.21 (1.10)
05:00	7.20 (6.53)	05:00	12.31 (15.42)	05:00	0.94 (0.85)	05:00	1.27 (1.15)
06:00	9.34 (8.48)	06:00	11.88 (14.88)	06:00	1.22 (1.11)	06:00	1.22 (1.11)
07:00	10.40 (9.44)	07:00	11.16 (13.98)	07:00	1.36 (1.23)	07:00	1.15 (1.04)
08:00	10.44 (9.47)	08:00	8.42 (10.55)	08:00	1.36 (1.24)	08:00	0.87 (0.79)
09:00	9.23 (8.37)	09:00	6.64 (8.31)	09:00	1.21 (1.09)	09:00	0.68 (0.62)
10:00	8.66 (7.86)	10:00	4.33 (5.43)	10:00	1.13 (1.03)	10:00	0.45 (0.40)
11:00	8.66 (7.86)	11:00	2.28 (2.86)	11:00	1.13 (1.03)	11:00	0.23 (0.21)
Total	**67.49 (61.23)**		**106.43 (96.55)**		**8.82 (8.00)**		**10.95 (9.94)**
Annual	**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**
	24,633.59 (22,347.24)		**38,845.58 (35,240.16)**		**3,218.32 (2,919.62)**		**3,998.55 (3,627.43)**
Annual Combined Total	**70,696.04 (64,134.45)**						

Results are rounded where appropriate.

Table 12: 2026 Alternative B1 Annual Emissions (CO_2e)

Road Segments (Combined)				Intersections (Combined)			
AM Hours	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**	**AM Hours**	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**
12:00 AM	1.21 (1.09)	12:00 PM	8.35 (7.57)	12:00 AM	0.18 (0.16)	12:00 PM	1.14 (1.04)
01:00	0.72 (0.65)	01:00	9.02 (8.18)	01:00	0.11 (0.10)	01:00	1.23 (1.12)
02:00	0.48 (0.44)	02:00	9.60 (8.70)	02:00	0.07 (0.06)	02:00	1.31 (1.19)
03:00	0.42 (0.38)	03:00	11.04 (10.01)	03:00	0.06 (0.06)	03:00	1.51 (1.37)
04:00	1.00 (0.90)	04:00	11.88 (10.77)	04:00	0.15 (0.13)	04:00	1.62 (1.47)
05:00	7.76 (7.04)	05:00	12.43 (11.26)	05:00	1.14 (1.03)	05:00	1.70 (1.54)
06:00	10.07 (9.14)	06:00	11.99 (10.87)	06:00	1.48 (1.34)	06:00	1.64 (1.49)
07:00	11.21 (10.17)	07:00	11.26 (10.21)	07:00	1.65 (1.49)	07:00	1.54 (1.40)
08:00	11.25 (10.21)	08:00	8.50 (7.71)	08:00	1.65 (1.50)	08:00	1.16 (1.05)
09:00	9.95 (9.02)	09:00	6.70 (6.07)	09:00	1.46 (1.32)	09:00	0.92 (0.83)
10:00	9.34 (8.47)	10:00	4.37 (3.96)	10:00	1.37 (1.24)	10:00	0.60 (0.54)
11:00	9.33 (8.47)	11:00	2.30 (2.09)	11:00	137 (1.24)	11:00	0.31 (0.29)
Total	**72.74 (65.99)**		**107.45 (97.40)**		**10.67 (9.68)**		**14.69 (13.32)**
Annual	**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**
	26,548.71 (24,084.61)		**39,218.49 (35,549.43)**		**3,895.65 (3,534.08)**		**5,360.29 (4,862.78)**
Annual Combined Total	**74,991.14 (68,030.90)**						

Results are rounded where appropriate.

Table 13: 2026 Alternative B2 Annual Emissions (CO_2e)

Road Segments (Combined)				Intersections (Combined)			
AM Hours	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**	**AM Hours**	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**
12:00 AM	1.18 (1.07)	12:00 PM	8.85 (8.03)	12:00 AM	0.18 (0.16)	12:00 PM	1.21 (1.10)
01:00	0.70 (0.64)	01:00	9.57 (8.68)	01:00	0.11 (0.10)	01:00	1.30 (1.18)
02:00	0.47 (0.43)	02:00	10.18 (9.23)	02:00	0.07 (0.06)	02:00	1.39 (1.26)
03:00	0.41 (0.37)	03:00	11.71 (10.62)	03:00	0.06 (0.06)	03:00	1.60 (1.45)
04:00	0.98 (0.89)	04:00	12.59 (11.43)	04:00	0.15 (0.13)	04:00	1.72 (1.56)
05:00	7.61 (6.90)	05:00	13.17 (11.95)	05:00	1.15 (1.04)	05:00	1.80 (1.63)
06:00	9.87 (8.95)	06:00	12.71 (11.53)	06:00	1.49 (1.35)	06:00	1.73 (1.57)
07:00	10.99 (9.97)	07:00	11.94 (10.83)	07:00	1.66 (1.51)	07:00	1.63 (1.48)
08:00	11.03 (10.01)	08:00	9.01 (8.18)	08:00	1.67 (1.51)	08:00	1.23 (1.12)
09:00	9.75 (8.85)	09:00	7.10 (6.45)	09:00	1.47 (1.34)	09:00	0.97 (0.88)
10:00	9.15 (8.30)	10:00	4.64 (4.21)	10:00	1.38 (1.26)	10:00	0.63 (0.57)
11:00	9.15 (8.30)	11:00	2.44 (2.22)	11:00	138 (1.25)	11:00	0.33 (0.30)
Total	**71.30 (64.68)**		**113.92 (103.35)**		**10.78 (9.78)**		**15.54 (14.10)**
Annual	**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**
	26,022.69 (23,607.41)		**41,581.90 (37,722.51)**		**3,934.03 (3,568.90)**		**5,671.61 (5,145.20)**
Annual Combined Total	**77,210.23 (70,044.02)**						

Results are rounded where appropriate.

Table 14: 2026 Alternative B3 Annual Emissions (CO_2e)

Road Segments (Combined)				Intersections (Combined)			
AM Hours	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**	**AM Hours**	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**
12:00 AM	1.19 (1.08)	12:00 PM	8.38 (7.60)	12:00 AM	0.18 (0.16)	12:00 PM	1.15 (1.04)
01:00	0.71 (0.64)	01:00	9.06 (8.22)	01:00	0.11 (0.10)	01:00	1.24 (1.13)
02:00	0.48 (0.43)	02:00	9.64 (8.75)	02:00	0.07 (0.06)	02:00	1.32 (1.20)
03:00	0.42 (0.38)	03:00	11.09 (10.06)	03:00	0.06 (0.06)	03:00	1.52 (1.38)
04:00	0.99 (0.90)	04:00	11.93 (10.82)	04:00	0.15 (0.13)	04:00	1.64 (1.49)
05:00	7.68 (6.97)	05:00	12.48 (11.32)	05:00	1.14 (1.04)	05:00	1.71 (1.55)
06:00	9.97 (9.05)	06:00	12.04 (10.92)	06:00	1.49 (1.35)	06:00	1.65 (1.50)
07:00	11.10 (10.07)	07:00	11.31 (10.26)	07:00	1.65 (1.50)	07:00	1.55 (1.41)
08:00	11.15 (10.11)	08:00	8.54 (7.74)	08:00	1.66 (1.51)	08:00	1.17 (1.06)
09:00	9.85 (8.94)	09:00	6.73 (6.10)	09:00	1.47 (1.33)	09:00	0.92 (0.84)
10:00	9.25 (8.39)	10:00	4.39 (3.98)	10:00	1.38 (1.25)	10:00	0.60 (0.55)
11:00	9.24 (8.39)	11:00	2.31 (2.10)	11:00	1.38 (1.25)	11:00	0.32 (0.29)
Total	**72.04 (65.35)**		**107.89 (97.88)**		**10.73 (9.73)**		**14.82 (13.44)**
Annual	**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**
	26,293.02 (23,852.65)		**39,381.61 (35,726.44)**		**3,915.64 (3,552.21)**		**5,408.97 (4,906.94)**
Annual Combined Total	**74,999.23 (68,038.90)**						

Results are rounded where appropriate.

Table 15: 2026 Alternative Annual Emissions Summary Table (CO_2e)

Road Segments & Intersections (Combined)			
Alternative	**AM Ton/yr (MT/yr)**	**PM Ton/yr (MT/yr)**	**Total Ton/hr (MT/hr)**
No-Build	27,852 (25,267)	42,844 (38,868)	70,696 (64,134)
B1	30,444 (27,619)	44,547 (40,412)	74,991 (68,031)
B2	29,957 (27,176)	47,254 (42,868)	77,210 (70,044
B3	30,209 (27,405)	44,791 (40,633)	74,999 (68,038)

Results are rounded where appropriate.

4.1.5.3 2074 Emissions

The 2074 horizon year emissions were also evaluated for the No-build scenario and Build alternatives B1, B2, and B3 using MOVES 4.0. Each alternative has a varying number of road segments, lengths, and road type. **Attachment A** provides information on the road segments by Build alternative.

Emissions for 2074 were calculated using the same methodology as baseline emissions, but with the vehicle age and corresponding fuel distribution set to mirror U.S. values in 2060 and scaled to 2074 as described in **Section 4.1.4.** Additionally, the total number of projected vehicle maximum hourly volumes increased from 2021 to 2074. The 2074 No-Build scenario had 27,381 daily vehicles, while the Build alternatives range from 35,158 to 36,016 daily vehicles. On average, this is over a threefold increase from 2026. Additionally, the average speeds vary by alternative, with the No-build scenario at approximately 21.7 mph (34.9 kmh), Alternative B1 at 32.6 mph (52.5 kmh), Alternative B2 at 31.2 mph (50.2 kmh), and Alternative B3 at 31.5 mph (50.7 kmh).

As illustrated in Olaverri-Monreal et al (2018), CO_2 emissions tend to be highest at the extremes when compared to vehicle speed, and larger vehicles have more variability (Olaverri-Monreal et al., 2018). The travel in year 2074 is projected to generate more emissions due to an increased number of large vehicles (average of 1,416 more large vehicles [single short haul and combo short haul] from 2026 to 2074) and generally lower speeds. While the percentage of electric vehicles is anticipated to increase, the number of compressed natural gas (CNG) buses is also projected to increase by nearly 20% from 2026 to 2074. CNG for heavy-duty vehicles produces more CO_2 emissions than diesel fuel by approximately 22% (CTCN 2011). Additionally, the percentage of diesel single haul and combo haul trucks were still 59.3% and 95% diesel fuel, respectively. GHG emissions for 2074 are shown in **Tables 16** through **19**.

As illustrated in **Table 20**, the summary of potential GHG traffic emissions by alternative shows that the No-Build scenario is the highest at 137,501 short tons (124,739 MT); followed by Alternative B1 with 127,516 short tons (115,681 MT). Alternative B2 is slightly lower than Alternative B1 at 127,028 short tons (115,238 MT). Alternative B3 is the lowest with 126,740 short tons (114,976 MT). The No-Build scenario has the highest potential emissions because of more congestion and intersection vehicle volumes (29,527 daily vs an average of 20,635 daily volume for the Build Alternatives).

Table 16: 2074 No-Build Annual Emissions

Road Segments (Combined)				Intersections (Combined)			
AM Hours	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**	**AM Hours**	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**
12:00 AM	2.48 (2.25)	12:00 PM	14.73 (13.36)	12:00 AM	0.29 (0.27)	12:00 PM	1.52 (1.38)
01:00	1.47 (1.34)	01:00	15.92 (14.44)	01:00	0.17 (0.16)	01:00	1.65 (1.49)
02:00	1.00 (0.90)	02:00	16.94 (15.37)	02:00	0.12 (0.11)	02:00	1.75 (1.59)
03:00	0.87 (0.79)	03:00	19.48 (17.67)	03:00	0.10 (0.09)	03:00	2.01 (1.83)
04:00	2.05 (1.86)	04:00	20.96 (19.01)	04:00	0.24 (0.22)	04:00	2.17 (1.97)
05:00	15.98 (14.50)	05:00	21.92 (19.89)	05:00	1.89 (1.72)	05:00	2.27 (2.06)
06:00	20.74 (18.81)	06:00	21.16 (19.19)	06:00	2.45 (2.23)	06:00	2.19 (1.98)
07:00	23.09 (20.94)	07:00	19.87 (18.03)	07:00	2.73 (2.48)	07:00	2.05 (1.86)
08:00	23.18 (21.03)	08:00	15.00 (13.61)	08:00	2.74 (2.49)	08:00	1.55 (1.41)
09:00	20.49 (18.59)	09:00	11.82 (10.73)	09:00	2.43 (2.20)	09:00	1.22 (1.11)
10:00	19.23 (17.45)	10:00	7.72 (7.00)	10:00	2.28 (2.06)	10:00	0.80 (0.72)
11:00	19.22 (17.44)	11:00	4.06 (3.69)	11:00	2.28 (2.06)	11:00	0.42 (0.38)
Total	**149.80 (135.89)**		**189.59 (171.99)**		**17.73 (16.09)**		**19.60 (17.78)**
Annual	**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**
	54,675.65 (49,600.97)		**69,199.92 (62,777.18)**		**6,471.74 (5,871.07)**		**7,153.72 (6,489.76)**
Annual Combined Total	**137,501.04 (124,738.99)**						

Results are rounded where appropriate.

Table 17: 2074 Alternative B1 Annual Emissions

Road Segments (Combined)				Intersections (Combined)			
AM Hours	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**	**AM Hours**	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**
12:00 AM	2.37 (2.15)	12:00 PM	13.81 (12.53)	12:00 AM	0.20 (0.18)	12:00 PM	1.30 (1.18)
01:00	1.40 (1.27)	01:00	14.93 (13.55)	01:00	0.12 (0.11)	01:00	1.40 (1.27)
02:00	0.95 (0.86)	02:00	15.89 (14.41)	02:00	0.08 (0.07)	02:00	1.49 (1.35)
03:00	0.83 (0.75)	03:00	18.27 (16.58)	03:00	0.07 (0.06)	03:00	1.72 (1.56)
04:00	1.96 (1.77)	04:00	19.66 (17.83)	04:00	0.17 (0.15)	04:00	1.85 (1.68)
05:00	15.22 (13.81)	05:00	20.56 (18.66)	05:00	1.29 (1.17)	05:00	1.93 (1.75)
06:00	19.76 (17.92)	06:00	19.84 (18.00)	06:00	1.68 (1.52)	06:00	1.86 (1.69)
07:00	22.00 (19.95)	07:00	18.64 (16.91)	07:00	1.87 (1.69)	07:00	1.75 (1.59)
08:00	22.08 (20.03)	08:00	14.07 (12.76)	08:00	1.87 (1.70)	08:00	1.32 (1.20)
09:00	19.52 (17.71)	09:00	11.09 (10.06)	09:00	1.66 (1.50)	09:00	1.04 (0.95)
10:00	18.32 (16.62)	10:00	7.24 (6.57)	10:00	1.55 (1.41)	10:00	0.68 (0.62)
11:00	18.32 (16.62)	11:00	3.81 (3.46)	11:00	1.55 (1.41)	11:00	0.36 (0.33)
Total	**142.72 (129.47)**		**177.82 (161.32)**		**12.11 (10.99)**		**16.71 (15.16)**
Annual	**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**
	52,091.23 (47,256.43)		**64,905.09 (58,880.97)**		**4,420.95 (4,010.62)**		**6,098.93 (5,532.86)**
Annual Combined Total	**127,516.20 (115,680.89)**						

Results are rounded where appropriate.

Table 18: 2074 Alternative B2 Annual Emissions

Road Segments (Combined)				Intersections (Combined)			
AM Hours	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**	**AM Hours**	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**
12:00 AM	2.34 (2.12)	12:00 PM	13.76 (12.48)	12:00 AM	0.19 (0.20)	12:00 PM	1.37 (1.24)
01:00	1.39 (1.26)	01:00	14.87 (13.49)	01:00	0.11 (0.12)	01:00	1.48 (1.34)
02:00	0.94 (0.85)	02:00	15.82 (14.36)	02:00	0.07 (0.08)	02:00	1.57 (1.43)
03:00	0.82 (0.74)	03:00	18.20 (16.51)	03:00	0.06 (0.07)	03:00	1.81 (1.64)
04:00	1.93 (1.75)	04:00	19.58 (17.76)	04:00	0.15 (0.17)	04:00	1.95 (1.77)
05:00	15.03 (13.64)	05:00	20.48 (18.58)	05:00	1.20 (1.32)	05:00	2.04 (1.85)
06:00	19.51 (17.70)	06:00	19.76 (17.93)	06:00	1.55 (1.71)	06:00	1.96 (1.78)
07:00	21.72 (19.71)	07:00	18.57 (16.84)	07:00	1.73 (1.91)	07:00	1.85 (1.67)
08:00	21.81 (19.78)	08:00	14.01 (12.71)	08:00	1.74 (1.91)	08:00	1.39 (1.26)
09:00	19.28 (17.49)	09:00	11.05 (10.02)	09:00	1.53 (1.69)	09:00	1.10 (1.00)
10:00	18.09 (16.41)	10:00	7.21 (6.54)	10:00	1.44 (1.59)	10:00	0.72 (0.65)
11:00	18.09 (16.41)	11:00	3.80 (3.44)	11:00	1.44 (1.59)	11:00	0.38 (0.34)
Total	**140.94 (127.86)**		**177.12 (160.68)**		**12.36 (11.22)**		**17.60 (15.97)**
Annual	**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**
	51,442.35 (46,667.77)		**64,647.61 (58,647.40)**		**4,512.88 (4,094.02)**		**6,424.86 (5,828.54)**
Annual Combined Total	**127,027.69 (115,237.72)**						

Results are rounded where appropriate.

