



Ministry of Public Infrastructure

Anchoring Guyana's Development

Consultancy Services for Preparation of **Detail Project Report for Construction of East Bank-East Coast Road Linkage Project, Georgetown (Guyana)**



Project Summary

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Acronyms

AASTHO	American Association of State Highway and Transportation Officials
ADV	Animal Drawn Vehicle
ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
CBR	California Bearing Ratio
CRICOM	Caribbean Community
CUBiC	Caribbean Uniform Building Code
CVPD	Commercial Vehicles Per Day
DGPS	Differential Global Positioning System
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESIA	Environmental Social Impact Assessments
EXIM	Export Import
FDDR	Final Detailed Project Report
FIDIC	International Federation of Consulting Engineers
GAD	General Arrangement Drawings
GNBS	Guyana National Bureau of Standards
Gol	Government of India
GoG	Government of Guyana
GUYSUCU	Guyana Sugar Corporation Inc.
GT	Geo-Technical
HFL	High Flood Level
HMV	Heavy Motor Vehicle
IRC	Indian Road Congress
ICZM	Guyana's Integrated Coastal Zone Management
ITCZ	Inter-Tropical Convergence Zone
LCV	Light Commercial Vehicle
LRFD	Load and Resistance Factor Design
LWL	Low Water Level
MoPI	Ministry of Public Infrastructure
MoF	Ministry of Finance
MUTCD	Manual on Uniform Traffic Control Devices
MoRTH	Ministry of Road Transports and Highways
NDCs	Neighborhood Democratic Councils
NFP	National Forest Policy
NGO	Non-Government Organisation
NICIL	National Industrial and Commercial Investments Limited
PCU	Passenger Car Unit
QAP	Quality Assurance Plan
RAP	Resettlement Action Plan
RoW	Right of Way
SIA	Social Impact Assessment
SP	Special Publication
TCS	Typical Cross Section
TL	Team Leader
TOR	Terms of Reference
URP	Utility Relocation Plan

Executive Summary

0.1 Project Background

0.1.1 General

The **Government of Guyana** (Employer/Client) desires to engage **RITES Limited** (Consultant) to carry out the detailed project preparation for the roads and also to provide Construction Supervision Consultancy Services for the construction of East Cost-East bank Road Linkage.

The project has been proposed to be taken up in three distinctive stages

- Stage-1 is for Detail Project Report Preparation
- Stage-2 is for Construction Supervision
- Stage-3 is Post-Construction stage-Defect Liability Period

This agreement has been signed for stage-1 i.e. preparation of Detail Project Report on January 10, 2018. The duration of consultancy services is 10 Months. The commencement of consultancy services is April 13, 2018.

The project agreement for Stage-2 and Stage-3 shall be mutually agreed between Ministry of Public Infrastructure Government of Guyana (GoG) and RITES Limited during or after completion of stage-1.

The Stage -1 is Consultancy Services for Preparation of Detailed Project Report for Construction of East Bank - East Coast Road Linkage (15 km) and 4 connectors (9.62 km) as follows:

I. East Bank - East Coast Alignment	= 15.00 km
II. Extension of Aubrey Barker Road (Connector-1)	= 1.57 km
III. Extension of Haags Bosch Road (Connector-2)	= 3.49 km
IV. Extension of Mocha Arcadia Road (Connector-3)	= 2.99 km
V. Extension of Great Diamond Road (Connector-4)	= 1.57 km

The tentative alignment had been identified by Ministry of Public Infrastructure for proposed road and connectors and included in the agreement.

The total project length considering the main green field alignment (15 km) and extension of connectors up to main alignment (length 9.62 km) i.e. total 24.62 km are to be finalized in the DPR by RITES, which is now proposed under GoI/LoC funding.

0.1.2 Objective and Scope of Work

The objective of the consultancy services is preparation of Detailed Project Report (including bidding documents) of the road links identified by the Ministry of Public Infrastructure Government of Guyana (GoG) under the line of credit from Government of India through EXIM Bank.

The scope of services shall cover the major tasks as under:

- (a) Review of all available reports and published information about the project road and the project influence area;*
- (b) Detailed reconnaissance;*
- (c) Terrain category and land use along the proposed roads;*
- (d) Traffic studies including traffic surveys and demand forecasting;*
- (e) Inventory and condition surveys for the existing road, (not required being green field alignment);*
- (f) Inventory and condition surveys for existing bridges, cross-drainage structures and drainage provisions and identification of new construction of works, if any;*
- (g) Detailed topographic surveys;*
- (h) Pavement investigations, (not required being green field alignment);*
- (i) Sub-grade characteristics and strength;*
- (j) Geotechnical Investigations & Exploration and selection of construction materials;*
- (k) Detailed design of road (including pavements), bridges and cross-drainage structures;*
- (l) Identification of the type and the design of intersections;*
- (m) Environmental Impact Assessment (EIA) Study, Social Impact Assessment (SIA) Study, preparation of Environmental Management Plan (EMP), Resettlement Action Plan (RAP), Tree Cutting Proposal, Utilities Relocation Plan and Land Requirements Plan;*
- (n) Project costing;*
- (o) Reports, documents and drawings; and,*
- (p) Bid Documents for inviting bids for construction by GoG.*

0.1.3 The Study

In accordance with (Para 6) of Consultancy Agreement, the study consists of submission of reports as follows:

- *Inception Report & Quality Assurance Plan (QAP)*
- *Feasibility Report*
- *Draft Detailed Project Report*
- *Final Detailed Project Report*
- *Bid Documents*

This report covers the work carried out by the consultants for Feasibility study Report stage.

0.2 Socio-Economic Profile in the Project Influence Area (PIA)

Guyana officially the Co-operative Republic of Guyana, is a sovereign state on the northern mainland of South America. It is, however, often considered part of the Caribbean region because of its strong cultural, historical, and political ties with other Anglo Caribbean countries and the Caribbean Community (CARICOM). Guyana is bordered by the Atlantic Ocean on the north, Brazil to the south and southwest, Suriname to the east and Venezuela to the west. With 215,000 square kilometers (83,000 sq mi), Guyana is the fourth-smallest country on mainland South America after Uruguay, Suriname and French Guiana (an overseas region of France).

Georgetown is the capital of Guyana, located in Region 4, which is also known as the Demerara-Mahaica region. Georgetown is Guyana's largest urban centre, containing a large portion of its commerce. It is situated on the Atlantic Ocean coast at the mouth of the Demerara River and it was nicknamed 'Garden City of the Caribbean. It is an important city for Guyana and the Caribbean. Within the metro area there is the CARICOM headquarters, the Administrative Arm of the Caribbean Regional Integration Organisation. Georgetown also is home to a seaport. Guyana's international airport, Cheddi Jagan International Airport/Timehri, an hour south of Georgetown is a destination for Caribbean Airlines (the airline formerly known as BWIA or ""bwee""), LIAT, META, and Travel Span GT. Closer to the city is the newly expanded Ogle Airport, with a terminal facility geared to handle regional, international and inter-Caricom flights, connecting CARICOM states with the CARICOM Secretariat.

The Project has direct influence on the CBD of Georgetown. The Main Green field alignment (15.0 km) is starting from East Coast Road (Rupert Craig Highway) and end at the connector of extension of great diamond road with East Bank Public Road.

The ogle airstrip road starts from the Rupert Craig highway (East Coast) and passes through the residence area of Courida Park, Prado Ville and connected to Eugene F. Correia International Airport and end at Sugar cane factory area. The Main Alignment passes through the existing Ogle Airport Road for a length approximate 1.3 km, thereafter it runs through the green field with sugar cane field with many crossing canals along and across.

The existing Road Network in Project Influence Area consists of following roads that will have direct impact on development of the project highway:

- The East Coast (Rupert Craig Highway), the volume of traffic on East Coast Road is high. The proposed bypass road starts from Ogle Airstrip road intersection
- The first connector link to existing Aubrey Barker Road connected to Critchlow Ave Road and Mandela Road
- The second connector link to existing Haags Bosch road connected to East Bank Road, the volume of traffic is also high on East Bank Road at the intersection of East Bank Road and Haags Bosch Road due to proximity to Demerara Harbour Bridge and traffic coming from west bank/coast to Georgetown.
- The Third Connector link to Mocha Arcadia road and also connected to East Bank Road.
- The fourth Connector link to Great Diamond Road and also connected to East Bank Road, the traffic on East Bank road leads to southwards for Eugene F. Correia International Airport, Timehri

0.3 Project Road

0.3.1 General

There are 5 road sections designated as project roads i.e. Main Alignment and its four connectors as detailed below:

0.3.1.1 Main Alignment: East Bank-East Coast Road (15 km)

The East Bank-East Coast Road designated as main alignment starts from East Coast (Rupert Craig Highway) road at Latitude N 06049.264' and terminates at Great Diamond Connector Road at Longitude W 58005.869' and ends at N 6041.858' & W 58008.779'. The existing road section passes through built-up area of Courida Park, Prado Ville. It has Intermediate configuration with 5.5 m wide bituminous carriageway from East Coast Junction to Ogle Airport (Km 2.3) which connects with Main Green Fields. The proposed main alignment will overlap with existing Ogle airport road for 1.3km only and thereafter runs into open cane fields and finally terminates at extension of connector 4 i.e. Great Diamond Road.

0.3.1.2 Connector 1: Extension of Aubrey Barker Road (1.57 km)

The Aubrey Barker Road existing section starts from Critchlow Ave Road. The existing length of road is 2.970 km and passes through built-up area of North Ruimveldt Gardens and South Ruimveldt Gardens. The existing road section has Intermediate lane configuration with 5.5 m wide bituminous carriageway. The extension of Aubrey Baker Road to main alignment is 1.57 km through open cane fields and designated as connector 2.

0.3.1.3 Connector 2: Extension of Haags Bosch Road (3.49 km)

The Haags Bosch Road starts from East Bank Public Road. The length of existing road is 3.56 km and passes through built-up area of North Romulus and Republic Park. The existing Road Section has intermediate lane configuration with 5.5 m wide bituminous carriageway. The extension of existing Haags Bosch road to main alignment is 3.49 km through open cane fields and designated as connector 2.

0.3.1.4 Connector 3: Extension of Mocha Arcadia Road (2.99 km)

The Mocha Arcadia Road starts from East Bank Public Road. The length of existing road is 3.63 km and passes through built-up area of Mocha Arcadia and Providence Cricket Stadium. The existing road section has intermediate lane configuration with 5.5 m wide bituminous carriageway. The extension of existing Mocha Arcadia Road to main alignment is 2.99 km through open areas with isolated built-up and designated as connector 3.

0.3.1.5 Connector 4: Extension of Great Diamond Road (1.57 km)

The Great Diamond Road starts from East Bank Public Road. The length of existing road is 3.45 km and passes through built-up area of Great Diamond and Golden Grove. The existing road section has intermediate lane configuration with 5.5 m wide bituminous carriageway. The extension of existing Great Diamond Road to main alignment is 1.57 km through open cane fields and designated as connector 4

0.4 Design Standards adopted for the Project

The highway design standards adopted for the project road are primarily based on American Association of State Highway and Transportation Officials (**AASHTO**), A Policy on Geometric Design of Highways and Streets 6th Edition 2011, Guide for Design of Pavement Structures, AASHTO LRFD Bridge Design Specifications, and relevant Indian Roads Congress Codes, Specifications for Road and Bridge Works of Ministry of Road Transport & Highways (5th Revision, 2013).

0.5 Traffic Survey and Analysis

Traffic studies play a major role in assessing the existing traffic characteristics, designing the future requirements of carriageway and pavement for carrying the projected traffic and in establishing viability of the project. Traffic studies play a major role in assessing the existing traffic characteristics, designing the future requirements of carriageway and pavement for carrying the projected traffic and in establishing viability of the project. Traffic forecasting, therefore, requires detailed studies on the type and composition of traffic.

0.5.1 Past Traffic

There is no sufficient past traffic data available with the MoPI. Demerara Harbour Bridge Corporation was requested to provide data based on traffic crossing the Demerara Bridge.

Demerara Harbour Bridge Corporation has provided traffic data for last five years as detailed below:

Year	2 W	Motor Cars/4WD Jeeps/Pick-up (Private)	Mini Bus	Goods Vehicle	Motor Lorry /Large Bus	Motor Tractor	Trailer	Others	Total Traffic (Nos.)	Yearly Growth
2014	596	5901	1229	628	483	8	15	29	8889	
2015	619	6309	1307	618	455	8	22	23	9361	5.30
2016	653	6705	1389	634	496	6	114	18	10015	6.98
2017	636	6612	1384	614	440	6	11	24	9727	-2.87
2018 (up to May)	658	6732	1353	628	466	6	11	23	9877	1.54

Table 0-1: Past Traffic Data

0.5.2 Present Traffic Scenario

The consultants have conducted the traffic surveys on the project highway to assess the present traffic plying on various road sections in the project influence area as detailed in table below and shown on map.

Sl. #	Description	Traffic Survey Stations	Duration
1.	Classified Traffic Volume Count	2	3 days for 16 hrs
2.	Origin-Destination and Commodity Movement Characteristics	2	1 day for 12 hrs
3.	Intersection Volume Count	6	1 day during peak hours (3 hours in morning and evening)

Table 0-2: Traffic Survey Stations



Figure 0.1: Traffic Volume Count Survey, Turning Movement and O-D Survey Station

0.5.3 ANNUAL AVERAGE DAILY TRAFFIC (AADT)

The classified traffic volume count survey has been conducted for 3-days (16-hr continuous, both directions) at 2-locations. The Traffic volume count data collected at different locations were analysed to arrive at average daily traffic (ADT) and finally seasonal variation correction has been applied to determine AADT traffic.

Counting Location	2W	Passenger (Car, Jeep, Van, etc.)	Utility vehicle Freight (Jeep, Van etc.)	Bus		LCV (Passenger)	LCV (Freight)	Truck			Agri Tractor		Slow Moving		Total AADT (Nos)	Total PCU
				Mini	Full			MCV	HCV	MAV	With Tr	Without Tr	Cycle	Horse Cart		
Movie Town Hall	581	19178	2652	4741	50	241	532	608	198	455	7	5	37	3	29284	35096
Near Harbour Bridge	2559	36283	1722	9172	96	132	1677	1010	349	512	43	14	796	20	54382	63142

Table 0-3: ANNUAL AVERAGE DAILY TRAFFIC (AADT)

Note: LCV=Light Commercial Vehicle; 2W=Two Wheeler; MCV: Medium Commercial Vehicle (2 Axle Rigid Chassis); HCV= Heavy Commercial Vehicle (3 Axle Rigid Chassis); MAV=; Multi Axle Vehicle (Heavy Semi- Articulated and Articulated Vehicle); PCU = Passenger Car Unit

0.5.4 Origin-Destination Survey and Commodity Movement Surveys

Origin-Destination survey has been conducted on the locations of volume count survey. The Origin – Destination survey and Commodity Movement Surveys has been conducted for 12 hours at two traffic volume count locations i.e. at Movie Town Hall on East Coast Road and Near Demerara Harbour Bridge on East Bank Road.

The road side interviews have been conducted by enumerators on random sample basis of four-wheeled vehicles. Data regarding vehicle registration, origin & destination, trip length, route adopted, route preference along with additional information on commodities carried and weight of commodities for goods vehicles were collected.

The location of origin and destination zones plays very important role to determine the possibility of traffic diversion to the Project Road from/to other road routes. In all 18 zones are identified for analysis of O-D survey data

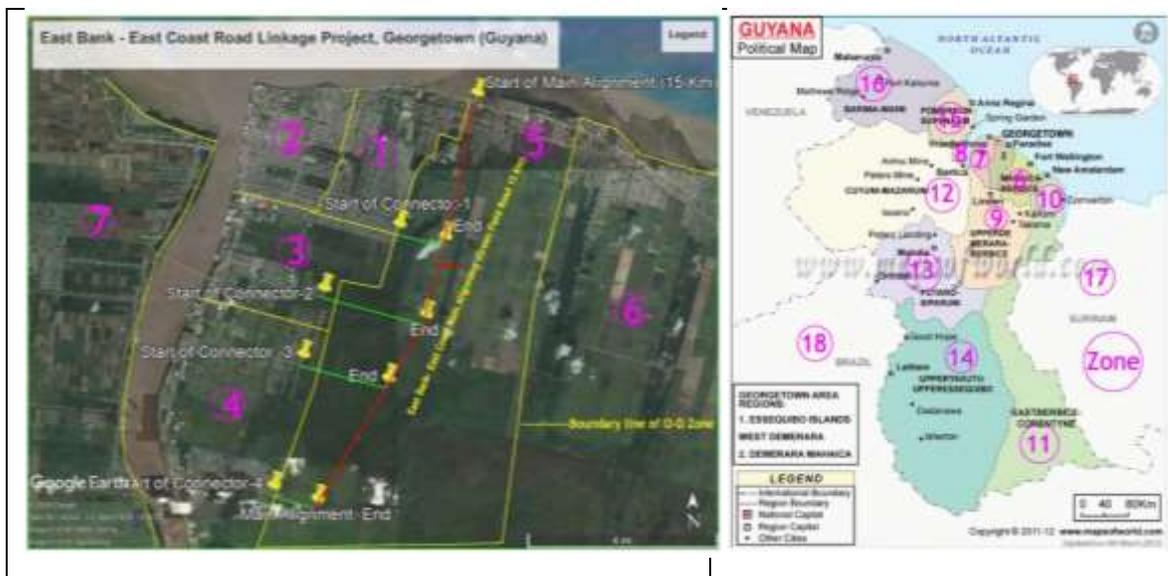


Figure 0.2: Origin-Destination Zones

It is observed from the O-D data analysis that major traffic plying between Georgetown and its suburbs.

0.5.5 Willingness to Use Road Survey

During traffic survey willingness to use bypass road, if the road section is constructed as new alignment, has been asked and the views/comments have been recorded. The majority of respondents i.e. 85% expressed their consent for construction of new road i.e. East Bank-East Coast link road.

0.5.6 Turning Movement Survey

The turning movement surveys have been conducted during morning and evening peak of 3 hours. The turning movement surveys are conducted for estimation of peak hour traffic for the design of major intersections.