Table 19: 2074 Alternative B3 Annual Emissions

Road Segments (Combined)				Intersections (Combined)			
AM Hours	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**	**AM Hours**	**Ton/hr (MT/hr)**	**PM Hours**	**Ton/hr (MT/hr)**
12:00 AM	2.34 (2.12)	12:00 PM	13.73 (12.45)	12:00 AM	0.20 (0.18)	12:00 PM	1.34 (1.21)
01:00	1.39 (1.26)	01:00	14.84 (13.46)	01:00	0.12 (0.11)	01:00	1.44 (1.31)
02:00	0.94 (0.85)	02:00	15.79 (14.32)	02:00	0.08 (0.07)	02:00	1.54 (1.39)
03:00	0.82 (0.74)	03:00	18.16 (16.47)	03:00	0.07 (0.06)	03:00	1.77 (1.60)
04:00	1.93 (1.75)	04:00	19.54 (17.72)	04:00	0.17 (0.15)	04:00	1.90 (1.73)
05:00	15.05 (13.66)	05:00	20.44 (18.54)	05:00	1.30 (1.18)	05:00	1.99 (1.81)
06:00	19.54 (17.72)	06:00	19.72 (17.89)	06:00	1.69 (1.53)	06:00	1.92 (1.74)
07:00	21.75 (19.73)	07:00	18.53 (16.81)	07:00	1.88 (1.70)	07:00	1.80 (1.64)
08:00	21.84 (19.81)	08:00	13.98 (12.68)	08:00	1.88 (1.71)	08:00	1.36 (1.24)
09:00	19.30 (17.51)	09:00	11.02 (10.00)	09:00	1.67 (1.51)	09:00	1.07 (0.97)
10:00	18.12 (16.44)	10:00	7.19 (6.53)	10:00	1.56 (1.42)	10:00	0.70 (0.64)
11:00	18.11 (16.43)	11:00	3.79 (3.44)	11:00	1.56 (1.42)	11:00	0.37 (0.33)
Total	**141.13 (128.03)**		**176.72 (160.31)**		**12.18 (11.05)**		**17.21 (15.61)**
Annual	**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**		**Ton/yr (MT/yr)**
	51,511.89 (46,730.86)		**64,501.03 (58,514.42)**		**4,446.15 (4,033.48)**		**6,280.48 (5,697.56)**
Annual Combined Total	**126,739.55 (114,976.32)**						

Results are rounded where appropriate.

Table 20: 2074 Alternative Annual Emissions Summary Table (CO_2e)

Road Segments & Intersections (Combined)			
Alternative	**AM Ton/yr (MT/yr)**	**PM Ton/yr (MT/yr)**	**Total Ton/hr (MT/hr)**
No-Build	61,147 (55,472)	76,354 (69,267)	137,501 (124,739)
B1	56,512 (51,267)	71,004 (64,434)	127,516 (115,681)
B2	55,955 (50,761)	71,072 (64,476)	127,028 (115,238)
B3	55,958 (50,764)	70,782 (64,212)	126,740 (114,976)

4.1.5.4 Traffic Emissions Conclusion

The projected GHG emissions incrementally increase from the Baseline 2021 to 2026 and the 2074 emissions increase significantly due primarily to a large increase in vehicle volumes. Afternoon/evening PM emissions are 33% higher on average compared to morning AM hours because of the projected lower traffic volumes between 12:00 AM to 5:00AM. **Table 21** provides the overall annual GHG emissions, which shows that the No-Build scenario and the three Build alternatives B1, B2, and B3 for 2074 would exceed the 100,000 MT threshold described in **Section 3.1**. Therefore, they would be considered a significant source of GHG emissions.

Table 21: Alternative GHG Emissions

Year	Scenario	AM Ton/yr (MT/yr)	PM Ton/yr (MT/yr)	Total Ton/yr (MT/yr)
		CO_2e Emissions		
2021	Baseline	21,829.02 (19,802.97)	37,147.08 (33,699.30)	58,976.10 (53,502.28)
2026	No-Build	27,851.91 (25,266.86)	42,844.13 (38,867.58)	70,696.10 (64,134.45)
	Alternative B1	30,444.36 (27,618.69)	44,546.78 (40,412.21)	74,991.14 (68,030.90)
	Alternative B2	29,956.72 (27,176.31)	47,253.50 (42,867.71)	77,210.23 (70,044.02)
	Alternative B3	30,208.66 (27,404.86)	44,790.58 (40,633.38)	74,999.23 (68,038.24)
2074	No-Build	61,147.39 (55,472.05)	76,353.64 (69,266.94)	137,501.04 (124,738.99)
	Alternative B1	56,512.18 (51,267.05)	71,004.01 (64,413.84)	127,516.20 (115,680.89)
	Alternative B2	55,955.22 (50,761.79)	71,072.47 (64,475.94)	127,027.69 (115,237.72)
	Alternative B3	55,958.04 (50,764.34)	70,781.51 (64,211.98)	126,739.55 (114,976.32)

AM and PM include through traffic and intersection traffic combined

Alternatives B1, B2, and B3 will produce similar emissions, while the 2074 No-Build scenario is projected to generate approximately 10,400 ton/yr (9,440 MT/yr) more than the average between Alternatives B1, B2, and B3. While 2074 emissions on a vehicle basis are improved when compared to the baseline and 2026, the overall number of projected vehicles on the road are much higher than the baseline (2021) and opening year (2026) conditions. Therefore, 2074 emissions will be greater in aggregate.

The variability between 2026 Alternatives is negligible with the No-Build scenario producing fewer GHG emissions primarily because of lower vehicular volumes. Overall, Alternative B3 is projected to produce the fewest annual GHG emissions between 2026 and 2074.

4.1.6 Habitat and Peat Methodology

GHG emissions resulting from the removal/excavation of biomass and organic soils (i.e., peat) were calculated for each of the three Build alternatives B1, B2, and B3 following IPCC guidelines (IPCC, 2006; IPCC, 2014). This methodology conservatively assumes all biomass and peat removed during construction are disposed of under aerobic conditions and all carbon is immediately emitted as CO_2. No biomass and peat will be removed as part of the No-Build scenario and, therefore, do not apply IPCC guidelines and equations (i.e., GHG emissions from biomass and peat removal are set to zero).

Equation 4.3 from IPCC (2014) served as the basis for calculating the loss in carbon stocks and subsequent GHG emissions (CO_2e) associated with excavation activities within vegetated habitats, and is presented in a streamlined formulation:

$$\Delta C_{excav} = -(\Delta C_{excav-B} + \Delta C_{excav-DOM} + \Delta C_{excav-SO}) \times \left(\frac{44}{12}\right)$$

Where:

ΔC_{excav} = Emissions from initial change in carbon stocks with excavation; tonnes CO_2e.

$\Delta C_{excav\text{-}B}$ = Initial change in biomass (above-/below-ground) carbon stocks with excavation; tonnes C.

$\Delta C_{excav\text{-}DOM}$ = Initial change in dead organic matter carbon stocks with excavation; tonnes C.

$\Delta C_{excav\text{-}SO}$ = Initial change in soil (i.e., peat) carbon stocks with excavation; tonnes C.

$\frac{44}{12}$ = Molecular-to-atomic weight ratio of CO_2 to C.

The approach for estimating changes in carbon stocks within the limits of disturbance (LOD) differed between mangrove and non-mangrove habitat types and carbon pools (e.g., biomass, soil). Biomass carbon stocks concern woody and herbaceous vegetation across various habitat types classified through geospatial analysis. Soil carbon stocks, in contrast, concern peat deposits spread across the entire LOD for each Build alternative. Additionally, peat data was volumetric, as opposed to geospatial. Method deviations, assumptions, and calculations for each carbon pool are detailed in the following subsections.

4.1.6.1 Habitat Data

Country-specific (Childs et al., 2015) and IPCC (2006; 2019) default data was sourced to estimate biomass carbon stocks for the various habitats across Grand Cayman anticipated to be impacted by the Build alternatives B1, B2, and B3. For mangroves, Childs et al. (2015) estimated above- and below-ground biomass carbon stocks for inland mangrove habitats across the Central Mangrove Wetland (CMW) on Grand Cayman, using field sampling, species-specific allometry (Smith and Wheelan, 2006; Komiyama et al., 2005) and carbon fractions. IPCC default biomass estimates, root-shoot ratios (to estimate belowground biomass) and carbon fractions were applied to the other habitats encompassed by this analysis (IPCC, 2006; IPCC; 2019).

Equation 4.4 (IPCC, 2014) was modified to accommodate mangrove data (Childs et al., 2015) and estimate the loss of biomass carbon stocks within mangrove habitats for each Build alternative:

$$\Delta C_{excav-B} = \left(B_{AFTER} - \left((AGB_{BEFORE} \times CF_{AGB}) + (BGB_{BEFORE} \times CF_{BGB})\right)\right) \times A_{CONVERTED}$$

Where:

$\Delta C_{excav\text{-}B}$ = Changes in biomass carbon stock from conversion due to extraction activities; tonnes C.

B_{AFTER} = Carbon stock in biomass per unit of area immediately after the conversion; tonnes dry matter (t.d.m.) ha^{-1}. This value is conservatively set to 0.

AGB_{BEFORE} = Carbon stock in above-ground biomass per unit of area immediately before conversion; t.d.m. ha^{-1}.

CF_{AGB} = Carbon fraction of above-ground biomass; tonnes C $(t.d.m.)^{-1}$.

BGB_{BEFORE} = Carbon stock in below-ground biomass per unit of area immediately before conversion; t.d.m. ha^{-1}.

CF_{BGB} = Carbon fraction of below-ground biomass; tonnes C $(t.d.m.)^{-1}$.

$A_{CONVERTED}$ = Area of conversion; ha.

Biomass stock loss for other (i.e., non-mangrove) habitats was estimated using a modified version of Equation 2.14 (IPCC, 2006) supplied with IPCC default values (IPCC, 2006; IPCC, 2019) specific to each habitat type included in the analysis:

$$\Delta C_{disturbance,i} = A_{disturbance,i} \times AGB_{BEFORE,i} \times (1 + R_i) \times CF_i \times fd$$

Where:

$\Delta C_{disturbance,i}$ = Losses in biomass carbon stock from disturbance for habitat type *i*; tonnes C.

$A_{disturbance,i}$ = Area affected by disturbance for habitat type *i*; ha.

$AGB_{BEFORE,i}$ = Carbon stock in above-ground biomass per unit of area immediately before disturbance for habitat type *i*; t.d.m. ha^{-1}.

R_i = Ratio of below-ground biomass to above-ground biomass; t.d.m. below-ground biomass for habitat type *i*; $(\text{t.d.m. above-ground biomass})^{-1}$.

CF_i = Carbon fraction of dry matter for habitat type *i*; tonnes C $(t.d.m.)^{-1}$.

fd = fraction of biomass lost in disturbance. This value is conservatively set to 1 (i.e., all biomass is lost during construction).

i = habitat type.

A summary of parameters used in Equation 4.4 (IPCC, 2014) and Equation 2.14 (IPCC, 2006) for habitat types encompassed in this assessment are listed in **Table 22**.

Table 22: Habitat Biomass Parameters

Habitat	Above-ground biomass (AGB)	Below-ground biomass (BGB)	Root-shoot ratio (*R*)	Carbon fraction (*CF*)
	t.d.m. ha^{-1}	t.d.m. ha^{-1}		
Mangroves	102.99 (Childs et al., 2015)	58.58 (Childs et al., 2015)	-	AGB: 0.48 BGB: 0.39 (Childs et al., 2015)
Tropical Moist Deciduous Forest (Older Secondary)	131 (IPCC, 2019)	37.20*	0.284 (IPCC, 2019)	0.47 (IPCC, 2006)
Tropical Moist Deciduous Forest (Younger Secondary)	55.7 (IPCC, 2019)	15.85*	0.2845 (IPCC, 2019)	0.47 (IPCC, 2006)
Tropical Shrubland	71.50 (IPCC, 2019)	20.34*	0.2845 (IPCC, 2019)	0.47 (IPCC, 2006)
Tropical Moist Grassland	6.20 (IPCC, 2006)	9.92*	1.6 (IPCC, 2006)	0.47 (IPCC, 2006)

* Calculated as [*AGB* x *R*].

Mangrove biomass estimates are also assumed to include dead trees. However, litter was assumed *de minimis* (i.e., negligible) and excluded from sampling (Childs et al., 2015). There are no default dead organic matter estimates across forest types provided by the IPCC (2006). Therefore, the change in dead organic matter carbon stocks from excavation/construction ($\Delta C_{excav\text{-}DOM}$) are either assumed to be encompassed by mangrove biomass estimates or excluded for other habitat types (e.g., tropical moist deciduous forest, tropical shrubland).

The extent of land cover types potentially impacted by each of the Build alternatives was determined by geospatial analysis (see **Attachment B**) and grouped into cohesive habitat classifications or excluded from analysis (**Table 23**). Methodology for the geospatial analysis and descriptions of the habitats can be found within the separate Terrestrial Ecology Assessment of Alternatives document. Habitat biomass estimates, calculated from the equations previously noted, and impact areas used in the analysis are provided in **Table 24**.

Table 23: Habitat Classifications

Habitat	Land Cover Type (GIS)	Assumptions / Justification
Mangroves	Seasonally flooded mangrove forest and woodland	Seasonally flooded mangrove biomass estimates specific to Grand Cayman (Childs et al., 2015) were applied to all mangrove habitat types in this assessment. No summary statistics (e.g., range of sample tree densities) within Childs et al. (2015) that could provide rationale for scaling estimates based on apparent density of mangrove habitats.
	Seasonally flooded mangrove shrubland	
	Seasonally flooded / saturated semi-deciduous forest	
	Seasonally flooded mangrove forest (low density)	
Tropical Moist Deciduous Forest (Older Secondary)	Dry forest and woodland	Grand Cayman contains very little primary (i.e., old-growth) forest (Childs et al., 2015). The area of remaining old-growth (Mastic) forest on the island (Childs et al., 2015) does not overlap with the proposed infrastructure developments. Additionally, IPCC estimates of secondary forest (>20 years) biomass for tropical moist deciduous forests (IPCC 2006; IPCC 2019) are only slightly less (appx. 10%) than biomass estimates specific to the old-growth (Mastic) forests generated by Childs et al. (2015). Therefore, we assume the IPCC default biomass estimate for Secondary (>20 years) tropical moist deciduous forests is representative of, and/or skews conservative compared to, the secondary deciduous forests across Grand Cayman.
	Palm Hammock	
	Seasonally flooded / saturated semi-deciduous forest	
Tropical Moist Deciduous Forest (Younger Secondary)	Man-modified with trees	Aerial imagery shows apparent anthropogenically degraded habitat in the early stages of forest regeneration. Conservatively classified as young (≤20 years) secondary tropical moist deciduous forest (IPCC, 2006; IPCC, 2019)
Tropical Shrubland	Coastal shrubland	Encompassed by tropical shrubland classification (IPCC, 2006; IPCC, 2019).
	Dry shrubland	
Tropical Moist Grassland	Man-modified without trees	Aerial imagery shows apparent converted / anthropogenically degraded habitat without trees. Conservatively classified as tropical grassland habitat (IPCC, 2006).
	Pasture	
Excluded	Agricultural	Land cover types excluded from analysis encompass built areas and infrastructure, human activities (e.g., agriculture, mining), and open-water systems that are assumed to be net sources of GHG emissions and/or contain biomass carbon stocks that are *de minimis* in their current state.
	Commercial	
	Disturbed land	
	Institutional	
	Mining	
	Residential	
	Roads	
	Man-Made Pond	
	Ponds, pools and mangrove lagoons	

Table 24: Habitat Biomass and Impact Area per Alternative

Habitat*	Biomass MT CO_2e ha^{-1} (Ton CO_2e $acre^{-1}$)	Hectares** (Acres)			
		No-Build	**B1**	**B2**	**B3**
Mangroves	265.06 (118.24)	0	77.25 (190.90)	50.34 (124.40)	60.01 (148.30)
Tropical Moist Deciduous Forest (Older Secondary)	289.87 (129.31)	0	1.25 (3.10)	1.21 (3.00)	1.21 (3.00)
Tropical Moist Deciduous Forest (Younger Secondary)	123.3 (55.00)	0	2.75 (6.80)	4.33 (10.70)	2.43 (6.00)
Tropical Shrubland	158.27 (70.60)	0	0.20 (0.50)	0	0.24 (0.60)
Tropical Moist Grassland	27.78 (12.39)	0	31.57 (78.00)	33.35 (82.40)	30.72 (75.90)
Total		**0**	**113.03 (279.30)**	**89.23 (220.50)**	**94.62 (233.80)**

**Habitat classification is based on Table 21 above.*
***Hectares (acres) of impact does not impact the "Excluded" habitat classification from Table 21 above.*

4.1.6.2 Peat Data

The anticipated volume of peat that would need to be excavated was provided for each of the Build alternatives (**Table 25**). Because peat volumetric data lacked a geospatial component, this assessment assumed, with consideration to the dominance of peat-producing mangrove swamps on Grand Cayman (Childs et al., 2015), all peat to have (inland) mangrove habitat soil characteristics.

Table 25: Peat Volume Excavated per Alternative

Alternative	Peat Excavated	
	Cu yd	**m^3**
No-Build	0	0
B1	550,994	421,265
B2	223,811	171,116
B3	454,153	347,225

Country-specific data were sourced to estimate carbon content of peat excavated for each of the proposed alternatives. Childs et al. (2015) estimated soil carbon stocks for inland mangrove habitats across the CMW using field sampling (i.e., soil cores). Soil carbon content varied little by depth (Childs et al., 2015). Therefore, the carbon content for excavated peat was assumed to be uniform and equal to the average of the entire soil profile for inland mangrove habitats (Childs et al., 2015). The methodology for determining the total quantity of peat removal for each alternative is based on the trial pit data supplied by NRA from 2008 and 2014. Additional information regarding peat quantities is provided within the Engineering Evaluation Document.

Given the average depth of the soil carbon pool, areal soil carbon stocks can be converted into a compatible volumetric format. Equation 4.6 (IPCC, 2014) was modified to accommodate volumetric data and estimate the loss of soil organic carbon stocks for each alternative:

$$\Delta C_{excav-SO} = (SO_{AFTER} - SO_{BEFORE}) \times V_{CONVERTED}$$

Where:

$\Delta C_{excav\text{-}SO}$ = Changes in soil carbon stock from conversion due to extraction activities.

SO_{AFTER} = Soil carbon stock per unit of volume, immediately after the conversion; tonnes C m^{-3}. This value is conservatively set to 0.

SO_{BEFORE} = Soil carbon stock per unit of volume, immediately before the conversion; 0.044 tonnes C m^{-3} (1060.39 tonnes C ha^{-1}) (Childs et al., 2015).

$V_{CONVERTED}$ = Volume of conversion; m^3.

4.1.7 Habitat and Peat Emissions

Emissions from the removal/excavation of biomass and peat deposits were estimated for each of the Build alternatives B1, B2, and B3 (**Tables 26 and 27**). The No-Build scenario is assumed to result in no biomass or peat deposit removals and therefore results in no GHG emissions. The magnitude of emissions from habitat and peat impacts varies by alternative. Impacts to mangroves are the most predominant among habitat types across alternatives, constituting from 88% (Alternative B2) to 93% (Alternative B1) of total GHG emissions from biomass removal. When impacts to both carbon pools (i.e., biomass and peat) are combined, Alternative B1 results in the most emissions at 90,335.89 MT CO_2e (99,578.15 ton CO_2e), followed by Alternative B3 at 73,702.62 MT CO_2e (81,243.14 ton CO_2e), and Alternative B2 at 42,877.71 MT CO_2e (47,264.52 ton CO_2e).

Table 26: GHG Emissions from Biomass Removal Across Habitat Types per Alternative

Alternative	Mangroves	Tropical Moist Deciduous Forest (Older Secondary)	Tropical Moist Deciduous Forest (Younger Secondary)	Tropical Shrubland	Tropical Moist Grassland	Total
	MT CO_2e (Ton CO_2e)	MT CO_2e (Ton CO_2e)	MT CO_2e (Ton CO_2e)	MT CO_2e (Ton CO_2e)	MT CO_2e (Ton CO_2e)	MT CO_2e (Ton CO_2e)
No-Build	0	0	0	0	0	0
B1	20,477.36 (22,572.40)	363.65 (400.86)	339.30 (374.02)	32.03 (35.30)	876.89 (966.61)	22,089.24 (24,349.19)
B2	13,344.08 (14,709.31)	351.92 (387.93)	533.90 (588.52)	0	926.36 (1,021.14)	15,156.26 (16,706.90)
B3	15,907.77 (17,535.29)	351.92 (387.93)	299.38 (330.01)	38.43 (42.36)	853.29 (940.59)	17,450.79 (19,236.18)

Table 27: GHG Emissions from Habitat and Peat Impacts per Alternative

Alternative	Habitat (Biomass) Removal	Peat Excavation	Total
	MT CO_2e (Ton CO_2e)	MT CO_2e (Ton CO_2e)	MT CO_2e (Ton CO_2e)
No-Build	0	0	0
B1	22,089.24 (24,349.19)	68,246.65 (75,228.96)	90,335.89 (99,578.15)
B2	15,156.26 (16,706.90)	27,721.45 (30,557.63)	42,877.71 (47,264.52)
B3	17,450.79 (19,236.18)	56,251.83 (62,006.95)	73,702.62 (81,243.14)

Peat impacts account for most of the emissions across the Build alternatives. This finding is consistent with the consensus on carbon cycling in coastal wetlands, where most of the ecosystem carbon is found in the soils (Donato et al., 2011).

Assumptions and Exclusions Summary

- All of the carbon stored in biomass and peat that is removed/excavated during construction is assumed to be lost and subsequently and immediately emitted as CO_2 to the atmosphere. Actual emissions from these extracted materials may vary quantitively and temporally, depending on their use (e.g., wood products), storage conditions and/or method of disposal (e.g., burning, *in-situ* decomposition).
- Mangrove biomass estimates encompass dead wood carbon stock (Childs et al., 2015).
- Mangrove litter carbon stocks are assumed *de minimis* (Childs et al., 2015).
- Impacts to dead organic matter (DOM) carbon stocks were excluded from analysis for non-mangrove habitat types as regional and/or default DOM estimates (IPCC, 2006; IPCC, 2019) were unavailable.
- Land cover types excluded from the analysis contain carbon stocks that are either *de minimis* or are net sources of GHG emissions (i.e., conservatively excluded).
- It is assumed the alternatives will not lead to leakage impacts outside of the LOD from the displacement of land use activities (e.g., agriculture, mining) and within wetland (e.g., mangrove) habitats due to hydrological changes that may produce indirect GHG emissions.
- The average soil organic carbon content and depth of inland mangrove habitats (Childs et al., 2015) is assumed to be representative of all peat excavated across LODs. Actual carbon content of extracted peat is likely variable across environmental gradients and by depth.
- The accuracy of the assessment is based on data that were provided and/or sourced in the form of habitat mapping, peat extraction data, and primary literature.
- Annual carbon sequestration loss can be found within the Terrestrial Ecology Assessment of Alternatives report.

4.1.8 Bulk Material Methodology

For each of the Build alternatives B1, B2, and B3 volumes for bulk material, road markings, light poles, and excavation materials were estimated. Total usage of asphalt, concrete, soil, rock, and kerb was applied along with appropriate emission factors as defined by the UK National Highway Carbon Tool (UKNH 2023). This is a carbon calculation tool applied for operational, construction, and maintenance activities for UK national highway projects. The tool incorporates factors derived from the Bath Inventory of Carbon and Energy Version 3. For the purposes of this assessment, the Bath Inventory of Carbon and Energy was used to ensure representative factors were applied for each material type.

Emissions are established on an input unit from a given material and CO_2e factor is applied. For example, the Bath Inventory of Carbon and Energy states that asphalt has a factor of 0.055 MT CO_2e per MT of asphalt (tCO_2e/t). Additionally, the Carbon tool utilizes density (tonnes/ m^3) for various materials via the Bath Inventory Version 2.0.

Material totals were determined in either square yards, linear feet, or cubic yards. Because all the emission factors are in tCO_2e/t material, the total volumes were calculated. For example, compacted asphalt with a depth of 3.5 inches (88.9 mm) is applied for new road construction. This allows for a volume to be established and converted to cubic metres to correlate with known densities (2.3 tonnes/m^3 for asphalt). Emissions are then calculated for both new construction and maintenance through the end of year 2074. See **Attachment C** for material quantities. Additional details regarding quantification of bulk materials can be found within the separate Engineering Assessment of Alternatives document. For the GHG evaluation, all construction and materials were assumed to occur in the initial construction phase (2024-2026) to provide a conservative estimate on emissions.

There are also a few materials that required specific calculation methodologies. These include road markings, tack coating, and concrete barriers. Additionally, the Carbon Tool applies some conversions directly related to the input units. Specifically applied for this analysis was kerb (precast concrete 125x150mm) of 0.0431 to convert from metres to tonnes with the appliable density.

4.1.9 Bulk Material Emissions

The Carbon Tool breaks down densities and emission factors by general material. This analysis included a review of the densities and emission factors and then correlated each quantity type to an appropriate density/emission factor. **Table 28** describes data applied to calculate GHG emissions.

Table 28: Emission Factor/Density by Material Breakdown

Quantity Name	Carbon Tool Density Category	Density tonnes/m^3	Emission Factors	Units	Carbon Tool Factor Category
Asphalt	Asphalt	2.3	0.055	tCO_2e/t	Asphalt
Rock	Quarried Aggregate	2	0.007		General Mixture
Concrete	Concrete	2.4	0.103		General Concrete
Excavation	Soil	1.7	0.007		General Mixture
Kerb	Concrete	2.4	0.132		Pre-cast Concrete
Markings	Plastic	1.4	5.7		Thermoplastic
Lightpoles	Steel	8	2.76		Steel 8m
Walls/Barrier	Concrete	2.4	0.122		General Concrete

To determine a volume from the known linear feet total, road markings width and thickness was assumed to be 6 inches (15.24 cm) and 0.118 inch (3 mm), respectively (FHWA 2015, SRRB 2015). Tack coat calculations incorporated a thickness of 0.0098 inch (0.25 mm) (Blacklidge 2020). In addition, the concrete barrier calculations applied a triangle shape, and the area is determined by 1/2 base multiplied by the height. The base is 2 feet (0.6096 m) and a height of 3 feet (0.9144 m). The following **Tables 29-32** provide the projected GHG emissions associated with the Will T Connector and each of the Build alternatives B1, B2, and B3. Note that the Will T Connector is encompassed within each of the Build alternatives. Therefore, its emissions will be added to each of the Build alternatives for their total value. The No-Build scenario is assumed to include no bulk material related emissions, and therefore not included within **Tables 29-32.**

Overall, Alternative B1 is estimated to emit the highest at 84,611 short tons (76, 803 MT) bulk material GHGs through 2074. Alternative B3 is estimated to emit 73,837 short tons (66,984 MT), while Alternative B2 is lowest at 70,772 short tons (64,203 MT).

Table 29: Will T Connector Material GHG Emissions

	Compacted* Asphalt	Crusher Run Rock	Cayman Rock Rock	Compacted[1] Asphalt	Tack Coat	Milling Asphalt	Pavement Concrete	Kerb Kerb	Marking Marking	Gen Excavation Soil	Shot Rock Rock	Total
	MT/yr CO_2e											
Total/Life	1,107.0	210.0	237.8	903.7	8.9	903.7	489.9	107.4	259.6	782.5	758.2	**5,768.7**
	Ton/Yr CO_2e											
Total/Life	1,220.3	231.5	262.1	996.2	9.8	996.2	540.0	118.3	286.1	862.6	835.8	**6,358.9**

* Compact Asphalt depth is either 3.5 inch or 6 inch.

Table 30a: Alternative B1 Material GHG Emissions

	Compacted* Asphalt	Compacted* Asphalt	Compacted* Asphalt	Crusher Run Rock	Cayman Rock Rock	Milling Asphalt	Tack Coat	Pavement Concrete	Kerb Kerb	Kerb/Gutter Kerb	Mountable Kerb
	MT/yr CO_2e										
Total/Life	8,405.2	7,135.6	1,180.8	1,353.8	1,561.0	8,405.2	82.7	1,641.4	37.2	97.7	18.8
	Ton/yr CO_2e										
Total/Life	9,265.2	7,865.6	1301.6	1,492.3	1,720.7	9,265.2	91.2	1,809.3	41.0	107.7	20.8

* Compact Asphalt depth is either 2 inch, 3.5 inch or 6 inch.

Table 30b: Alternative B1 Material GHG Emissions

	Barrier Concrete	Yellow Marking Marking	White Marking Marking	Light Poles Poles	Undercut Excav Soil	Aggregate Rock	Shot Rock Rock	Corridor Excav Soil	**Will T**	**Total***
	MT/yr CO_2e									
Total/Life	1,666.3	555.7	1,295.2	126.4	577.7	6,577.4	30,245.9	70.3	5,768.7	**76,803.2**
	Ton/yr CO_2e									
Total/Life	1,836.7	612.6	1,427.7	139.4	636.9	7,250.3	33,340.4	77.5	6,358.9	**84,660.9**

* The overall total values incorporate all emission sources in Table "a" and "b".

Table 31a: Alternative B2 Material GHG Emissions

	Compacted*	Compacted*	Compacted*	Crusher Run	Cayman Rock	Milling	Tack	Pavement	Kerb	Kerb/Gutter	Mountable
	Asphalt	**Asphalt**	**Asphalt**	**Rock**	**Rock**	**Asphalt**	**Coat**	**Concrete**	**Kerb**	**Kerb**	**Kerb**
	MT/yr CO_2e										
Total/Life	6,052.0	6,115.6	924.6	1,160.3	1,346.4	6,052.0	59.6	1,469.3	28.9	33.7	25.3
	Ton/yr CO_2e										
Total/Life	6,671.1	6,741.3	1,019.2	1,279.0	1,484.1	6,671.1	65.7	1,619.6	31.8	37.1	27.9

* Compact Asphalt depth is either 2 inch, 3.5 inch or 6 inch

Table 31b: Alternative B2 Material GHG Emissions

Year	Barrier	Yellow Marking	White Marking	Light Poles	Undercut Excav	Aggregate	Shot Rock	Corridor Excav	**Will T**	**Total***
	Concrete	**Marking**	**Marking**	**Poles**	**Soil**	**Rock**	**Rock**	**Soil**		
	MT/yr CO_2e									
Total/Life	2,120.6	528.3	1,022.4	119.5	1,415.9	4,061.4	25,839.3	59.8	5,768.7	**64,203.2**
Year	**Ton/yr CO_2e**									
Total/Life	2,337.5	582.3	1,127.0	131.7	1,560.8	4,476.9	28,482.9	65.9	6,358.9	**70,771.9**

* The overall total values incorporate all emission sources in Table “a” and “b”.

Table 32a: Alternative B3 Material GHG Emissions

	Compacted* Asphalt	Compacted* Asphalt	Compacted* Asphalt	Crusher Run Rock	Cayman Rock Rock	Milling Asphalt	Tack Coat	Pavement Concrete	Kerb Kerb	Kerb/Gutter Kerb	Mountable Kerb
	MT/yr CO_2e										
Total/Life	7,305.2	6,286.7	957.4	1,192.7	1,357.9	7,305.2	71.9	1,512.6	34.3	31.1	16.8
	Ton/yr CO_2e										
Total/Life	8,052.6	6,929.9	1,055.4	1,314.8	1,496.8	8,052.6	79.3	1,667.4	37.8	34.2	18.5

* Compact Asphalt depth is either 2 inch, 3.5 inch or 6 inch

Table 32b: Alternative B3 Material GHG Emissions

	Barrier Concrete	Yellow Marking Marking	White Marking Marking	Light Poles Poles	Undercut Excav Soil	Aggregate Rock	Shot Rock Rock	Corridor Excav Soil	**Will T**	**Total***
	MT/yr CO_2e									
Total/Life	1853.5	540.8	1048.0	122.4	492.0	5,440.0	25,584.2	62.0	5,768.7	**66,983.5**
	Ton/yr CO_2e									
Total/Life	2043.2	596.1	1155.3	134.9	542.4	5,996.6	28,201.8	68.3	6,358.9	**73,836.6**

* The overall total values incorporate all emission sources in Table “a” and “b”.

4.2 Qualitative

Not applicable per the UK Department for Transport "Transport Analysis Guidance".

4.3 Monetary

As part of the Cost Benefit Analysis prepared for this project, the GHG emissions of each alternative will be monetized for the No-Build scenario and for each of the Build alternatives B1, B2 and B3. See the separate Cost Benefit Analysis included in the Shortlist Evaluation Document for details regarding GHG monetary valuation.