The consultants have conducted intersection turning traffic survey at 6 locations although these were not envisaged as per ToR. The survey locations have been selected in a manner to cover the intersections on Ogle road and East Bank Road with proposed connectors (4 nos). Locations of intersection survey are as below:

Sl. No.	Location	Name of Junction	Type of Junction
1	East Coast Road	East Coast –Ogle Road	4 legged
2	Ogle Junction	Railway Embankment Ogle Junction	4 legged
3	Aubrey Barker Road	David Road St -Aubrey Barker Road Junction	4 legged
4	East Bank	Haag Bosch Junction	T-Junction
5	East Bank	Mocha Arcadia Junction	T- Junction
6	East Bank	Diamond Junction	T-Junction

Table 0-4: Turning Movement Volume Count Survey Locations

Peak hour traffic has been analyzed for all arms of the junctions and total inflow and outflow at the junctions have also been analyzed. The

As per traffic wise, it can be seen that at 08:00-09:00 am is Peak Hour traffic on East Coast-Ogle Road Junction is 3249 PCUs and 07:00-08:00 am is peak hours traffic on Haag Bosch Junction with East Bank Road is 4461 pcu.

Name of intersection	Morning Peak Time	Total (PCU's)	Evening Peak Time	Total (PCU's)
East Coast –Ogle Road	08:00-09:00	3249	17:00-18:00	2528
Railway Embankment Ogle Junction	07:00-08:00	1908	17:00-18:00	1781
David Road St -Aubrey Barker Road Junction	07:00-08:00	813	16:00-17:00	788

Haag Bosch Junction	07:00-08:00	4461	17:00-18:00	4026
Mocha Arcadia Junction	08:00-09:00	2360	16:00-17:00	2321
Diamond Junction	08:00-09:00	2203	16:00-17:00	1888

Table 0-5: Peak Hours Traffic on Each Junction

0.5.7 Axle Load Survey

Axle load surveys are not envisaged for the assignment as per ToR. The consultant has worked out vehicle damaged factor by collecting secondary data as follows:

- During O-D Surveys at two locations, the weight of commodities carried by drivers were collected
- The axle load data has been collected from working weigh bridge at Toolsie Persaud Group of Companies, Georgetown

In Guyana, the legal axle load limit is 7.26 t as detailed by MoPI. MoPI further informed that the legal axle load limit is in process for revision.

Accordingly, the internationally adopted standard axle load of 8.16 t (18000 ib) has been considered for calculation of Vehicle Damage Factor.

Type of Vehicle	No. of Vehicles sampled	VDF	Weighted VDF
LCV (2 Axle)	15	0.15	2.25
2-Axle Truck	42	6.63	278.46
3-Axle Truck	33	2.75	90.75
4-Axle Truck	146	4.17	608.82
Total	236		980.28
Av. Weighted VDF = 980.28/236 = 4.15			

Table 0-6: Summary of Axle Load Survey

The consultants have also determined the truck load factor as per AASTHO guide for Design of Pavement Structures, mixed traffic must be converted to an equivalent number of 18-kip single loads. Truck Load factor is equivalency factors representing the ratio of the number of repetitions of any axle load and axle configuration (Single, tandem, tridam, etc) necessary to cause the same reduction in Pavement Serviceability Index (PSI) as one application of an 18-kpi single axle load

0.5.8 Traffic Assignments

To estimate traffic for a route, which does not exist is a challenging task. Under such circumstances, traffic characteristics of adjoining network are quite useful. It is possible to estimate traffic on Proposed Road after analyzing traffic volume and origin-destination of trip patterns. Classified traffic volume gives an idea of traffic volume along the route and desire lines help to find out directional distribution of trips of traffic which will be interested in using the proposed road.

In a road network, trips from a particular origin to a particular destination may have more than one route to choose from. The decision to choose a route is driven by the distance saved in each route, time taken in each route, etc. The speed along each route is a function of road condition in the route and also traffic in the link forming the route.

The traffic diversion has been done separately for East Bank-East Coast Road and Connectors. The separate diversion estimate for different sections has been carried out depending on the flow of traffic, nature of traffic and zonal movement to be occurred on new facility when it will be operational.

Based on the O-D survey O-D desire line matrices have been prepared. The East Bank-East Coast road will shorten the distance travelled between various zones. Similarly, the time taken between various zones will get reduced as East Bank – East Coast Road will be constructed as partial access controlled 4 lane divided facility for the design speed of 120 kmph. So, the traffic will get diverted to the East Bank-East Coast road due to saving in distance and time. In addition, other factors will also influence a driver’s route choice decision, such as safety, comfort, and reliability.

The diversion between various zones is presented in Tables below.

From		To	
Zone	Name of Place	Zone	Name of Place
1	Prasad Nagar, Turkeyan, UG, Festival City, Cummings Park, North and South Ruimveldt, Bel Air etc.	4	Providence, Mocha , Little Diamond, Great Diamond, Timehri etc.
2	Bel Air Park, Kitty, Campbellville, Queenstown, Bournda, Lcytown, Stabroek, Kignston, Cummings burg etc.	4	Providence, Mocha , Little Diamond, Great Diamond, Timehri etc.
2	Bel Air Park, Kitty, Campbellville, Queenstown, Bournda, Lcytown, Stabroek, Kignston, Cummings burg etc.	7	Parika, LaGrange, Essequibo Island, Windsor Forest

3	Industrial Estate, Huston, Agricola, Republic Park, Eccles etc.	6	Lusignan, Buston, Enmore, Victoria, Belfield, Mahaica, cane Grove, Mahicony, Rosignol, Montrose etc.
4	Providence, Mocha , Little Diamond, Great Diamond, Timehri etc.	5	Prado Ville, Plaisance , Courida Park, Success etc.
6	Lusignan, Buston, Enmore, Victoria, Belfield, Mahaica, cane Grove, Mahicony, Rosignol, Montrose etc.	4	Providence, Mocha , Little Diamond, Great Diamond, Timehri etc.
9	Linden, Ituni, Ebini, Pubu, Kwakwani etc	2	Bel Air Park, Kitty, Campbellville, Queenstown, Bournda, Lcytown, Stabroek, Kignston, Cummings burg etc.
9	Linden, Ituni, Ebini, Pubu, Kwakwani etc	6	Lusignan, Buston, Enmore, Victoria, Belfield, Mahaica, cane Grove, Mahicony, Rosignol, Montrose etc.

Table 0-7: Traffic Diversion Zones

Traffic plying between Georgetown CBD, Parika, West Bank, Diamond, Timehri, Ogle, Enmore, Barbice, Mahaica and Linden is expected to be diverted.

		Main Alignment (Bypass)				Connectors			
	Vehicle	Ogle to Cont-1	Cont- 1 to Cont- 2	Cont- 2 to Cont- 3	Cont- 3 to Cont-4	Cont- 1	Cont- 2	Cont- 3	Cont- 4
Diverted Traffic from O-D Survey	Nos.	3257	18457	12976	12976	15200	5480	0	12976
	In PCU	4227	21504	15528	15528	17276	5976	0	15528
Existing Traffic on Connectors (Turning movement survey)	Nos.	540	-	-	-	637	312	252	998
	In PCU	572	-	-	-	794	431	305	1000
Total Traffic (in Nos.)		3797	18457	12976	12976	15837	5792	252	13974
Total Traffic (in PCU)		4799	21504	15528	15528	18070	6407	305	16528

Table 0-8: Traffic Diverted to Main Alignment and Connectors

0.5.9 Traffic Growth Rates

For any transportation project, traffic growth rate is an essential component required to be estimated reasonably well for the future traffic on the project road. Traffic forecasting using traffic growth pattern, which is the most important governing factor, in the present state of knowledge can at best be only approximate. Traffic is generated as a result of the interplay of a number of contributory factors like population, gross domestic product, vehicle ownership, agriculture output, fuel consumption etc. to name a few. Any change in the pattern of these factors can only be estimated approximately with a limited degree of accuracy. The major factors affecting the transport demand are as follows:

- *Growth in population; and*
- *Economic performance*

The mathematical models used for forecasting the growth rates by regression method for passenger and freight traffic are given below:

For Passenger traffic: $\text{Log } P_N = n \times \text{Log } (1+r) + \text{log } P_0$ - Equation -A

Where,

- P_0 = Traffic flow in base year
- P_N = Traffic in the nth year
- N = Number of years
- r = annual growth rate of traffic

For freight traffic: $\text{Log } P = A_1 \times \text{Log } (\text{GDP}) + A_0$ - Equation-B

Where,

- P = Traffic Volume
- GDP = Gross Domestic product
- A_0 = Regression constant
- A_1 = Regression coefficient

0.5.10 The finally Adopted Traffic Growth Rate is as follows:

VEHICLES TYPE	2019-23 (%)	2024-28 (%)	2029-33 (%)
Two-wheeler	8.1	8.0	7.0
Car, Jeep, Van	9.4	9.0	8.0
Pickup	8.3	8.0	7.0

Bus	11.9	11.0	10.0
Trucks/Freight	8.7	8.0	7.0

Table 0-9: Final Adopted Growth rates (%)

0.5.11 Traffic Projections

The traffic projections have been made for each section i.e. East Bank-East Coast Road and connectors considering the base traffic, generated and traffic growth factors.

The traffic projections for above two sections have been done based on the traffic growth rate calculated for the design life of 15 years.

Maximum Traffic has been generated from O-D Survey Data in-between Connectors as follows:

- On Main Alignment: In between Connector-1 to Connector-2 on main alignment, the maximum traffic will be plying due to traffic diverted from East Coast Road, Railway Embankment Road (Ogle), Diamond (East Bank Road) and Aubrey Barker Road to join main alignment road (East Bank- East Coast Road Linkage)
- On Connectors: Connector-1, the maximum traffic will be plying due to traffic diverted from East Coast Road, Railway Embankment Road (Ogle) and Diamond (East Bank Road).

SECTION ID	Light Fast Passenger			Public Transport		Freight Vehicles			Total Fast Vehicle	Total AADT (Nos.)
	Car	Utility	Mini Bus	Bus (Full)	LCV	MCV	HCV	MAV		
Main Alignment (EB-EC Road)	14095	1226	1439	15	697	509	172	304	18457	18457
Connectors	12222	1063	1522	15	377	330	112	197	15837	15837

Table 0-10: Diverted Traffic on Main Alignment and Connectors (In Year 2018)

The diverted traffic has been considered as the base traffic in year 2018 and traffic projections have been made for year 2037 as follows

Year	Car/Jeep/Taxi/Van etc.	Utility (Pickup, Jeep/Van etc.)	Mini Bus	Std Bus	LCV	Truck			Total Fast Vehicle in Nos.	All Vehicle in Nos.	All Vehicle in PCU
						MCV	HCV	MAV			
2018	14095	1226	1439	15	697	509	172	304	18457	18457	21982
2037	74670	12469	10405	130	3127	2336	785	1344	105266	105266	123238

Table 0-11: Diverted Traffic Projection for Main Alignment (Bypass Road)

Year	Car/ Jeep/ Taxi/Van etc.	Utility (Pickup , Jeep/Van etc.)	Mini Bus	Std Bus	LCV	Truck			Total Fast Vehicle in Nos.	All Vehicle in Nos.	All Vehicle in PCU
						MCV	HCV	MAV			
2018	12222	1063	1522	15	377	330	112	197	15837	15837	18391
2037	61852	10502	10954	121	1707	1495	507	896	88034	88034	101747

Table 0-12: Diverted Maximum Traffic Projection for Connectors

Enhanced infrastructure facility promotes economic activity in the project influence area. Benefits derived from lower operating costs partially translate to additional vehicular trips. Therefore, generated traffic is expected on the project road once the East Bank-East Coast will be opened to traffic in the year 2022. The project development is linked with the development of land along the East Bank-East Coast Road and Connectors. The current and proposed development pattern along East Bank-East Coast road has been finalized by Central Housing & Planning Authority and considered for generated traffic. The projected population in proposed development is 2280. Therefore, considering the vehicle ownership of 33.4%, it is expected to add 760 new vehicles in 2025 when these new settlements will be occupied.

0.6 Engineering Surveys and Investigations

Engineering Surveys and Investigations has been carried out by the consultant on project road section as per Terms of Reference. The Engineering Surveys and Investigations include:

❖ Inventory & Condition Surveys

- *Inventory and Condition Surveys for Road and Pavement*

Road and Pavement Condition Inventory Survey has been done from East Coast Road to Ogle Airport. The Bituminous carriageway width is 5.5m with 2.4m earthen shoulder both side and condition of pavement generally found in good condition from 0+000 to 1+700 km.

- *Engineering Survey, Investigations for Cross Drainage Structures*

Sl. No.	Existing Ch. (Km)	Drainage Id No.	Structure Type & Span	Overall Width (m)	Carriageway width (m)	Adequacy of Vent way	Overall Condition
1	0.425	E-1	1 x 5.300 m RCC Slab on RSJ	5.80	5.50	No	Poor

2	0.608	E-2	1 x 0.500 m dia Pipe Culvert	15.00	5.00	No	Fair
3	1+070	E-3	1X 0.5 Pipe	15.00	5.50	No	Very Poor (Not Visible from one side)

Table 0-13: Details of Inventory and condition of existing Bridge and Culverts

❖ **Pavement Investigations**

- *Existing Pavement Trial Pit Investigations: The purpose of the Trial Pit excavation is to allow for an exploration of the existing alignment roadway pavement and existing subgrade conditions.*

S. No.	Trial Pit Identification Number	Road Section	Trial Pit Location
1	TP – 1	At Junction of Ogle Airport Road and East Coast Road	on East Coast Road
2	TP – 2	On Ogle Airport Road	1.5km from East Coast Road Intersection
3	TP – 3	On Haags Bosch Road	Near Workshop
4	TP – 4	On Diamond Road	Near 21 st Avenue Road

Table 0-14: Trial Pit Investigations

Pavement Layer	TP 1	TP 2	TP4
	East Coast Road	Ogle Airport Road	Diamond Connector Existing Road
Asphalt Concrete	130	50	30
Crusher run	200	80	150
Loam	0	0	250
White Sand	300	0	460
Quarry Cleaning	0	130	0
Mini Boulders	0	280	0
Clay	370	470	110

Table 0-15: Trial Pit Investigations: Summary of Pavement Composition

- ***Soil Investigation Pits along the Main Alignment.*** The consultant has identified 4 locations for carrying out test pits for soil investigation along the main alignment from Ogle to Diamond. The field works for trial pits were completed for three trial pits. . The remaining one identified trial pits is within the swamp location and would be taken up after drying up.
- ***Soil and Construction Material Investigations***

Road Construction would essentially require naturally occurring materials viz. stones, sand, soil etc. Geological formations of Guyana detail that sufficient quantities of construction materials are available for infrastructure projects, though there can be certain apprehensions w.r.t. extraction, crushing quality and supply mechanism

The Consultant has requested details of quarry products from following five quarry operators in Guyana as details provided by MoPI for providing details w.r.t. supply rates of products to project, quality of materials etc.

- M/s Toolsie Persaud Group of Companies;
- M/s B K International Inc.;
- M/s Baracara Quarries Inc.;
- M/s Metallica CC Guyana Ins.;
- M/s Durban Quarries;

The Annual extraction of stones data as obtained from Guyana Geology and Mines Commission for different quarries in Guyana for the year 2017 detailed that it was around 588,935 Tone.

The details of production / extraction of stones from different quarries in MT done, by individual quarry operators is 257517, 134440, 141550, 27796 & 27632 respectively.

The data details that 91% of Production is carried out by three major quarry operators i.e. M/s Toolsie Persaud Group of Companies (44%), M/s B K International Inc (23%), and M/s Baracara Quarries Inc. (24%). The testing of samples for Soil, Loam and mix of Soil & loam are in progress.

The rate of Royalty charge by Government of Guyana on extraction of Stones is Guyanese Dollars 25 per MT and on Sand / Loom soil is Guyanese Dollars 15 per MT.

Apart from above, M/s Gafsons also supply Aggregates imported from Surinam and St. Lucia. Accordingly the consultant has contacted these supplier and obtained rates for supply of quarry products to the project.

The consultants consider that contractors may be permitted to import aggregates in case of volume of supplies or quality fails to meet the project requirements.

- ❖ **Sub-soil Investigations:** In order to prepare Design and General Arrangement Drawings (GADs) of proposed new/ reconstructed structures, geo-technical investigations for bridges / structures have been carried out as per provision of TOR for deciding the type and depth of foundations. Boring has been conducted for required depth at decided location. The works have been carried out through Geotechnical Consultants M/s Demerara Engineering, PLLC, New York.

The locations of bore holes, where sub-soil investigations have already been completed along with depth of borehole are presented in Table 0.14.

Sl. No.	Bore Hole No.	Bore Hole Depth (m)	Location of Bore Holes	Remarks
1	BH-1	35.70	Km 0/000 on Ogle, East Coast Demerara Road	On Main Alignment
2	BH-2	35.50	Km 2/900 on Ogle Backland	On Main Alignment
3	BH-3	20.10	Km 8/000 on Ogle Backland	On Main Alignment
4	BH-4	24.60	Km 11/300 on Mocha Backland	On Main Alignment
5	BH-5	30.00	Km 1/340 Eccles Backland	On Connector 2
6	BH-6	29.10	Km 1/500 Ogle Backdam	On Connector 1

Table 0-16: List of Bore Holes

The preliminary conclusions of soil investigation indicate that a generalized consistent subsurface profile, exists across the project site. This profile is generally composed of Soft Normally Consolidated to Under-consolidated Clays with inclusions of Silt and Silty Clay. This soil is generally unsatisfactory for the foundation support of shallow spread foundations as bearing capacity is low, and its primary and secondary consolidation settlement potential very high

- *Hydraulic and Hydrological Investigations*

The project road between East Coast (Rupert Craig Highway) Road and Ogle near Airport (Chainage 0.00 to 1.30 Km.) follow alignment of existing road. The project also includes extension of existing Aubrey Barker Road (Connector-1), Haags Bosch Road (Connector-2) and Mocha Arcadia Road (Connector-3) up to main green field alignment. There are 2 existing cross drainage structures on main project road and connectors.

After 1.30 Km the main project road alignment traverse through open cane field (Chainage 1.30 to 15.60 Km.) where most of the cross drainage are either drains or canals that was serving sugar estates. A network of rectangular pattern irrigational canal (Navigational Canals & Punt Canals) and drainage channel system as shown in Figure below dug from early eighteenth century present here. These canal systems were served now abandoned sugar estates.