5 Shortlist Evaluation Summary

The No-Build scenario and each of the Build alternatives B1, B2, and B3 were assessed in terms of anticipated GHG emissions throughout the horizon year (2074). For the unavoidable impacts reported, mitigation measures to aid in offsetting impacts may be possible. Mitigation measures have not been considered as part of this analysis but will be investigated and identified for the Preferred Alternative and documented in the forthcoming Environmental Statement Document.

Total GHG emissions associated with the No-Build scenario and for each of the Build alternatives B1, B2, and B3 are provided in **Table 33 and 34** below. These emissions include both one-time emissions related to construction (2024-2026) and annual emissions related to traffic operations (2026-2074).

Table 33: GHG One-Time Emissions (2024-2026)

Alternative	Habitat/Peat		Construction		Bulk Material		Total Emissions	
	MT CO_2e	Ton CO_2e	MT CO_2e	Ton CO_2e	MT CO_2e	Ton CO_2e	MT CO_2e	Ton CO_2e
No-Build	0	0	0	0	0	0	**0**	**0**
B1	90,336	99,578	2,364	2,606	27,199	29,982	**119,899**	**132,166**
B2	42,878	47,265	2,001	2,206	22,449	24,745	**67,328**	**74,216**
B3	73,703	81,243	2,075	2,288	22,798	25,131	**98,576**	**108,662**

Table 34: GHG Annual Operational Traffic Emissions (2026 through 2074)

Alternative	2026 Traffic		2074 Traffic		Average Annual Emissions (2026-2074)	
	MT CO_2e	Ton CO_2e	MT CO_2e	Ton CO_2e	MT CO_2e	Ton CO_2e
No-Build	64,134	70,696	124,739	137,501	**94,437**	**104,099**
B1	68,031	74,991	115,681	127,516	**91,856**	**101,254**
B2	70,044	77,210	115,238	127,028	**92,641**	**102,119**
B3	68,038	74,999	114,976	126,740	**91,507**	**100,870**

Table 35: Summary of GHG Expected Emissions by Alternative

Alternative	One Time Total		Average Annual Traffic	
	MT CO_2e	Ton CO_2e	MT CO_2e	Ton CO_2e
No-Build	0	0	94,437	104,099
B1	119,899	132,166	91,856	101,254
B2	67,328	74,216	92,641	102,119
B3	98,576	108,662	91,507	100,870

The following summarizes the results of the analysis for the identified GHG emissions. Please note that the below is not a ranking; further comparison of alternatives in relation to GHG emissions can be found in the separate Cost Benefit Analysis and Shortlist Evaluation Document.

No-Build: The No-Build scenario is assumed to require no habitat/peat removal, construction, or bulk materials; therefore, it results in no GHG emissions within these categories. Compared to the Build alternatives, the No-Build scenario results in the lowest total one-time emissions outlined in (**Tables 33 and 35)**. However, the GHG emissions from traffic are projected to generate approximately 9,000 MT (10,000 short tons) more than the Build alternatives by 2074 (**Table 34**).

Alternative B1: Alternative B1 is anticipated to contribute the highest one-time related emissions of the three Build alternatives, primarily due to the greater peat emission (increase of approximately 110% to Alternative B2) (**Tables 33 and 35**). Alternative B1 is anticipated to contribute the second lowest average annual traffic related emissions of the three Build alternatives (**Tables 34 and 35**).

Alternative B2: Alternative B2 is anticipated to contribute the lowest one-time related emissions of the three Build alternatives (**Tables 33 and 35**). Alternative B2 is anticipated to contribute the highest average annual traffic related emissions of the three Build alternatives (**Tables 34 and 35**).

Alternative B3: Alternative B3 is anticipated to contribute the second lowest one-time related emissions of the three Build alternatives (**Tables 33 and 35**). Peat emissions are anticipated to increase by approximately 72% from Alternative B2 to Alternative B3. Alternative B3 is anticipated to contribute the lowest average annual traffic related emissions of the three Build alternatives (**Tables 34 and 35**).

This Greenhouse Gases Assessment is one in a series of Technical Reports that have been prepared for the Shortlist Evaluation. The level of impacts and the identification of the least impactful alternative will differ based on the resource/feature evaluated in each of the Technical Reports. Therefore, the least impactful alternative described in this evaluation summary and in each technical document **does not** move an alternative forward to the Preferred Evaluation nor does it constitute any special weighting or extra consideration in the Shortlist Evaluation Document. The comprehensive analysis of all the resources/features evaluated along with the rationale for the identification of the Preferred Alternative are presented in the Shortlist Evaluation Document.

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Attachment A

Traffic Road Segment Information

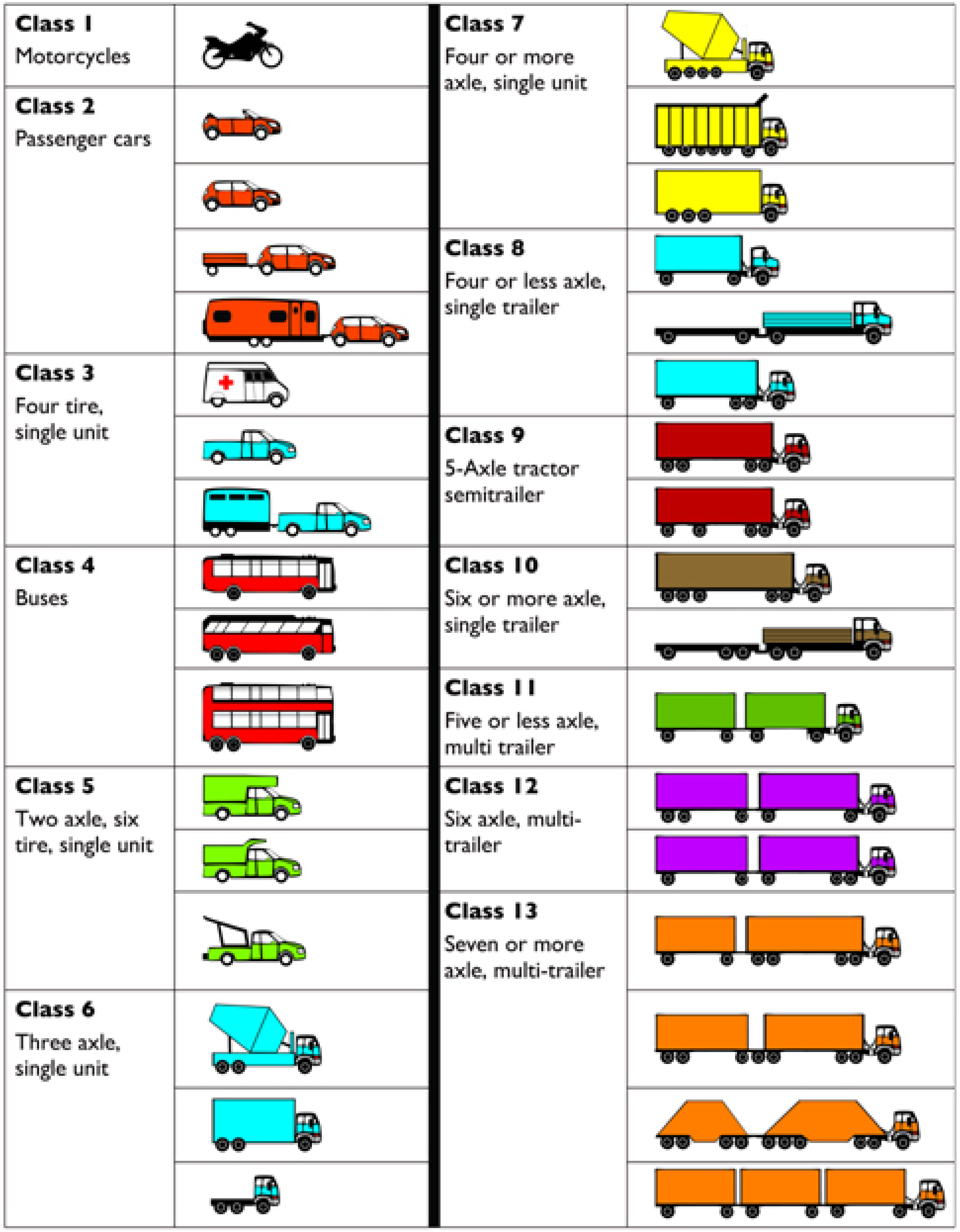


Figure A-1 Federal Highway Administration Vehicle Classification

All EPA MOVES runs applied the identical Federal Highway Administration vehicle classification distribution. Table A-1 provides the classifications by vehicle type discussed throughout the Greenhouse Gas Report

Table A-1 Segment Data – Morning AM Baseline 2021

MOVES Category	FHWA Classification
Motorcycles	1
Passenger cars	2-3
Buses	4
Single Unit Short-Haul Trucks	6-10
Combination Unit Short-Haul Trucks	11-13

Table A-2 Segment Data – Morning AM Baseline 2021

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	1388	2.09	34.7	ATR 815
2	Urban	656	1.17	27.8	ATR 922
3	Urban	624	4.54	35.9	ATR 909
4	Urban	360	0.71	29.6	ATR 803
5	Urban	262	3.60	40.7	ATR 926

Table A-3 Segment Data – Evening PM Baseline 2021

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	1580	2.09	32.8	ATR 815
2	Urban	929	1.17	26.7	ATR 922
3	Urban	917	4.54	34.7	ATR 909
4	Urban	795	0.71	28.3	ATR 803
5	Urban	417	3.60	45.7	ATR 926

Table A-4 Segment Data – Morning AM No Build 2026

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	1726	2.09	32.9	ATR 815
2	Urban	653	1.17	27.8	ATR 902
3	Urban	863	4.54	34.9	ATR 909
4	Urban	189	0.71	29.9	ATR 803
5	Urban	491	3.60	40.4	ATR 926

Table A-5 Segment Data – Evening PM No Build 2026

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	1905	2.09	31.7	ATR 815
2	Urban	955	1.17	26.5	ATR 902
3	Urban	1124	4.54	33.6	ATR 909
4	Urban	656	0.71	28.6	ATR 803
5	Urban	608	3.60	45.3	ATR 926

Table A-6 Segment Data – Morning AM Alternative B1 2026

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	207	1.21	24.6	ATR 812
2	Urban	1132	2.50	44.1	ATR 815
3	Urban	814	1.25	46.9	ATR 922
4	Rural	790	4.31	44.4	ATR 909
5	Urban	175	1.61	39.6	ATR 926
6	Urban	794	2.09	37.8	ATR 815
7	Urban	223	1.17	28.8	ATR 922
8	Urban	192	4.54	36.6	ATR 909
9	Urban	159	0.71	29.9	ATR 803
10	Urban	262	3.60	42.2	ATR 926

Table A-7 Segment Data – Evening PM Alternative B1 2026

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	96	1.21	24.8	ATR 812
2	Urban	1292	2.50	42.3	ATR 815
3	Urban	980	1.25	46.0	ATR 922
4	Rural	952	4.31	43.6	ATR 909
5	Urban	248	1.61	37.9	ATR 926
6	Urban	802	2.09	38.0	ATR 815
7	Urban	322	1.17	28.7	ATR 922
8	Urban	285	4.54	36.5	ATR 909
9	Urban	435	0.71	29.7	ATR 803
10	Urban	323	3.60	46.4	ATR 926

Table A-8 Segment Data – Morning AM Alternative B2 2026

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	196	1.21	24.6	ATR 812
2	Urban	1152	2.50	43.9	ATR 815
3	Urban	863	1.25	46.6	ATR 922
4	Rural	841	3.95	47.2	ATR 909
5	Urban	799	2.09	37.8	ATR 815
6	Urban	204	1.17	28.8	ATR 922
7	Urban	169	4.54	36.6	ATR 909
8	Urban	168	0.71	29.9	ATR 803
9	Urban	316	3.60	39.7	ATR 926

Table A-9 Segment Data – Evening PM Alternative B2 2026

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	117	1.21	24.7	ATR 812
2	Urban	1323	2.50	41.2	ATR 815
3	Urban	1066	1.25	45.3	ATR 922
4	Rural	1076	3.95	46.1	ATR 909
5	Urban	775	2.09	38.1	ATR 926
6	Urban	272	1.17	28.7	ATR 815
7	Urban	217	4.54	36.6	ATR 922
8	Urban	340	0.71	29.7	ATR 909
9	Urban	504	3.60	45.0	ATR 926

Table A-10 Segment Data – Morning AM Alternative B3 2026

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	205	1.21	24.6	ATR 812
2	Urban	1140	2.50	44.0	ATR 815
3	Urban	843	1.25	46.8	ATR 922
4	Rural	821	4.16	47.3	ATR 909
5	Urban	802	2.09	37.8	ATR 815
6	Urban	212	1.17	28.8	ATR 922
7	Urban	182	4.54	36.6	ATR 909
8	Urban	165	0.71	29.9	ATR 803
9	Urban	316	3.60	39.7	ATR 926

Table A-11 Segment Data – Evening PM Alternative B3 2026

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	103	1.21	24.8	ATR 812
2	Urban	1304	2.50	42.2	ATR 815
3	Urban	998	1.25	45.9	ATR 922
4	Rural	970	4.16	46.4	ATR 909
5	Urban	807	2.09	37.9	ATR 815
6	Urban	325	1.17	28.7	ATR 922
7	Urban	283	4.54	36.5	ATR 909
8	Urban	342	0.71	29.7	ATR 803
9	Urban	500	3.60	46.1	ATR 926

Table A-12 Segment Data – Morning AM No Build 2074

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	4627	2.09	14.8	ATR 815
2	Urban	2998	1.17	15.1	ATR 922
3	Urban	3582	4.54	15.9	ATR 909
4	Urban	782	0.71	28.1	ATR 803
5	Urban	1379	3.60	37.4	ATR 926

Table A-13 Segment Data – Evening PM No Build 2074

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	4699	2.09	14.0	ATR 815
2	Urban	3157	1.17	14.2	ATR 922
3	Urban	3592	4.54	15.8	ATR 909
4	Urban	1199	0.71	25.7	ATR 803
5	Urban	1366	3.60	36.2	ATR 926

Table A-14 Segment Data – Morning AM Alternative B1 2074

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	243	1.21	24.5	ATR 812
2	Urban	3768	2.50	31.9	ATR 815
3	Urban	3060	1.25	39.0	ATR 922
4	Rural	3027	4.31	37.9	ATR 909
5	Urban	399	1.61	39.1	ATR 926
6	Urban	2039	2.09	31.0	ATR 815
7	Urban	749	1.17	27.4	ATR 922
8	Urban	963	4.54	33.7	ATR 909
9	Urban	990	0.71	27.9	ATR 803
10	Urban	2595	3.60	34.8	ATR 926

Table A-15 Segment Data – Evening PM Alternative B1 2074

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	292	1.21	24.2	ATR 812
2	Urban	3688	2.50	29.1	ATR 815
3	Urban	3085	1.25	37.5	ATR 922
4	Rural	3042	4.31	36.9	ATR 909
5	Urban	439	1.61	39.0	ATR 926
6	Urban	1905	2.09	31.5	ATR 815
7	Urban	766	1.17	27.4	ATR 922
8	Urban	989	4.54	33.5	ATR 909
9	Urban	1194	0.71	26.8	ATR 803
10	Urban	2783	3.60	38.6	ATR 926

Table A-16 Segment Data – Morning AM Alternative B2 2074

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	242	1.21	24.5	ATR 812
2	Urban	3842	2.50	30.5	ATR 815
3	Urban	3187	1.25	37.6	ATR 922
4	Rural	3154	3.95	36.1	ATR 909
5	Urban	1986	2.09	30.9	ATR 815
6	Urban	705	1.17	27.6	ATR 922
7	Urban	875	4.54	34.3	ATR 909
8	Urban	1006	0.71	27.8	ATR 803
9	Urban	2701	3.60	34.0	ATR 926