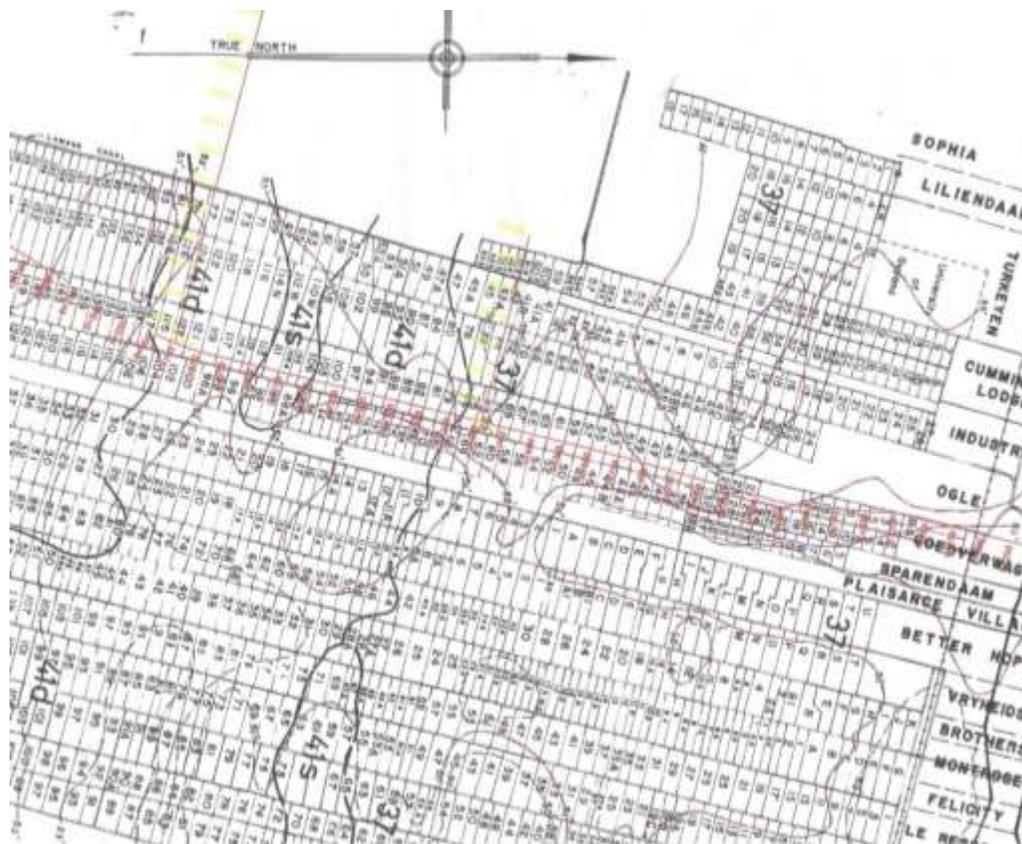


Figure 0.3: Canal System in Cane Field

The details of un-bridged canal & drainage crossing with measureable catchment area located beyond Km 1.30 are compiled and shown in Table below. Flood estimation is done only for those waterways whose catchment area is measureable.

The project road traverses through a green field alignment and crosses numbers of Irrigation ditch. To find out the cross drainage requirement for project road, the Consultant has collected the rainfall data of the project area and delineated the catchment of watercourses whose catchment is measureable. By using Rational formula, the discharge of the channel has been estimated. The adequacy for proposed waterway has also been checked by well known manning's equation. For channels with non identifiable catchment area, balancing culverts at regular interval have been provided to make flow paths remain unhindered due to construction of project road.

Sl. No.	Un-bridged Cross Drainage Id No.	Chainage (Km.)	Name of Channel	Remarks
On Main Alignment				
1	U-1	1.330	Drain	
2	U-2	2.861	Drain	
3	U-3	2.914	Drain	

Table 0-17: Details of Un-bridged canal & drainage crossing

Beside above inventory of minor irrigation canal and drain has also been conducted. The project area has lot of vegetation. It is very difficult to locate the small water course during inventory. However, all the visible and accessible water course haven been inventoried. This has been compiled from the topographic survey data. The details of existing minor channels with non-measureable catchment are given below:

Sl. No.	Chainage (Km)	Remarks	Sl. No.	Chainage (Km)	Remarks
On Main Alignment			On Main Alignment		
1	1.330	Drain	54	7.680	Drain
2	1.413	Drain	55	7.815	Drain
3	15.10	Drain	56	7.958	Drain
4	1.608	Drain	57	8.034	Drain
5	1.716	Drain	58	8.127	Drain
6	1.830	Drain	59	8.150	Drain
7	1.939	Drain	60	8.225	Drain

Sl. No.	Chainage (Km)	Remarks	Sl. No.	Chainage (Km)	Remarks
8	2.047	Drain	61	8.315	Drain
9	2.620	Drain	62	8.471	Drain
10	2.736	Drain	63	8.600	Drain
11	2.820	Drain	64	8.723	Drain
12	2.914	Drain	65	8.845	Drain
13	2.966	Drain	66	8.970	Drain
14	3.073	Drain	67	9.092	Drain
15	3.184	Drain	68	9.151	Drain
16	3.292	Drain	69	9.200	Drain
17	3.395	Drain	70	9.247	Drain
18	3.508	Drain	71	9.358	Drain
19	3.602	Drain	72	9.482	Drain
20	3.730	Drain	73	9.657	Drain
21	3.853	Drain	74	9.678	Drain
22	3.982	Drain	75	10.072	Drain
23	4.106	Drain	76	10.140	Drain
24	4.209	Drain	77	10.450	Drain
25	4.348	Drain	78	10.472	Drain
26	4.470	Drain	79	10.490	Drain
27	4.585	Drain	80	10.686	Drain
28	4.690	Drain	81	10.873	Drain
29	4.794	Drain	82	10.942	Drain
30	4.900	Drain	83	11.075	Drain
31	5.040	Drain	84	11.142	Drain
32	5.135	Drain	85	11.207	Drain
33	5.228	Drain	86	11.340	Drain
34	5.326	Drain	87	11.500	Drain
35	5.462	Drain	88	11.590	Drain
36	5.585	Drain	89	11.643	Lamaha Canal (regulated discharge)
37	5.700	Drain	90	11.730	Drain
38	5.823	Drain	91	11.900	Drain
39	5.940	Drain	92	12.175	Drain
40	6.070	Drain	93	12.195	Drain
41	6.185	Drain	94	12.335	Drain
42	6.300	Drain	95	12.765	Drain

Sl. No.	Chainage (Km)	Remarks	Sl. No.	Chainage (Km)	Remarks
43	6.411	Drain	96	12.782	Drain
44	6.542	Drain	97	13.085	Drain
45	6.635	Drain	98	13.453	Drain
46	6.731	Drain	99	13.600	Drain
47	6.854	Drain	100	13.788	Drain
48	6.990	Drain	101	14.102	Drain
49	7.047	Drain	102	14.133	Drain
50	7.143	Drain	103	14.328	Drain
51	7.279	Drain	104	14.647	Drain
52	7.419	Drain	105	14.917	Drain
53	7.558	Drain	106	15.282	Drain
On Connector-1			On Connector-1		
1	0.285	Ogle West Middle Canal	4	1.243	Industry Canal
2	0.306	Drain	5	1.500	Lamaha Canal (regulated discharge)
3	0.825	Ogle West Canal	6	1.610	Drain
On Connector-2			On Connector-2		
1	0.275	Ogle West Middle Canal	13	2.025	Drain
2	0.292	Drain	14	2.100	Drain
3	0.900	Ogle West Canal	15	2.200	Drain
4	1.300	Industry Canal	16	2.295	Drain
5	1.340	Lamaha Canal (regulated discharge)	17	2.390	Drain
6	1.370	Drain	18	2.483	Drain
7	1.440	Drain	19	2.575	Drain
8	1.573	Drain	20	2.668	Drain
9	1.708	Drain	21	2.736	Drain
10	1.830	Drain	22	2.801	Drain
11	1.900	Drain	23	2.878	Drain
12	1.968	Drain	24	3.488	Drain
On Connector-3			On Connector-3		
1	0.246	Drain	9	1.380	Drain
2	0.267	Drain	10	1.524	Drain

Sl. No.	Chainage (Km)	Remarks	Sl. No.	Chainage (Km)	Remarks
3	0.675	Lamaha Canal (regulated discharge)	11	1.666	Drain
4	0.715	Drain	12	1.808	Drain
5	0.830	Drain	13	1.961	Drain
6	0.950	Drain	14	2.094	Drain
7	1.100	Drain	15	2.237	Drain
8	1.235	Drain	16	2.640	Drain
On Connector-4			On Connector-4		
1	0.140	Drain	7	0.818	Drain
2	0.221	Drain	8	0.922	Drain
3	0.318	Drain	9	1.111	Drain
4	0.523	Drain	10	1.322	Drain
5	0.618	Drain	11	1.512	Drain
6	0.710	Drain	-	-	-

Table 0-18: Details of minor watercourse with non-measureable catchment

❖ **Topographic Survey**

The basic objective of the topographic survey would be to capture the essential ground features on the alignment after the completion of reconnaissance surveys.

Carrying out of topographic surveys is one of the important and crucial field tasks under the project. The detailed field surveys shall be carried out using high precision instruments i.e. total stations. The topographic survey has three controlling parameters i.e. X, Y and Z. Whereas X & Y represent the horizontal location of any feature on earth and Z represents its elevation

As the project highway is in the very difficult open cane fields having grid of canals, swamps and wild creatures, the consultants have carried additional field survey works beyond scope of ToR to maintain highest level of accuracy. **The consultants have ensured horizontal accuracy by fixing GPS control stations at regular intervals. Similarly the vertical accuracy has been ensured by identifying Land and Surveys department permanent bench marks on both ends of the main alignment.**

Topographic survey covered a strip of 200 m widths with cross sections taken at 50 meter intervals in plain terrain to form a Digital Terrain Model (DTM). Topographic surveying and levelling has been done by Total Station in combination with Auto level/Digital level so as to ensure higher degree of accuracy while fixing benchmarks and reference pillars.

The topographic survey for main road is being carried out along the revised alignment provided by MPI on April 26, 2018 by shifting East Bank-East Coast proposed alignment by 100-150m east of the alignment provided in the contract agreement.

Similarly, the modifications of alignment for connector 3 has been carried by MPI by shifting it Northwards by 30m of the alignment provided in the contract and confirmed it on July 16, 2018.

However, the decision of MoPI pending for 3 km stretch from km 8/500 to km 11/500 passing through mini conservancy of GAYUSCO regarding discharge of flood water or closure of conservancy with high embankments / provisions of viaduct spans.

0.7 Design Proposal

The Project Road section passing through Ogle area, abandoned cane field area from East Coast to Diamond. The Project road will be life line for the Georgetown near future to reduce the traffic load from East Bank Road, East Coast Road and various other roads such as Mandela Avenue Road and Sharif Street. The Project Proposals have been derived based on design standards, terrain conditions, environment and relevant applicable AASTHO (Green Book 2011).

0.7.1 Design Speed

The design speed is the guiding criteria for correlating features such as sight distance, curvature and super elevation upon which the safe operation of the vehicle depends. The design speeds for plain terrain have been proposed as under:

S. No.	Existing Location (km)			Proposed Location (km)			Speed km/h
	From	To	Length	From	To	Length	
1	0.000	0.800	0.800	0.000	0.800	0.800	100
2	-	-	-	0.800	15.350	14.550	120

Table 0-19: Design Speed Main Alignment Road

The summary of adopted design speed for connectors is presented in table below.

Name of Connector	Connector No.	Proposed Location (km)			Speed km/h
		From	To	Length	
Aubrey Barker	1	0.000	1.643	1.643	80
Haag Bosch	2	0.000	3.538	3.538	100
Mocha Arcadia	3	0.000	2.632	2.632	100
Great Diamond	4	0.000	1.552	1.552	80

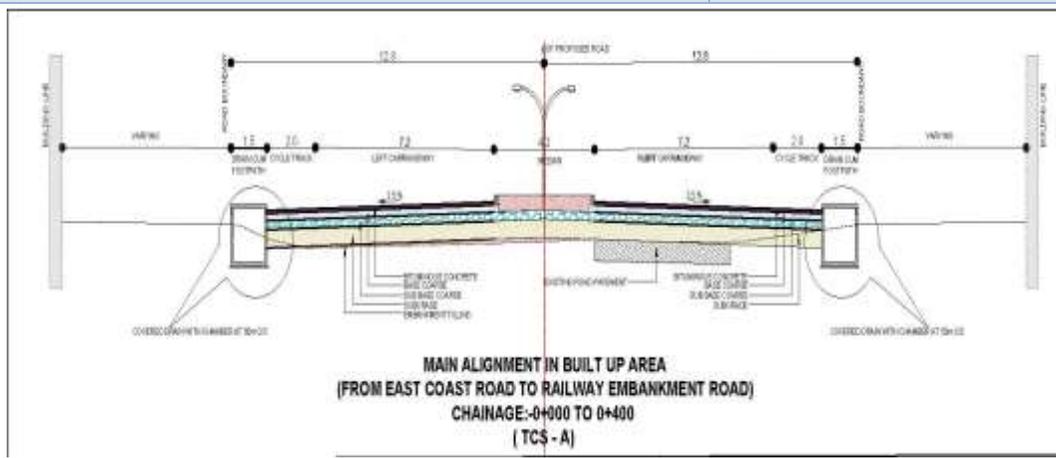
Table 0-20: Design Speed Connectors Road

0.7.2 Cross-Sectional Details

The Cross Section of highway considers its adequacy for the function of the road and the mix of traffic likely to use it. The cross section applicable as follows:

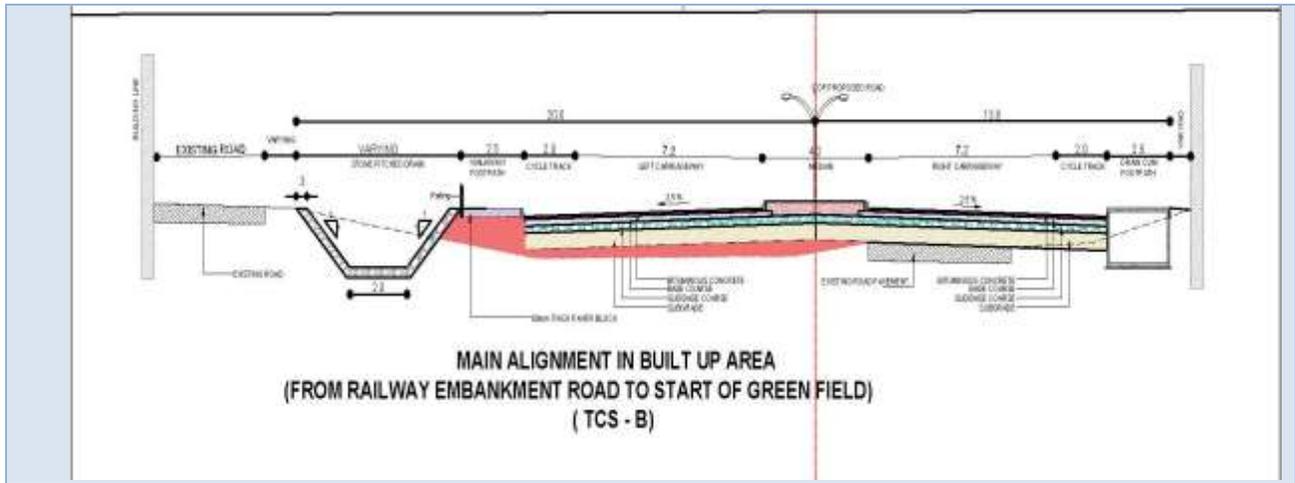
Main Alignment: TCS A: Km 0/000 to Km 0/400

Carriageway Width	2 x 7.2 m = 14.40m
Cycle Track on Both Sides	2 x 2.0 m = 4.00m
Covered Drain cum Foot Path on Both of Carriageways	2 x 1.5 m = 3.00m
Raised Median Width	4.20m
Roadway Width	25.60m
Utility Corridor on Both Sides	<i>Varying as per available land</i>



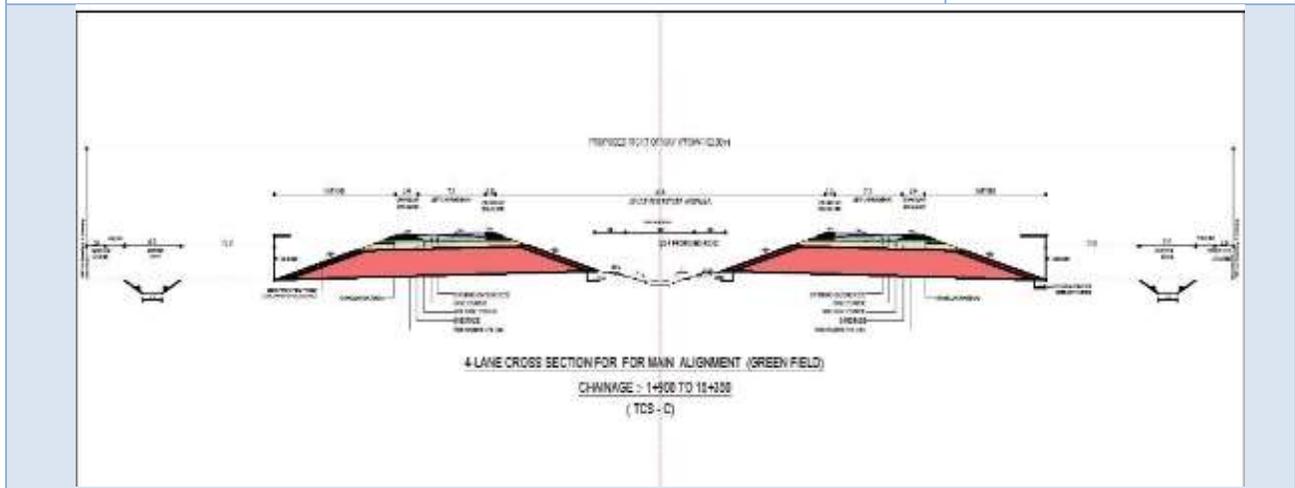
Main Alignment: TCS B: Km 0/400 to Km 1/900

Carriageway Width	2 x 7.2 m = 14.40m
Cycle Track on Both Sides	2 x 2.0 m = 4.00m
Covered Drain cum Foot Path on RHS of Carriageways	1 x 2.5 m = 2.50m
Walkway cum Footpath on Left Side of Carriageways	1 x 2.5 m = 2.50m
Raised Median Width	4.20m
Roadway Width	27.60m
LHS: Open Drain (Stone Pitched if drain side slopes are 1: 1)	<i>Varying as per available land</i>
LHS: Open Drain earthen (if drain side slopes are 2: 1)	
Utility Corridor on Both Sides	<i>Varying as per available land</i>



Main Alignment: TCS C: Km 1/900 to Km 15/300

	Carriageway Width	2 x 7.2 m = 14.40m
Granular Shoulder towards median side on each side each Carriageways		2 x 1.0 m = 2.00m
Granular Shoulder on outer side of each side Carriageways		2 x 2.4 m = 4.80m
Granular Shoulder on Both side of inner edge of Carriageways		2 x 1.0 m = 2.00m
Depressed Central Median with Earthen Drain at Centre (Provision for 4 lane Future Development towards median)		40.00m
	Roadway Width	61.20m
Earthen Drain on Both Side at end of Right of Way (RoW)		2x 6.0 m
Utility Corridor on Both Sides at end of Right of Way (RoW) boundary		2x 2.0 m (Varying)
Side Slope		4 H : 1 V