Table A-17 Segment Data – Evening PM Alternative B2 2074

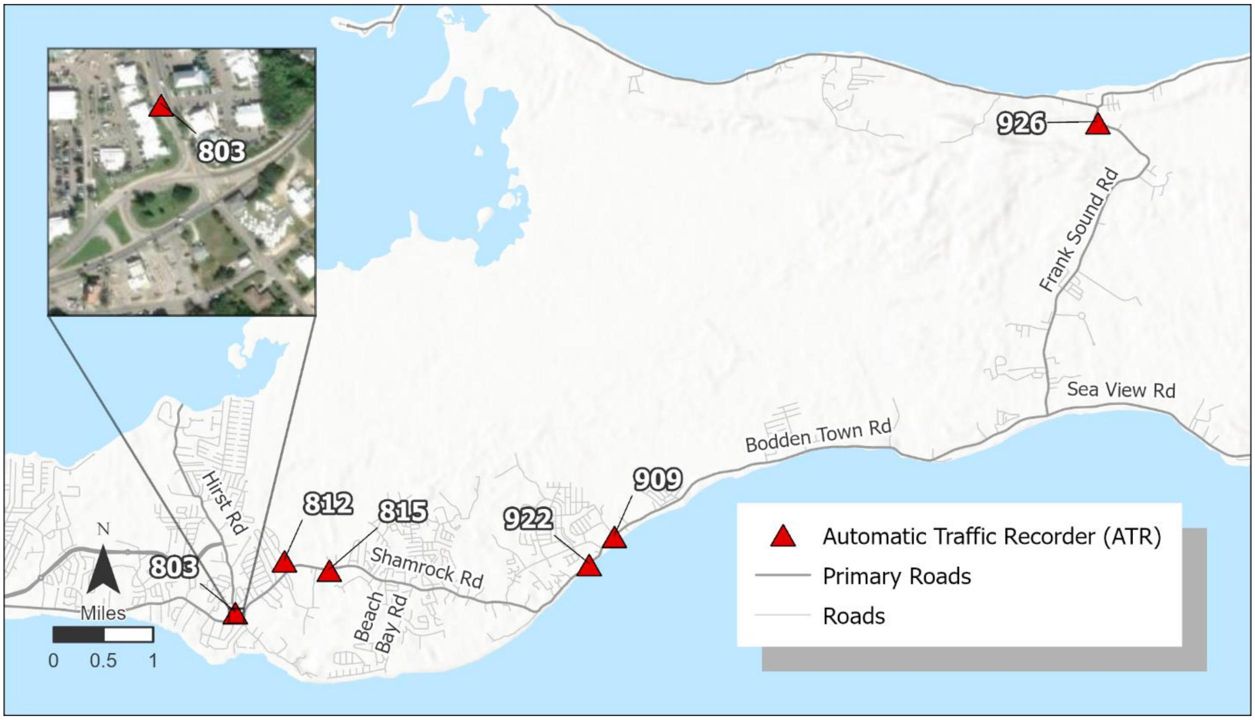
Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	295	1.21	24.5	ATR 812
2	Urban	3859	2.50	27.2	ATR 815
3	Urban	3287	1.25	35.2	ATR 922
4	Rural	3251	3.95	34.3	ATR 909
5	Urban	1731	2.09	32.9	ATR 815
6	Urban	667	1.17	27.8	ATR 922
7	Urban	812	4.54	34.6	ATR 909
8	Urban	1204	0.71	26.2	ATR 803
9	Urban	2975	3.60	37.1	ATR 926

Table A-18 Segment Data – Morning AM Alternative B3 2074

Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	243	1.21	24.5	ATR 812
2	Urban	2792	2.50	31.4	ATR 815
3	Urban	3100	1.25	38.6	ATR 922
4	Rural	3067	4.16	37.0	ATR 909
5	Urban	2026	2.09	30.6	ATR 815
6	Urban	718	1.17	27.6	ATR 922
7	Urban	940	4.54	33.6	ATR 909
8	Urban	998	0.71	27.8	ATR 803
9	Urban	2651	3.60	34.1	ATR 926

Table A-19 Segment Data – Evening PM Alternative B3 2074

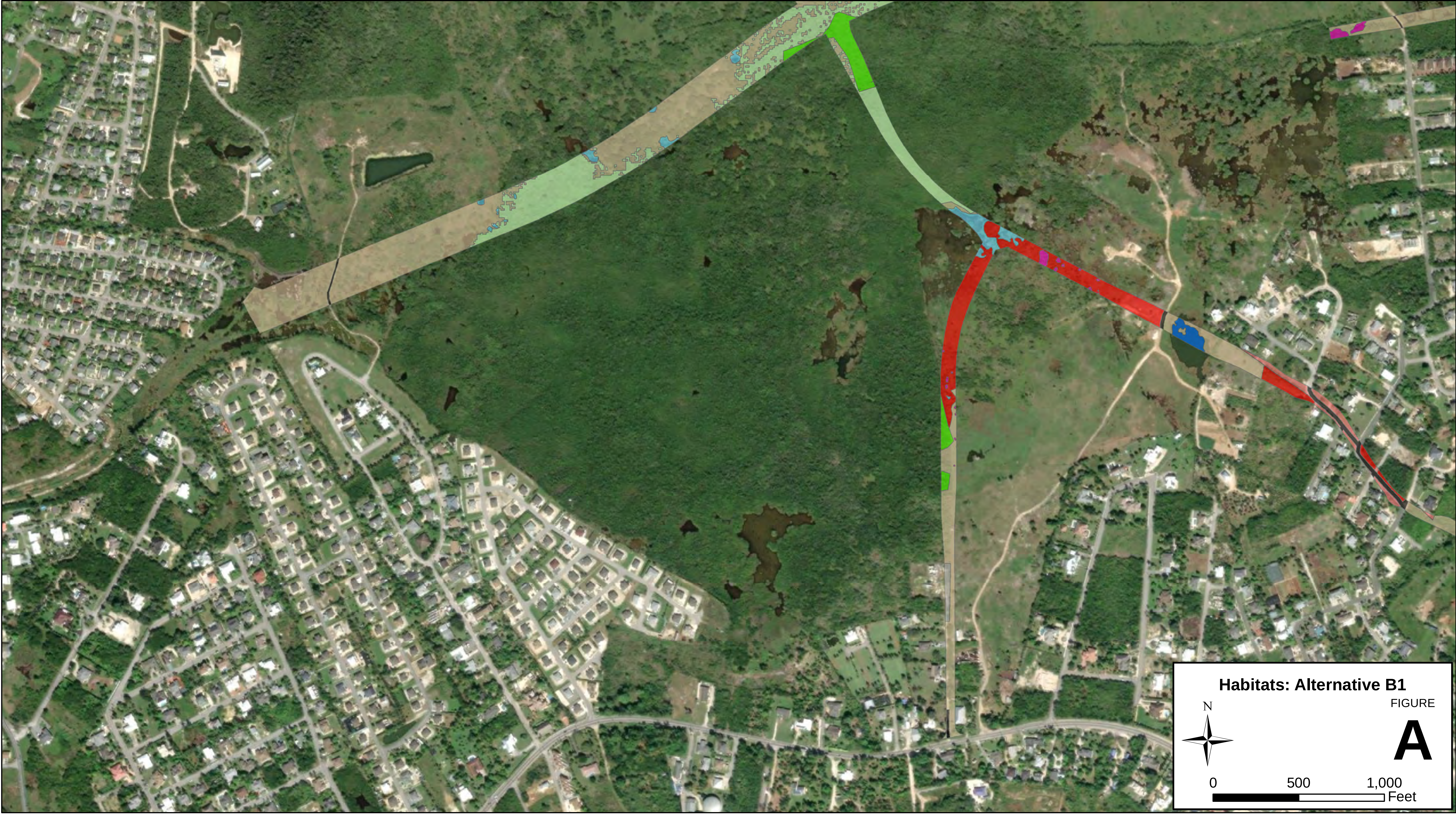
Segment ID	Road Type	Segment Volume (veh/hr)	Segment Length (miles)	Segment Average Speed (mph)	Segment Description
1	Urban	295	1.21	24.2	ATR 812
2	Urban	3776	2.5	28.4	ATR 815
3	Urban	3185	1.25	36.5	ATR 922
4	Rural	3148	4.16	35.4	ATR 909
5	Urban	1818	2.09	31.6	ATR 815
6	Urban	706	1.17	27.7	ATR 922
7	Urban	894	4.54	34.1	ATR 909
8	Urban	1170	0.71	26.8	ATR 803
9	Urban	2903	3.60	37.3	ATR 926



Automatic Traffic Recorder(ATR) sites associated with listed Segment Descriptions

Attachment B

Alternatives Habitat Maps



Legend

Man-modified

- Man-Modified Without trees
- Man-Modified With Trees
- Commercial
- Residential
- Roads
- Man-Made Pond

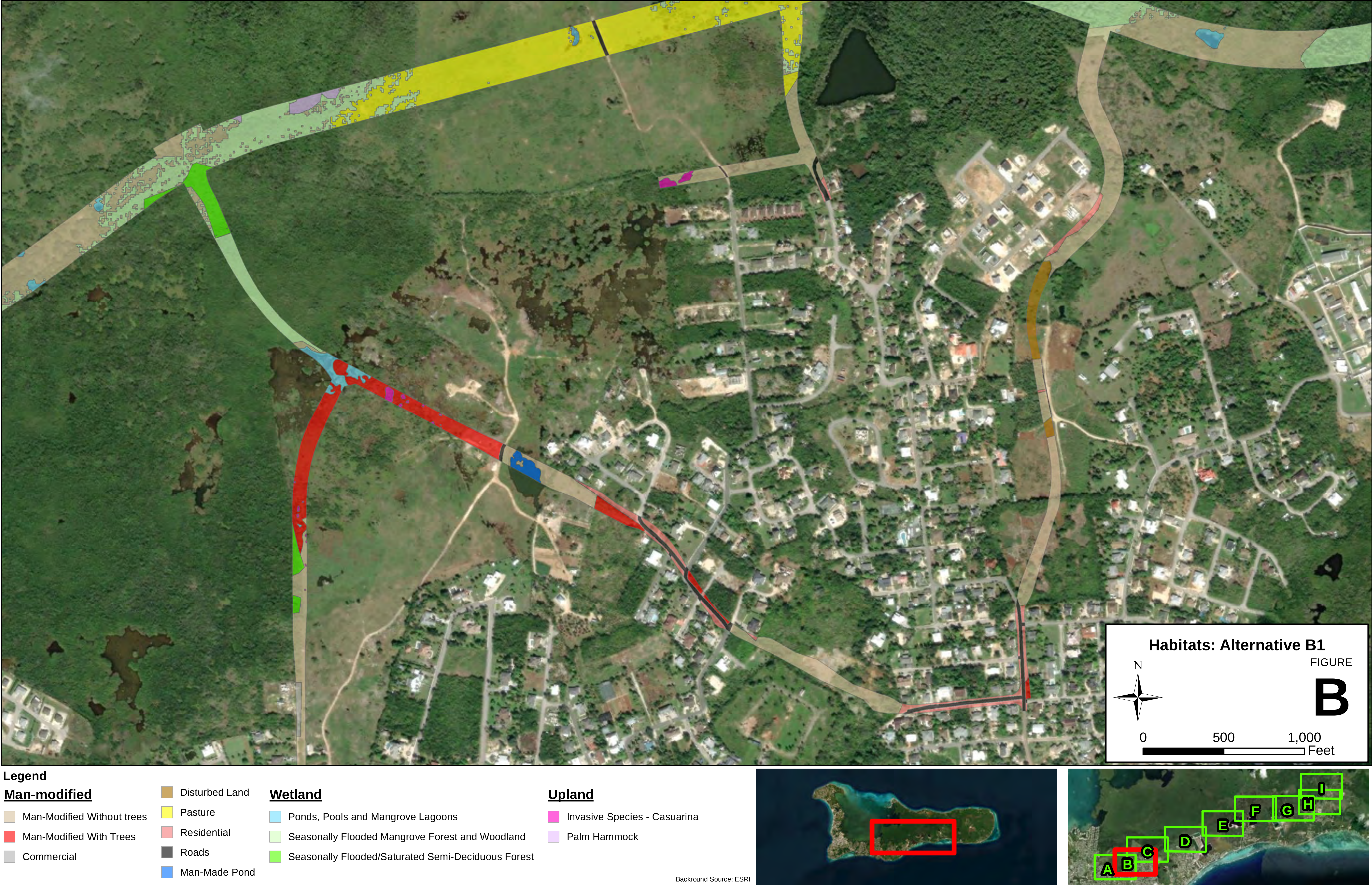
Wetland

- Ponds, Pools and Mangrove Lagoons
- Seasonally Flooded Mangrove Forest and Woodland
- Seasonally Flooded/Saturated Semi-Deciduous Forest

Upland

- Invasive Species - Casuarina

Backround Source: ESRI



Habitats: Alternative B1
FIGURE
B
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0
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Feet
Legend
Man-modified
Man-Modified Without trees
Man-Modified With Trees
Commercial
Disturbed Land
Pasture
Residential
Roads
Man-Made Pond
Wetland
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded/Saturated Semi-Deciduous Forest
Upland
Invasive Species - Casuarina
Palm Hammock
Backround Source: ESRI
A
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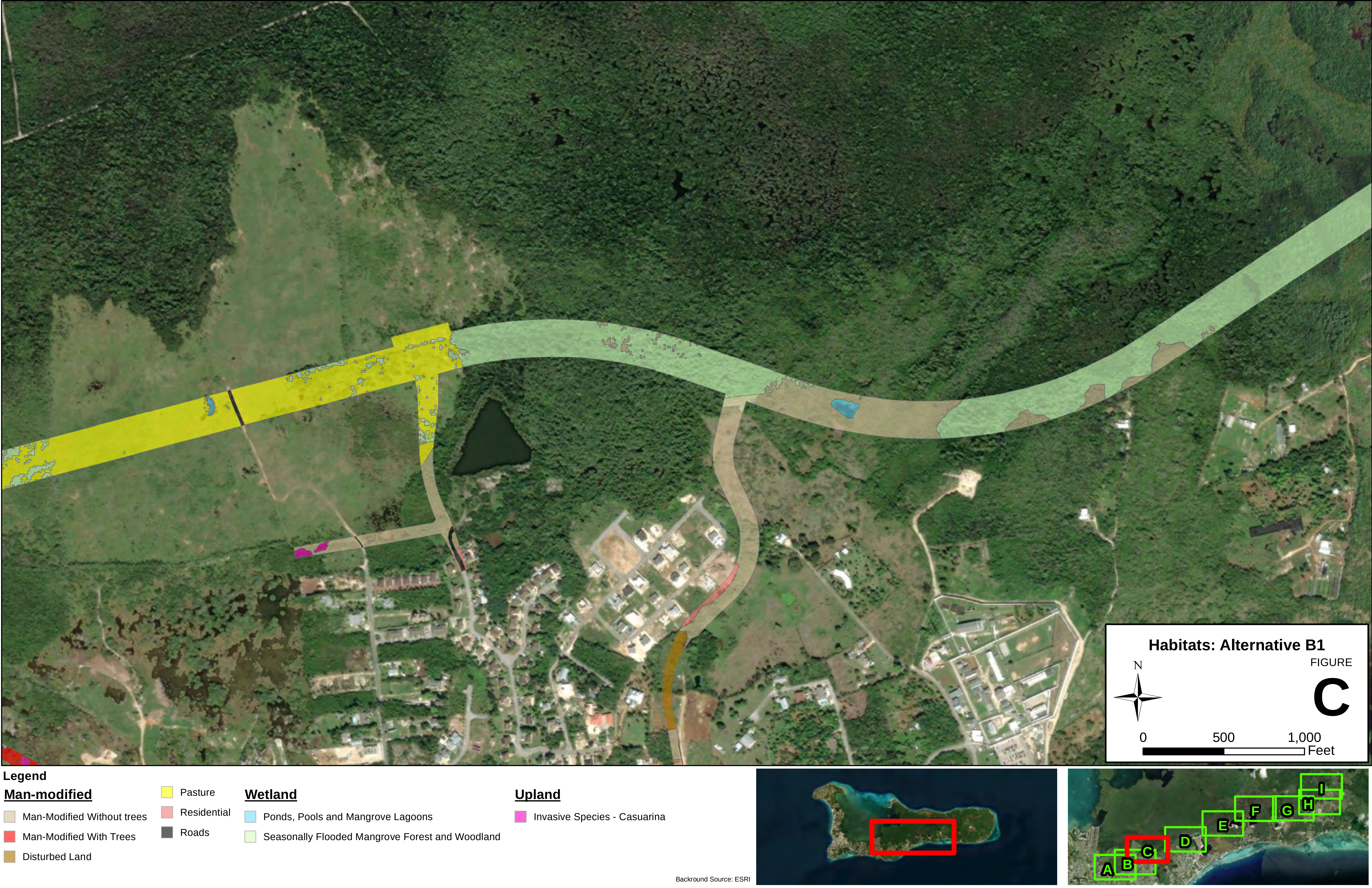

Habitats: Alternative B1
FIGURE
C
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0
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1,000
Feet
Legend
Man-modified
Man-Modified Without trees
Man-Modified With Trees
Disturbed Land
Pasture
Residential
Roads
Wetland
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Upland
Invasive Species - Casuarina
Backround Source: ESRI
A
B
C
D
E
F
G
H
I

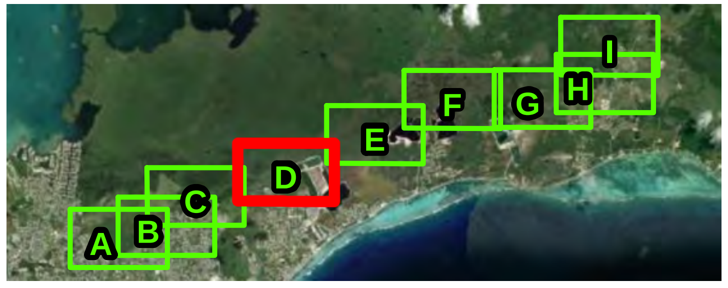
Legend

Man-modified
- Man-Modified Without trees
- Roads

Wetland
- Ponds, Pools and Mangrove Lagoons
- Seasonally Flooded Mangrove Forest and Woodland
- Seasonally Flooded Mangrove Forest (low density)

Upland
- Palm Hammock

Backround Source: ESRI



Habitats: Alternative B1
FIGURE
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1,000
Feet
Legend
Man-modified
Man-Modified Without trees
Man-Modified With Trees
Wetland
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded Mangrove Forest (low density)
Backround Source: ESRI
A
B
C
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H
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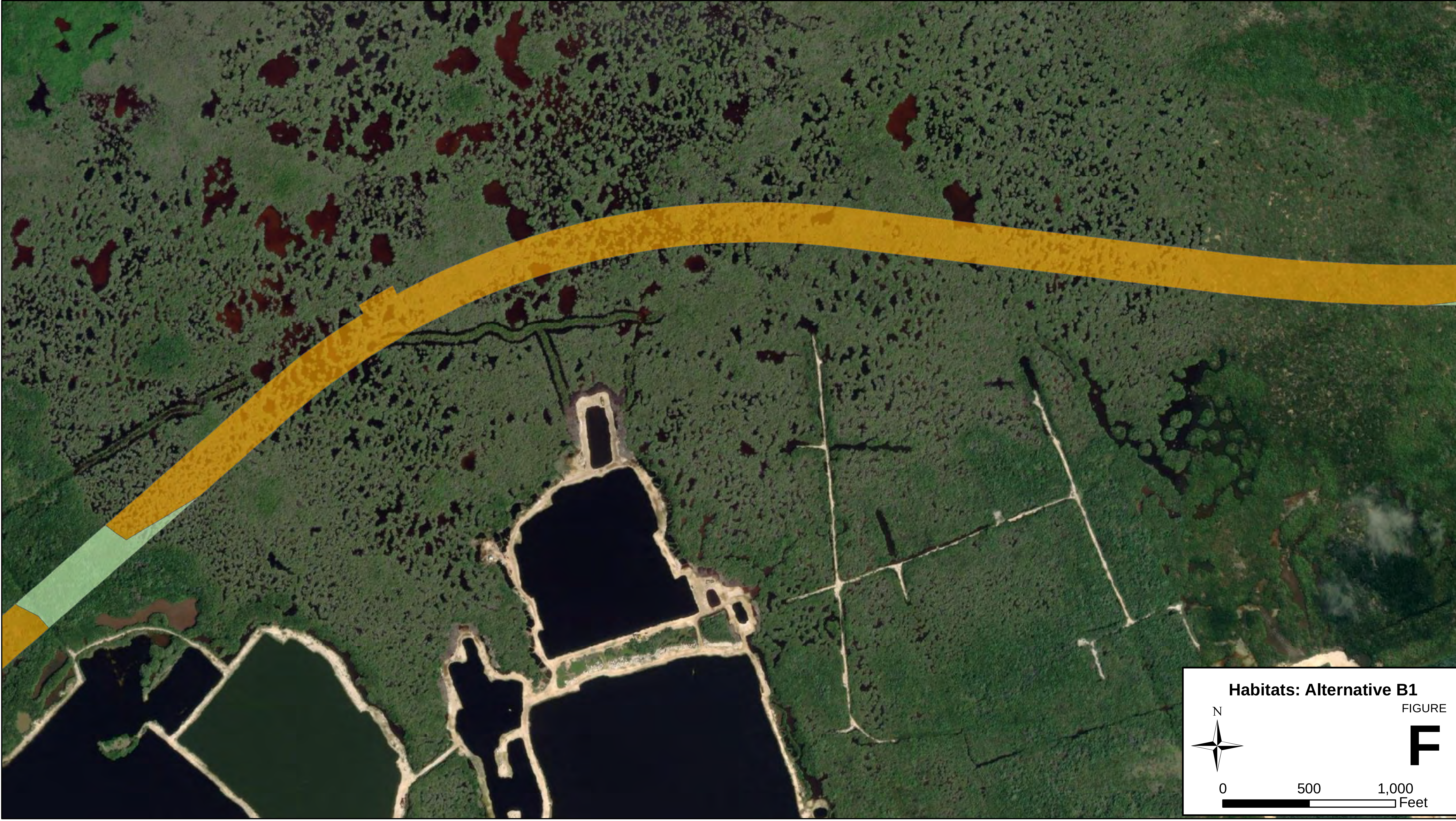
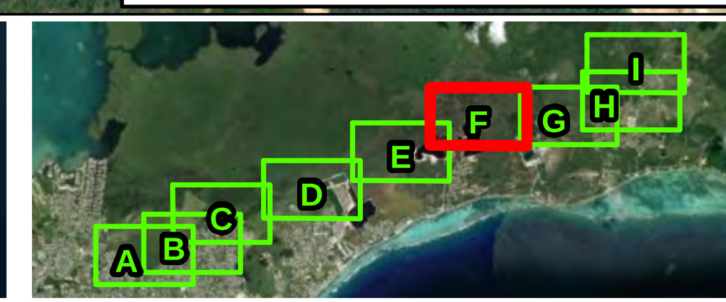


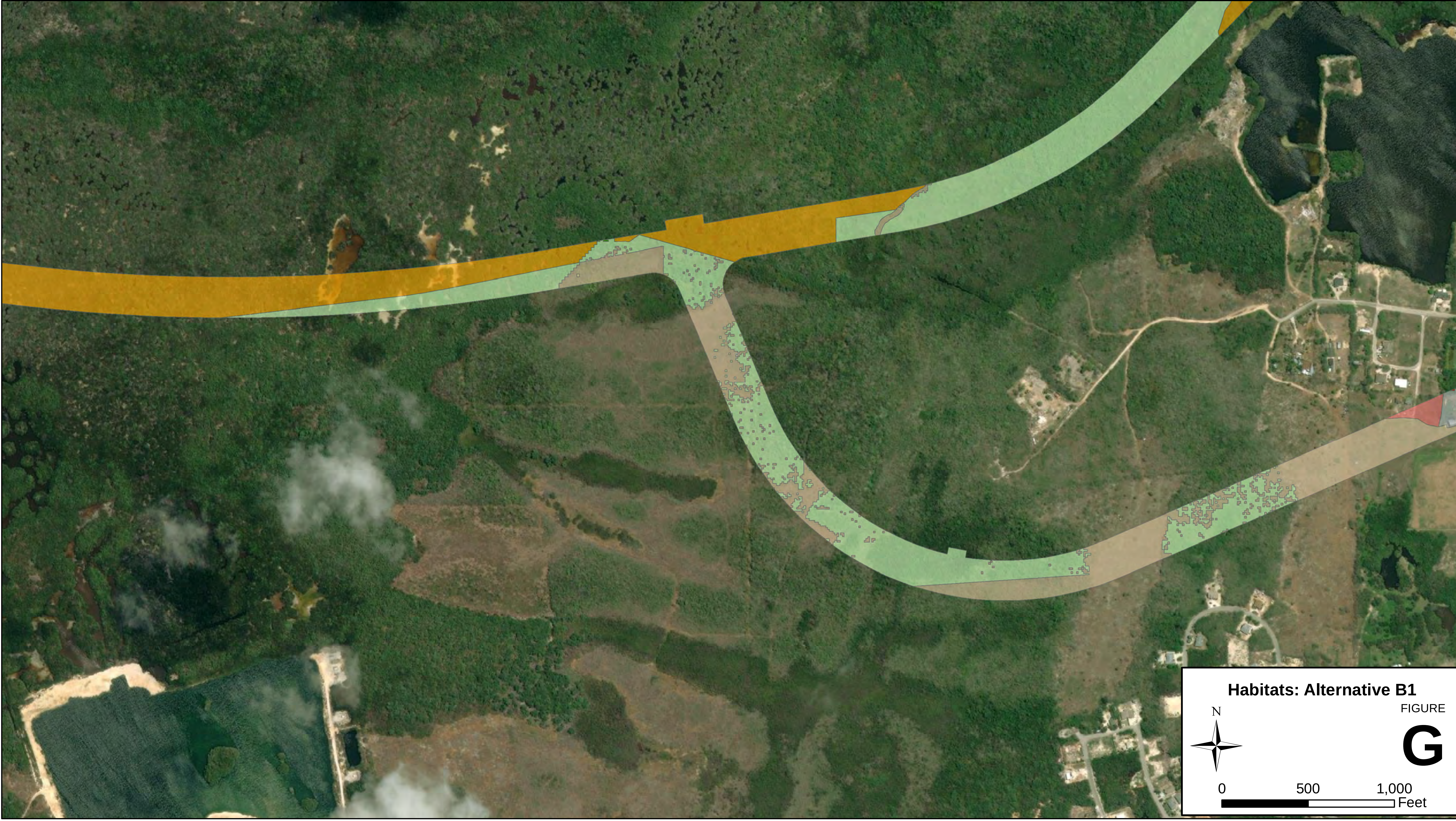
Legend

Wetland

- Seasonally Flooded Mangrove Forest and Woodland
- Seasonally Flooded Mangrove Forest (low density)

Backround Source: ESRI





Legend

Man-modified

- Man-Modified Without trees
- Man-Modified With Trees
- Commercial
- Residential

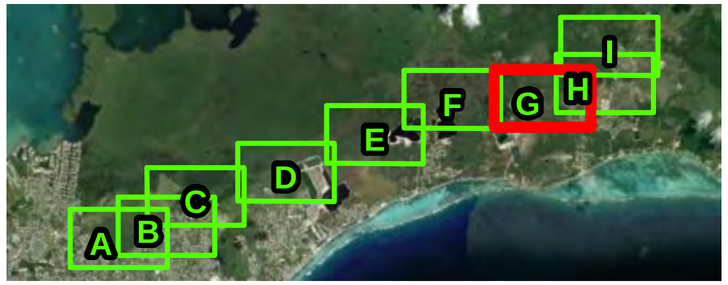
Wetland

- Seasonally Flooded Mangrove Forest and Woodland
- Seasonally Flooded Mangrove Forest (low density)

Upland

- Dry Forest and Woodland
- Dry Shrubland

Backround Source: ESRI




Habitats: Alternative B1
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FIGURE
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1,000
Feet
Legend
Man-modified
Man-Modified Without trees
Man-Modified With Trees
Commercial
Institutional
Residential
Roads
Wetland
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded Mangrove Forest (low density)
Backround Source: ESRI
A
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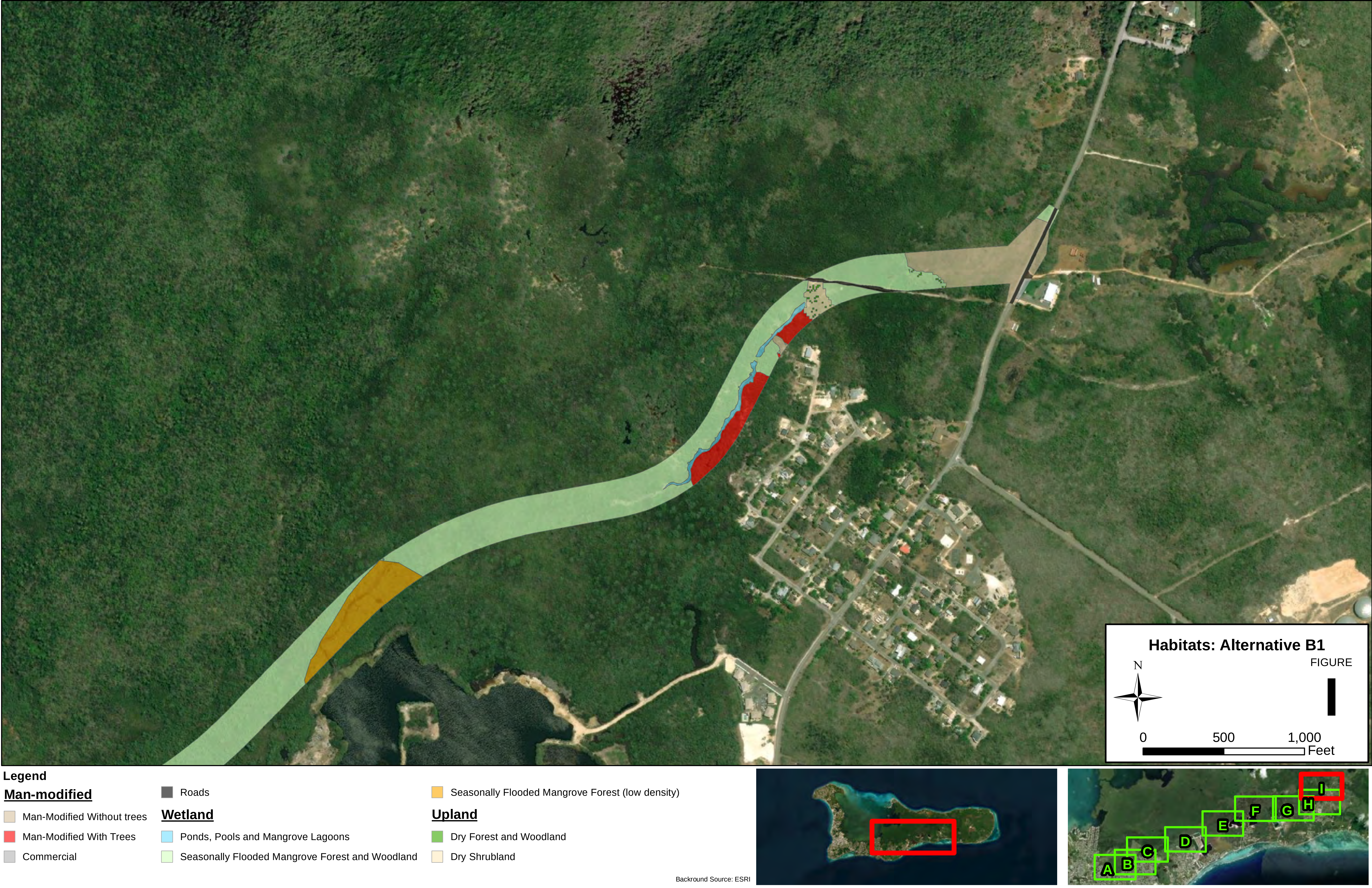
Habitats: Alternative B1
FIGURE
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Feet
Legend
Man-modified
Man-Modified Without trees
Man-Modified With Trees
Commercial
Roads
Wetland
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded Mangrove Forest (low density)
Upland
Dry Forest and Woodland
Dry Shrubland
Backround Source: ESRI
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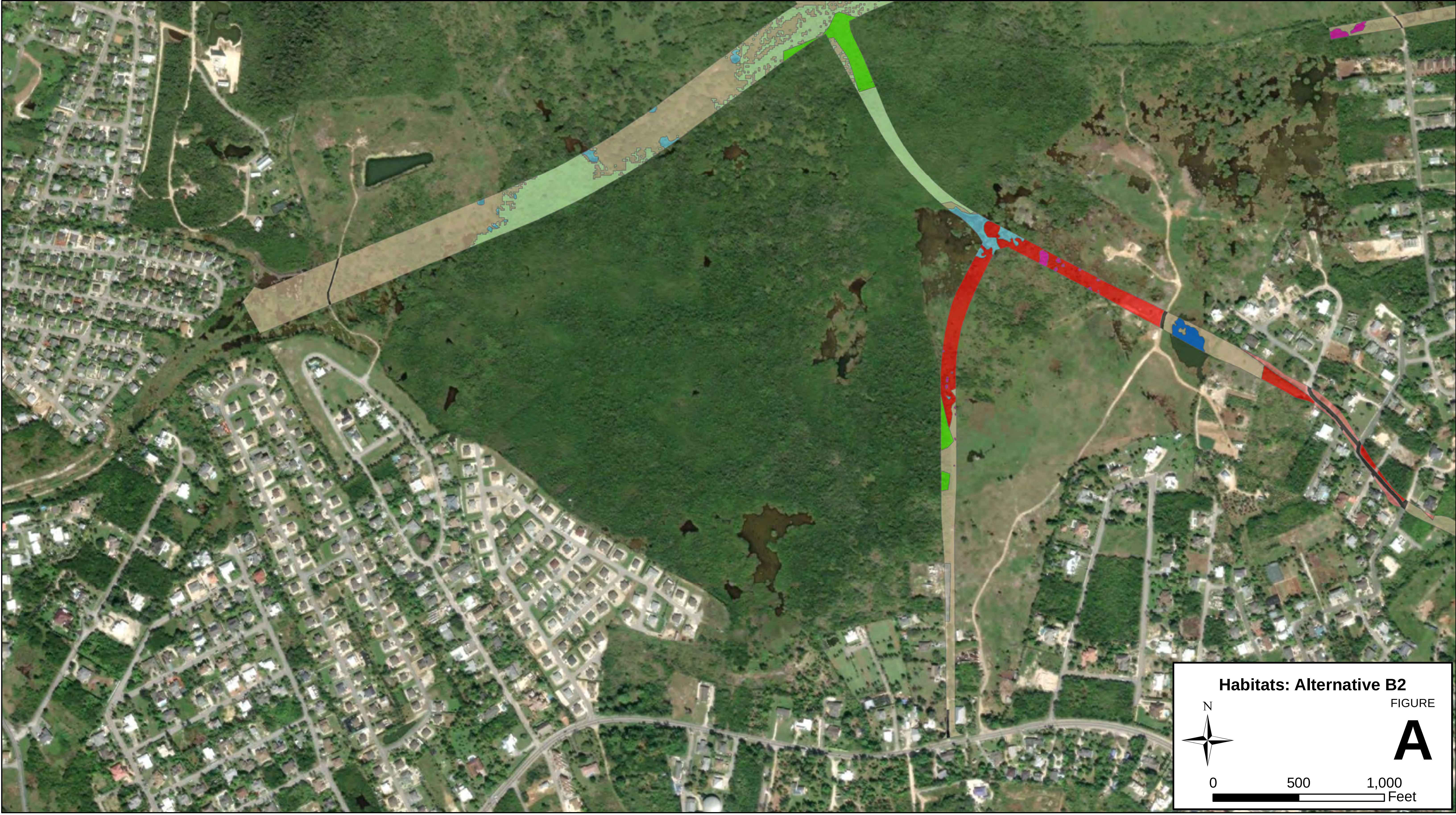