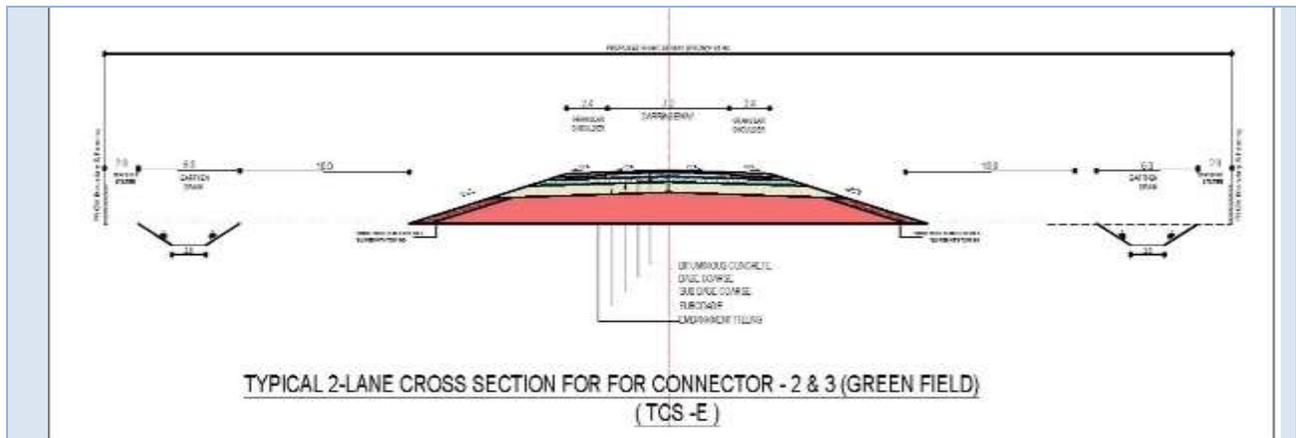
Connectors 1 and Connector 4: TCS D: This cross section is applicable for 4 lane Section for in open cane fields

Connector 1: Km 0/000 to km 1/643 (Lamha Canal) Connector 4: km 0/000 to km 1/552 (Major Drain)	
Carriageway Width	$2 \times 7.2 \text{ m} = 14.40\text{m}$
Granular Shoulder on outer side of each Carriageways	$2 \times 2.4 \text{ m} = 4.80\text{m}$
Central Raised Median	$= 4.20\text{m}$
Roadway Width	22.40m
Earthen Drain on Both Side at end of Right of Way (RoW)	2x 6.0 m
Utility Corridor on Both Sides at end of Right of Way (RoW) boundary	2x 2.0 m (Varying)
Side Slope	4 H : 1 V

TYPICAL 2-LANE CROSS SECTION FOR FOR CONNECTOR - 1 & 4 (GREEN FIELD)
(TCS-D)

Connectors 2 and Connector 3-TCS E: This cross section is applicable for 4 lane Section for in open cane fields

Connector 2: Km 0/000 to 3/538 km Connector 3: Km 0/000 to 2/632 km	
Carriageway Width	$1 \times 7.2 \text{ m} = 7.20\text{m}$
Granular Shoulder on Both side of Carriageway	$2 \times 2.4 \text{ m} = 4.80\text{m}$
Roadway Width	12.00m
Earthen Drain on Both Side at end of Right of Way (RoW)	2x 6.0 m
Utility Corridor on Both Sides at end of Right of Way (RoW) boundary	2x 2.0 m (Varying)
Side Slope	4 H : 1 V



0.7.3 Geometric Design

The project have two distinct sections, main alignment connecting East Bank-East Coast Road and extension of existing connectors and joining this new proposed road. Both alignments are further segregated into alignment passing through built-up stretch and open cane fields.

Horizontal alignment essentially comprises of three major elements: tangent sections, circular curve and transition curve elements. A balanced control on the above elements is required to provide safe and continuous flow of vehicles under general traffic conditions. Horizontal alignment has been design as per AASTHO green Book -2011.

Similarly, there are two major elements in vertical geometry of an alignment i.e. longitudinal gradient and vertical curve. Vertical alignment has been design as per AASTHO green Book - 2011.

0.7.4 Design Main Alignment: East Bank-East Coast Road

The Main alignment has been designed for a speed of 100 km/hr in built-up residential areas along Ogle Airport road and provided 4 lane road with cycle track and pedestrian footpath. Thereafter, the main alignment has been designed for a speed of 120 km/hr with depressed median.

0.7.5 Design of Connector-1: Aubrey Barker Road

The start of connector has been considered from main alignment at ch 4/960 and designed with 4 lane + granular shoulders section from Main Alignment to Lamha Canal for a length of 1.5km for a designed speed of 100 km/hr. Thereafter, it has been designed for a speed of 80 km/hr having 4 lane sections with drain cum footpath on both sides from km 1/500 to 1/643 and finally tapered from 4 lane to match the 5.5m carriageway width and meet the existing road level.

0.7.6 Design of Connector-2 Haag Bosch Road

The start of connector has been considered from main alignment ch 7/715 and designed with 2 lane + granular shoulders for a speed of 100 km/hr from Main Alignment to km 3/400. Thereafter, it has been designed for a speed of 80 km/hr and tapered from 2 lanes to match the 5.5m carriageway width and meet the existing road level at km 3.358

0.7.7 Design of Connector-3 Mocha Arcadia Road

The start of connector has been considered from main alignment at Ch 10/160 and designed for a speed of 100 km/hr with 2 lane + granular shoulders from Main Alignment to km 2/800. Thereafter, it has been designed for a speed of 80 km/hr tapered from 2 lanes to match the 5.5m carriageway width and meet the existing road level at km 3.630

0.7.8 Design of Connector-4 Great Diamond Road

The start of connector has been considered from main alignment at ch 14/900 and designed with 4 lane + granular shoulders section from Main Alignment to Canal for a length of 1.5km for a designed speed of 100 km/hr. Thereafter, it has been designed for a speed of 80 km/hr having 4 lane sections with drain cum footpath on built-up sides & open drain on other side from km 1/500 to 1/600 and finally tapered from 4 lane to match 5.5m carriageway width and meet the existing road level.

0.7.9 Intersection Design

Project road sections are well connected with proposed connectors. The peak hour distribution at each arm of the junctions has been analysed. Based on peak hour traffic at junctions the following improvement has been proposed as per AASTHO Green Book -2011.

Sl. No.	Existing Chainage (km)	Proposed Design Chainage & Location	Approach Arm	Design Proposal
1	0+000	Km 0.000 East Coast Road Junction	Georgetown	4-Legged Junction (At grade Intersection)
			Mahaica	
			Ogle Airport	
			Seawall	
2	0+530	Km 0+550 Railway Embankment Road Junction	East Coast	4-Legged Junction (At grade Intersection)
			Mahaica	
			Georgetown	
			Ogle Airport	
3	Bypass	Km 1+700	East Coast	T-Legged Junction (At grade Intersection)
			Ogle Airport	

Sl. No.	Existing Chainage (km)	Proposed Design Chainage & Location	Approach Arm	Design Proposal
	(Main Alignment)	Ogle Airport Junction	Great Diamond	
4		Km 4+ 954 Connector-1 Aubrey barker Road Junction	East Coast Road	T-Legged Junction
			Aubrey barker Road	At grade Intersection
			Great Diamond	With left in left out arrangement
5		Km 7+704 Connector-2 Haag Bosch Road Junction	East Coast Road	T-Legged Junction
			Haag Bosch Road	At grade Intersection
			Great Diamond	With left in left out arrangement
6		Km 10+145 Connector-3 Mocha Arcadia Road Junction	East Coast Road	T-Legged Junction
			Mocha Arcadia	At grade Intersection
			Great Diamond	With left in left out arrangement
7		Km 14+855 Connector-4 Great Diamond Road Junction	East Coast Road	T-Legged Junction
			Great Diamond	At grade Intersection
			Temehri	With left in left out arrangement

Table 0-21: Major Junctions/Intersections (at Grade Junctions)

Since, the total traffic at major junctions is less than 10,000 PCU. The junctions are proposed to be designed as at grade intersection.

The main alignment in open field has been designed on the concept of partial access controlled. Therefore, the connectors have been proposed to be designed as Left In and Left Out arrangement. The right turning traffic from & to the connectors will take U-turn on the main alignment as follows:

Sl #	Chainage	Turning Traffic
1,	4+100	Traffic Coming on Aubrey Barker Road will take right turn for Diamond via U-turn on main road
2.	5+800	Traffic Coming from East Coast Road will take right turn for Aubrey Barker via U-turn on main road

SI #	Chainage	Turning Traffic
3.	6+900	Traffic Coming on Haags Bosch Road will take right turn for Diamond via U-turn on main road
4.	8+500	Traffic Coming from East Coast Road will take right turn for Haags Bosch via U-turn on main road
5.	9+300	Traffic Coming on Mocha Arcadia Road will take right turn for Diamond via U-turn on main road
6.	11+000	Traffic Coming from East Coast Road will take right turn for Aubrey Barker via U-turn on main road
7.	15+300	Traffic Coming from East Coast Road will take right turn for Great Diamond Road via U-turn on main road

0.7.10 Pavement Design

The design of flexible pavement having design life of 15 years have been proposed using AASTHO GUIDE for Design of Pavement Structure and Indian Roads Congress Publication IRC 37 2012 : Tentative Guidelines for the Design of Flexible Pavements.