Legend

Man-modified

Man-Modified Without Trees

Man-Modified With Trees

Commercial

Residential

Roads

Man-Made Pond

Upland

Invasive Species - Casuarina

Ponds, Pools and Mangrove Lagoons

Seasonally Flooded Mangrove Forest and Woodland

Seasonally Flooded/Saturated Semi-Deciduous Forest

Backround Source: ESRI


Habitats: Alternative B2
FIGURE
B
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1,000
Feet
Legend
Man-modified
Man-Modified Without Trees
Man-Modified With Trees
Commercial
Disturbed Land
Pasture
Residential
Roads
Man-Made Pond
Upland
Invasive Species - Casuarina
Palm Hammock
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded/Saturated Semi-Deciduous Forest
Backround Source: ESRI
A
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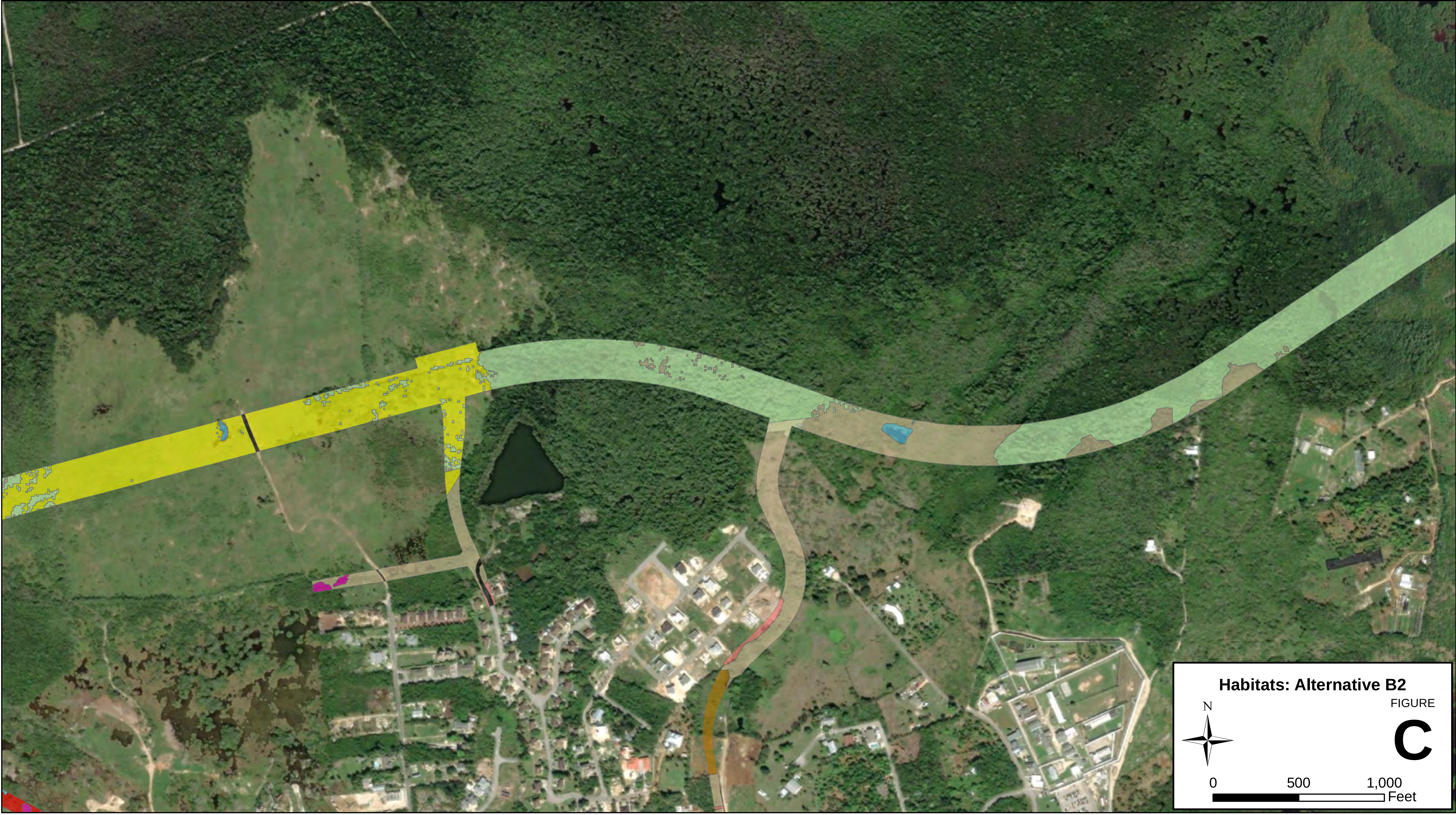
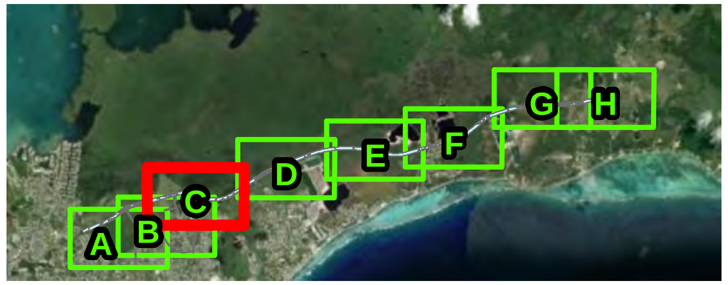


Legend

Man-modified
- Man-Modified Without Trees
- Man-Modified With Trees
- Disturbed Land
- Pasture
- Residential
- Roads

Upland
- Invasive Species - Casuarina
- Ponds, Pools and Mangrove Lagoons
- Seasonally Flooded Mangrove Forest and Woodland

Backround Source: ESRI




Habitats: Alternative B2
FIGURE
D
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Feet
Legend
Man-modified
Man-Modified Without Trees
Roads
Upland
Palm Hammock
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded Mangrove Forest (low density)
Backround Source: ESRI
A
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Habitats: Alternative B2
FIGURE
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1,000
Feet
Legend
Man-modified
Man-Modified Without Trees
Man-Modified With Trees
Mining
Residential
Roads
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded Mangrove Forest (low density)
Backround Source: ESRI
A
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Habitats: Alternative B2
FIGURE
F
N
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1,000
Feet
Legend
Man-modified
Man-Modified Without Trees
Man-Modified With Trees
Mining
Residential
Roads
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest (low density)
Backround Source: ESRI
A
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Habitats: Alternative B2
N
FIGURE
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Feet
Legend
Man-modified
Man-Modified Without Trees
Man-Modified With Trees
Commercial
Residential
Roads
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded Mangrove Forest (low density)
Backround Source: ESRI
A
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Habitats: Alternative B2
FIGURE
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1,000
Feet
Legend
Man-modified
Man-Modified Without Trees
Man-Modified With Trees
Commercial
Institutional
Residential
Roads
Seasonally Flooded Mangrove Forest and Woodland
Backround Source: ESRI
A
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Habitats: Alternative B3
FIGURE
A
N
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1,000
Feet
Legend
Man-modified
Man-Modified Without Trees
Man-Modified With Trees
Commercial
Residential
Roads
Man-Made Pond
Upland
Invasive Species - Casuarina
Wetland
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded/Saturated Semi-Deciduous Forest
Backround Source: ESRI
A
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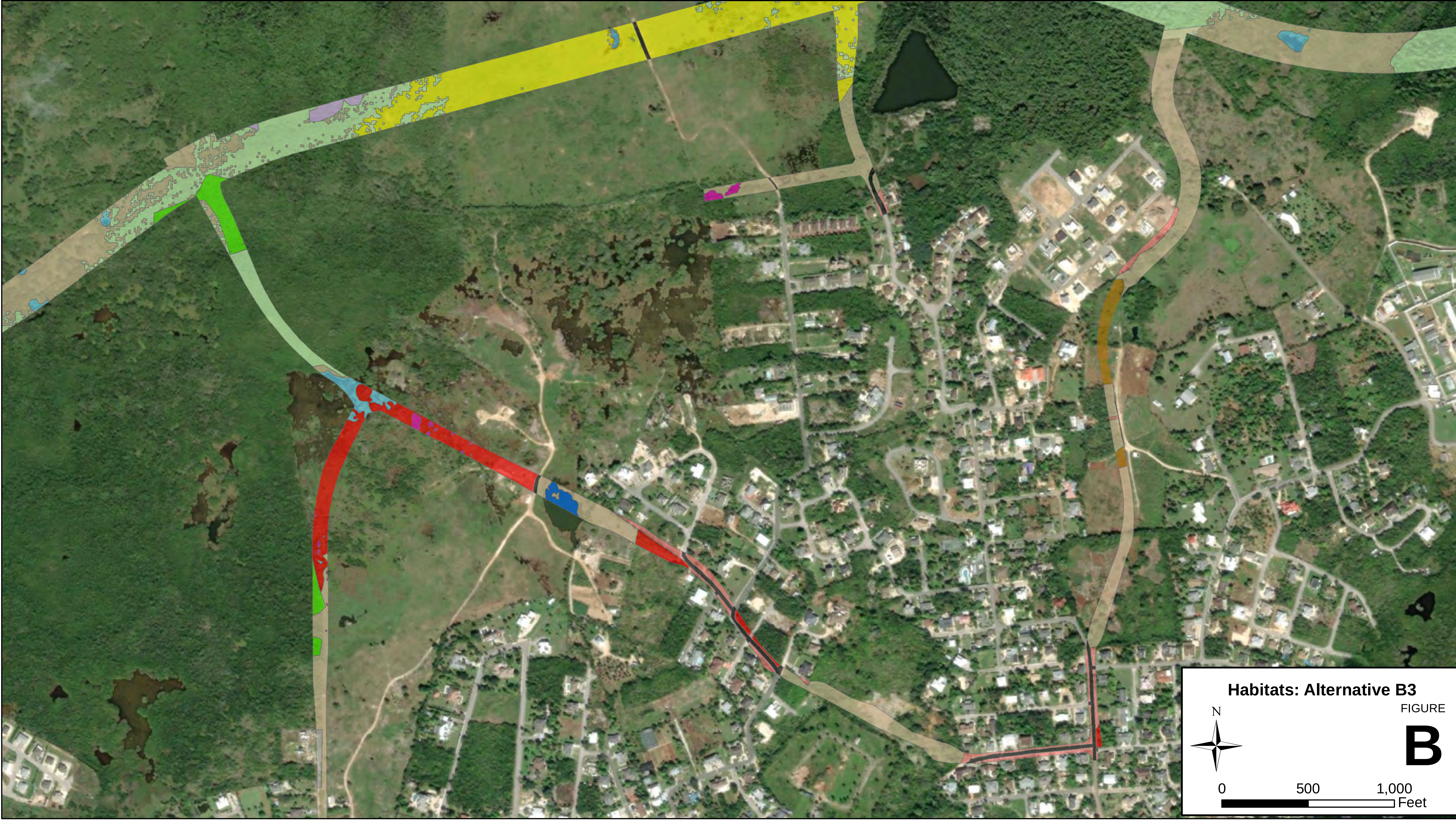


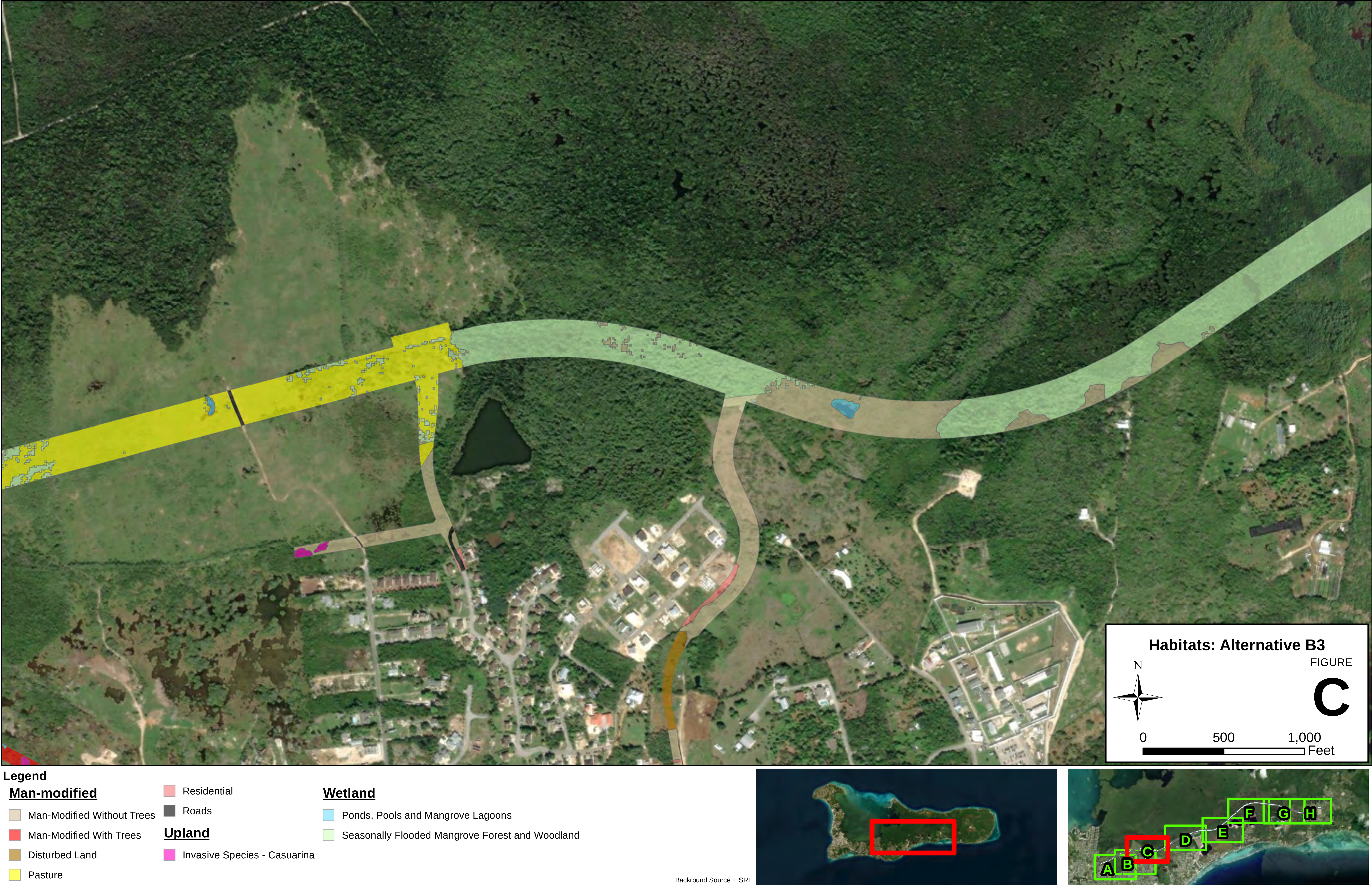
Legend

Man-modified
- Man-Modified Without Trees
- Man-Modified With Trees
- Commercial
- Disturbed Land
- Pasture
- Residential
- Roads
- Man-Made Pond

Upland
- Invasive Species - Casuarina
- Palm Hammock

Wetland
- Ponds, Pools and Mangrove Lagoons
- Seasonally Flooded Mangrove Forest and Woodland
- Seasonally Flooded/Saturated Semi-Deciduous Forest

Backround Source: ESRI


Habitats: Alternative B3
FIGURE
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Feet
Legend
Man-modified
Man-Modified Without Trees
Man-Modified With Trees
Disturbed Land
Pasture
Residential
Roads
Upland
Invasive Species - Casuarina
Wetland
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Backround Source: ESRI
A
B
C
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Habitats: Alternative B3
FIGURE
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1,000
Feet
Legend
Man-modified
Man-Modified Without Trees
Roads
Upland
Palm Hammock
Wetland
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded Mangrove Forest (low density)
Backround Source: ESRI
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Habitats: Alternative B3
FIGURE
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Feet
Legend
Man-modified
Man-Modified Without Trees
Man-Modified With Trees
Wetland
Ponds, Pools and Mangrove Lagoons
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded Mangrove Forest (low density)
Backround Source: ESRI
A
B
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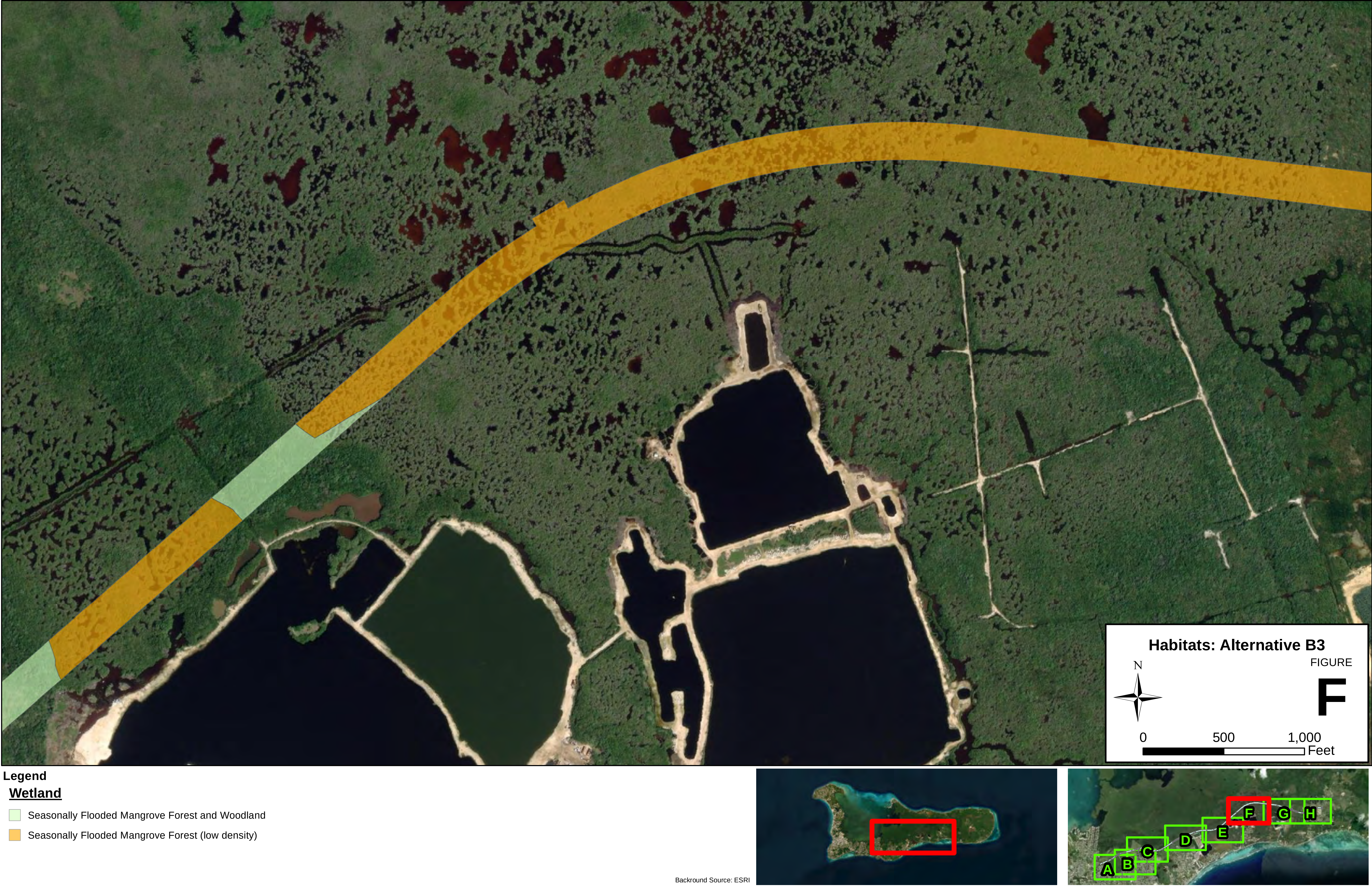
Habitats: Alternative B3
FIGURE
F
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500
1,000
Feet
Legend
Wetland
Seasonally Flooded Mangrove Forest and Woodland
Seasonally Flooded Mangrove Forest (low density)
Backround Source: ESRI
A
B
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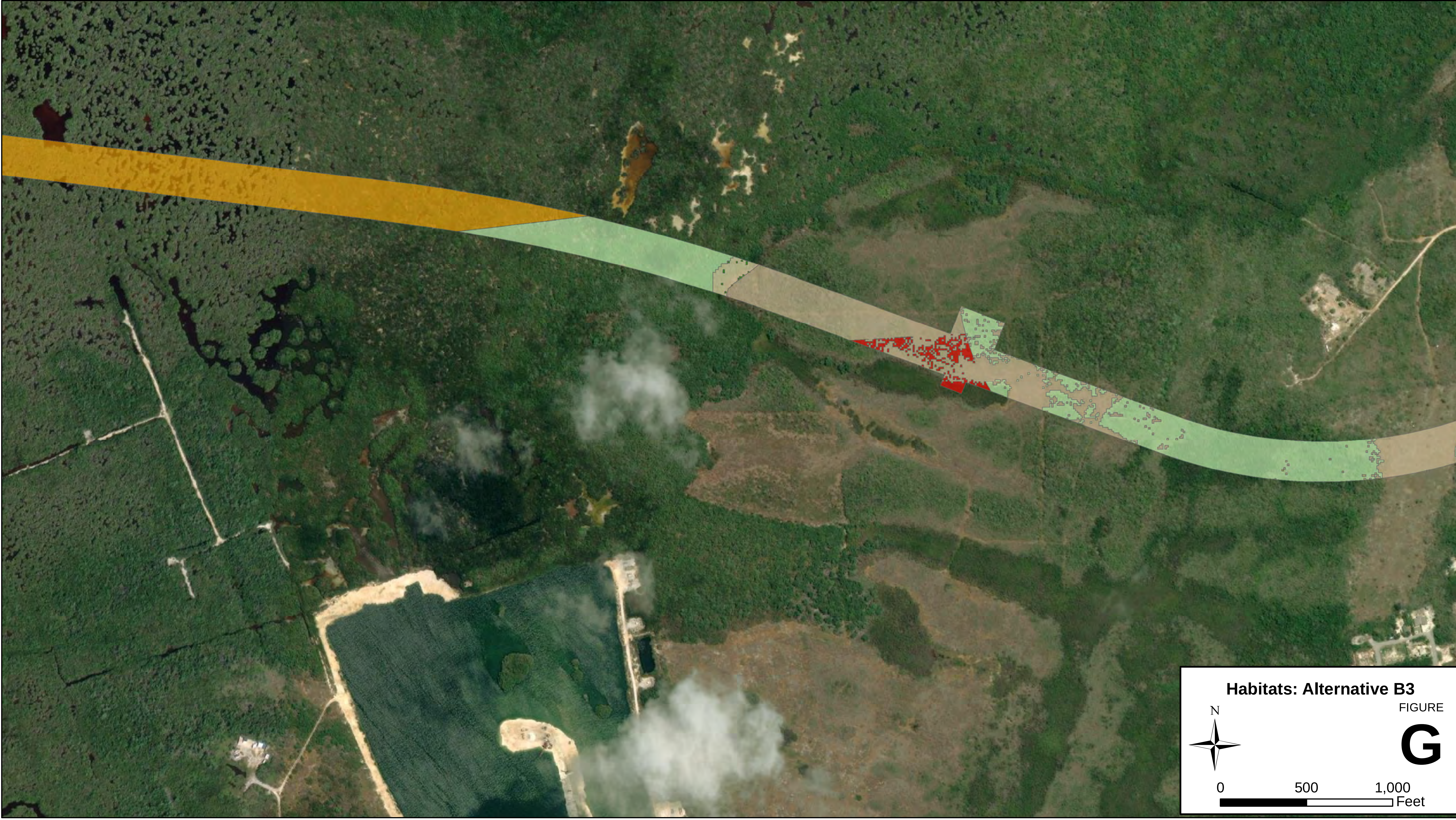


Legend

Man-modified
- Man-Modified Without Trees
- Man-Modified With Trees

Upland
- Dry Forest and Woodland
- Dry Shrubland

Wetland
- Seasonally Flooded Mangrove Forest and Woodland
- Seasonally Flooded Mangrove Forest (low density)

Backround Source: ESRI

Legend

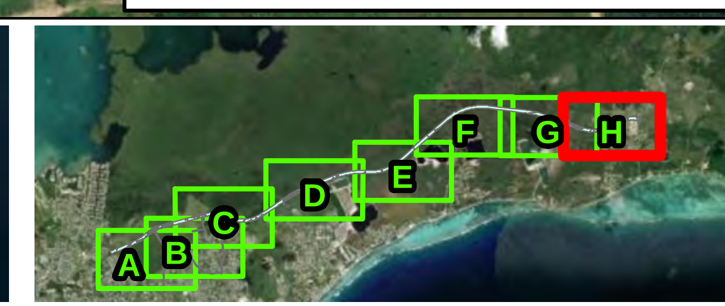
Man-modified

- Man-Modified Without Trees
- Man-Modified With Trees
- Commercial
- Institutional
- Residential
- Roads

Wetland

- Seasonally Flooded Mangrove Forest and Woodland

Backround Source: ESRI



Attachment C

Material Quantities

Will T Connector Quantity Summary

	Build Year	COMPACTED ASPHALT, 3.5" DEPTH	CRUSHER RUN, 6" DEPTH	CAYMAN ROCK, 6" DEPTH	COMPACTED ASPHALT, 2" DEPTH	ASPHALT TACK COAT	MILLING, 2" DEPTH	CONCRETE PAVEMENT, 6" DEPTH	CONCRETE KERB & GUTTER, 6" HEIGHT	PAVEMENT MARKINGS, WHITE	GENERAL EXCAVATION	EMBANKMENT MATERIAL (SHOT ROCK)
		SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	LF	LF	CU YD	CU YD
Total/Life	New Construction	117,734	117,734	133,286				15,552	61,910	93,372	86,006	70,838
	Rehabilitation/Resurfacing				168,192	336,384	168,192			140,058		
	Item Grand Total	**117,734**	**117,734**	**133,286**	**168,192**	**336,384**	**168,192**	**15,552**	**61,910**	**233,430**	**86,006**	**70,838**

Bulk Material Quantities - See the seperate Engineering Assessment of Alternatives document for further methdology

Alternative B1 Quantity Summary

	Build Year	COMPACTED ASPHALT, 2" DEPTH	COMPACTED ASPHALT, 3.5" DEPTH	COMPACTED ASPHALT, 6" DEPTH	CRUSHER RUN, 6" DEPTH	CAYMAN ROCK, 6" DEPTH	MILLING, 2" DEPTH	ASPHALT TACK COAT	CONCRETE PAVEMENT, 6" DEPTH	CONCRETE KERB, 6" HEIGHT	CONCRETE KERB & GUTTER, 6" HEIGHT	CONCRETE MOUNTABLE KERB	CONCRETE MEDIAN BARRIER	PAVEMENT MARKINGS, YELLOW	PAVEMENT MARKINGS, WHITE	LIGHT POLES	UNDERCUT EXCAVATION	PEAT EXCAVATION	AGGREGATE BORROW MATERIAL (18" ROCK)	EMBANKMENT MATERIAL (SHOT ROCK)	CORRIDOR EXCAVATION
		SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	LF	LF	LF	LF	LF	LF	EACH	CU YD	CU YD	CU YD	CU YD	CU YD
Total/Life	New Construction		508,431	73,255	508,431	622,912			50,751	11,668	45,811	8,563	44,056	128,916	358,403	347	63,501	550,994	614,495	2,825,727	7,730
	Rehabilitation/Resurfacing	1,564,311	250,431		250,431	252,120	1,564,311	3,128,622	1,356	9,783	10,520	2,303	35,291	370,796	806,286						
	Item Grand Total	**1,564,311**	**758,862**	**73,255**	**758,862**	**875,032**	**1,564,311**	**3,128,622**	**52,107**	**21,451**	**56,331**	**10,866**	**79,347**	**499,712**	**1,164,689**	**347**	**63,501**	**550,994**	**614,495**	**2,825,727**	**7,730**

Bulk Material Quantities - See the seperate Engineering Assessment of Alternatives document for further methdology

Alternative B2 Quantity Summary

		COMPACTED ASPHALT, 2" DEPTH	COMPACTED ASPHALT, 3.5" DEPTH	COMPACTED ASPHALT, 6" DEPTH	CRUSHER RUN, 6" DEPTH	CAYMAN ROCK, 6" DEPTH	MILLING, 2" DEPTH	ASPHALT TACK COAT	CONCRETE PAVEMENT, 6" DEPTH	CONCRETE KERB, 6" HEIGHT	CONCRETE KERB & GUTTER, 6" HEIGHT	CONCRETE MOUNTABLE KERB	CONCRETE MEDIAN BARRIER	PAVEMENT MARKINGS, YELLOW	PAVEMENT MARKINGS, WHITE	LIGHT POLES	UNDERCUT EXCAVATION	PEAT EXCAVATION	AGGREGATE BORROW MATERIAL (18" ROCK)	EMBANKMENT MATERIAL (SHOT ROCK)	CORRIDOR EXCAVATION
	Build Year	**SQ YD**	**SQ YD**	**SQ YD**	**SQ YD**	**SQ YD**	**SQ YD**	**SQ YD**	**SQ YD**	**LF**	**LF**	**LF**	**LF**	**LF**	**LF**	**EACH**	**CU YD**	**CU YD**	**CU YD**	**CU YD**	**CU YD**
Total/Life	New Construction		446,729	57,358	446,729	549,505			45,418	8,331	10,656	7,294	67,320	122,328	243,810	328	155,626	223,811	379,437	2,414,033	6,569
	Rehabilitation/Resurfacing	1,126,338	203,661		203,661	205,214	1,126,338	2,252,676	1,227	8,331	8,771	7,294	33,660	352,700	675,536						
	Item Grand Total	**1,126,338**	**650,390**	**57,358**	**650,390**	**754,719**	**1,126,338**	**2,252,676**	**46,645**	**16,662**	**19,427**	**14,588**	**100,980**	**475,028**	**919,346**	**328**	**155,626**	**223,811**	**379,437**	**2,414,033**	**6,569**

Bulk Material Quantities - See the seperate Engineering Assessment of Alternatives document for further methdology

Alternative B3 Quantity Summary

	Build Year	COMPACTED ASPHALT, 2" DEPTH	COMPACTED ASPHALT, 3.5" DEPTH	COMPACTED ASPHALT, 6" DEPTH	CRUSHER RUN, 6" DEPTH	CAYMAN ROCK, 6" DEPTH	MILLING, 2" DEPTH	ASPHALT TACK COAT	CONCRETE PAVEMENT, 6" DEPTH	CONCRETE KERB, 6" HEIGHT	CONCRETE KERB & GUTTER, 6" HEIGHT	CONCRETE MOUNTABLE KERB	CONCRETE MEDIAN BARRIER	PAVEMENT MARKINGS, YELLOW	PAVEMENT MARKINGS, WHITE	LIGHT POLES	UNDERCUT EXCAVATION	PEAT EXCAVATION	AGGREGATE BORROW MATERIAL (18" ROCK)	EMBANKMENT MATERIAL (SHOT ROCK)	CORRIDOR EXCAVATION
		SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	SQ YD	LF	LF	LF	LF	LF	LF	EACH	CU YD	CU YD	CU YD	CU YD	CU YD
Total/Life	New Construction		460,408	59,395	460,408	552,986			46,905	10,824	8,956	7,772	50,055	125,259	250,726	336	54,078	454,153	508,231	2,390,208	6,811
	Rehabilitation/Resurfacing	1,359,579	208,181		208,181	208,181	1,359,579	2,719,158	1,116	8,939	8,956	1,909	38,210	361,044	691,704						
	Item Grand Total	**1,359,579**	**668,589**	**59,395**	**668,589**	**761,167**	**1,359,579**	**2,719,158**	**48,021**	**19,763**	**17,912**	**9,681**	**88,265**	**486,303**	**942,430**	**336**	**54,078**	**454,153**	**508,231**	**2,390,208**	**6,811**

Bulk Material Quantities - See the seperate Engineering Assessment of Alternatives document for further methdology