The required Pavement Structure for Project Roads *Main Alignment (4 Lane), Connector 1 & 4 (4 Lane), and Connectors 2, 3 (2 Lane)* have been calculated as per AASHTO & IRC design methodologies and detailed in previous paragraphs. The Pavement Structure Number required for Pavement Design Life of 15 years is 4.64 for Main Alignment, 4.32 for Connectors 1 & 4 (4 Lane) and 4.51 for Connectors 2 & 3 (2 Lane).

The Pavement Structure in accordance with AASHTO which requires total asphalt layer thickness varying from 169 mm to 183 mm for project roads, whereas IRC details total asphalt layer thickness as 90 mm to 105 mm.

It is proposed adopt total asphalt layer thickness as calculated by IRC method as 105 mm for main alignments and connectors to maintain uniformity. The consultants proposed thickness of asphalt as per IRC methods based on their extensive road design and construction experience in India on ongoing massive highway construction in India. Moreover, the pavement design has been done considering legal axle load of 8.10 tonne against 7.26 tonne currently applicable in Guyana. Further, flexible pavement is designed for stage construction and additional Asphalt surfacing layers if required can be provided after 10 years of opening of road to traffic as being done in India. Otherwise also rehabilitation / resurfacing required

after 10 years in order to improve pavement roughness to overcome wear & tear due to traffic plying and weathering effects on asphalt concrete.

The total thickness of Granular Base and Granular Sub base is almost the same with respect to both methodologies i.e. 450 mm. The location of Project Road Pavement Structure has been utilized for cane cultivation and abandoned network of Drainage/Navigational/Punt canals exists. Thus, a proposed pavement structure would essentially require granular Sub base layer which would act as Sub base cum Drainage layer. Therefore, it is proposed to provide thickness of Granular Base Layer as per IRC.

Proposed Layer	Layer Coefficient	Main Alignment (4 Lane)	Connector 1 & 4 (4 Lane)	Connector 2 & 3 (2 Lane)
		(MSA =25)	(MSA-16)	(MSA-22)
Bituminous Concrete (VG 30)	0.425	40	40	40
Dense Bituminous Macadam (VG 30)	0.425	65	65	65
Wet Mix Macadam	0.14	250	250	250
Granular Sub Base	0.11	200	200	200
Sub grade (min CBR 15% @ 97% of MDD)		500	500	500
SN Provided		4	4	4

Table 0-22: Proposed Layers: Stage Construction

0.7.11 Bridge and Culverts Proposals

The project road between East Coast (Rupert Craig Highway) Road and Ogle near Airport follow alignment of existing road. In the remaining portion the project road traverse through green field align. The existing cross drainage structure at Km 0.425 of the project road has RCC slab on RSJ and resting on RCC Column type abutment. The spill protection component of abutment is also in damaged condition and the overall condition of the structure is poor. Beside above, there is a pipe culvert located at KM 0.603 on the project road. The culvert vent way is not visible and due to low height of head wall the embankment slope is eroding. Considering the condition of existing structures, it is proposed to reconstruct the structures according to geometric standard of the project.

In the green filed alignment of the project new bridges and culverts have been proposed based on site investigations, hydraulic studies, geo technical investigations, topographic studies and various other parameters like bridge siting, alignment, hydrological adequacy, H.F.L, scour, bearing capacity at bridge locations etc. The summarized improvement proposal

for bridges and culverts on main alignment and connectors of the project road has been tabulated below:

Sl. No.	Design Chainage (Km)	Span Arrangement (m)	Structure Width (m)	Structure Type	Remarks
On Main Alignment					
1.	0.425	3x3.0x3.0	2 x 12.7	RCC Box on precast pile foundation	Reconstructed
2.	2.861	3x3.0x3.0	2 x 11.80	RCC Box on precast pile	New Construction
3.	11.643	4x25.0	2 x 11.80	Steel Composite Girder on bored pile foundation	New Construction (Lamha Canal crossing)
On Connector - 1					
1.	0.285	2x3.0x3.0	2 x 11.80	RCC Box on precast pile foundation	New Construction
2.	0.306	2x3.0x3.0	2 x 11.80	RCC Box on precast pile foundation	New Construction
3.	0.825	2x3.0x3.0	2 x 11.80	RCC Box on precast pile foundation	New Construction
4.	1.500	1x25.0	2 x 11.80	Steel Composite Girder on bored pile foundation	New Construction (Lamha Canal crossing)
5.	1.610	2x3.0x3.0	2 x 11.80	RCC Box on precast pile foundation	New Construction
On Connector - 2					
1.	0.275	2x3.0x3.0	1x13.00	RCC Box on precast pile foundation	New Construction
2.	0.900	2x3.0x3.0	1x13.00	RCC Box on precast pile foundation	New Construction
3.	1.300	1x25.0	1x13.00	Steel Composite Girder on bored pile foundation	New Construction (Lamha Canal crossing)
4.	1.370	2x3.0x3.0	1x13.00	RCC Box on precast pile foundation	New Construction
On Connector - 3					

Sl. No.	Design Chainage (Km)	Span Arrangement (m)	Structure Width (m)	Structure Type	Remarks
1.	0.675	1x25.0	1x13.00	Steel Composite Girder on bored pile foundation	New Construction (Lamha Canal crossing)
On Connector - 4					
1.	1.512	2x3.0x3.0	2 x 11.80	RCC Box on precast pile foundation	New Construction

Table 0-23: Improvement Proposal for Bridges

Sl. No.	Design Chainage (Km)	Span Arrangement (m)	Structure Width (m)	Structure Type	Remarks
On Main Alignment					
1.	0.676	1x1.5x2.0	1x27.6	RCC Box	Re Construction
2.	1.110	1x1.5x2.0	1x27.6	RCC Box	New Construction
3.	1.510	1x3.0x3.0	1x27.6	RCC Box on precast pile foundation	New Construction
4.	1.716	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
5.	1.939	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
6.	2.047	1x3.0x3.0	2 x 13.00	RCC Box on precast pile foundation	New Construction
7.	2.620	1x3.0x3.0	2 x 13.00	RCC Box on precast pile foundation	New Construction
8.	3.184	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
9.	3.395	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
10.	3.620	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
11.	3.853	1x3.0x3.0	2 x 13.00	RCC Box on precast pile foundation	New Construction
12.	4.209	1x1.5x2.0	2 x 13.00	RCC Box	New Construction

Sl. No.	Design Chainage (Km)	Span Arrangement (m)	Structure Width (m)	Structure Type	Remarks
13.	4.585	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
14.	4.794	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
15.	5.135	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
16.	5.585	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
17.	6.070	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
18.	6.542	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
19.	6.990	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
20.	7.419	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
21.	7.815	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
22.	8.127	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
23.	8.351	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
24.	8.700	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
25.	8.970	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
26.	9.151	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
27.	9.500	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
28.	9.657	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
29.	10.140	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
30.	10.450	1x1.5x2.0	2 x 13.00	RCC Box	New Construction

Sl. No.	Design Chainage (Km)	Span Arrangement (m)	Structure Width (m)	Structure Type	Remarks
31.	10.873	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
32.	11.207	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
33.	11.500	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
34.	11.900	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
35.	12.175	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
36.	12.765	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
37.	13.085	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
38.	13.453	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
39.	14.133	1x3.0x3.0	2 x 13.00	RCC Box on precast pile foundation	New Construction
40.	14.328	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
41.	14.647	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
42.	14.917	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
43.	15.282	1x1.5x2.0	2 x 13.00	RCC Box	New Construction
On Connector - 1					
1.	1.243	1x1.5x2.0	1 x 24.40	RCC Box	New Construction
2.	1.420	1x3.0x3.0	1 x 24.40	RCC Box on precast pile foundation	New Construction
3.	1.550	1x1.5x2.0	1 x 24.40	RCC Box	New Construction
On Connector - 2					
1.	0.292	1x3.0x3.0	1 x 24.40	RCC Box on precast pile foundation	New Construction

Sl. No.	Design Chainage (Km)	Span Arrangement (m)	Structure Width (m)	Structure Type	Remarks
2.	1.830	1x1.5x2.0	1x13.00	RCC Box	New Construction
3.	2.025	1x1.5x2.0	1x13.00	RCC Box	New Construction
4.	2.295	1x1.5x2.0	1x13.00	RCC Box	New Construction
5.	2.575	1x1.5x2.0	1x13.00	RCC Box	New Construction
6.	2.736	1x1.5x2.0	1x13.00	RCC Box	New Construction
7.	2.878	1x1.5x2.0	1x13.00	RCC Box	New Construction
8.	3.488	1x3.0x3.0	1x13.00	RCC Box on precast pile foundation	New Construction
On Connector - 3					
1.	0.246	1x3.0x3.0	1x13.00	RCC Box on precast pile foundation	New Construction
2.	0.715	1x3.0x3.0	1x13.00	RCC Box on precast pile foundation	New Construction
3.	1.100	1x1.5x2.0	1x13.00	RCC Box	New Construction
4.	1.380	1x1.5x2.0	1x13.00	RCC Box	New Construction
5.	1.808	1x1.5x2.0	1x13.00	RCC Box	New Construction
6.	2.237	1x1.5x2.0	1x13.00	RCC Box	New Construction
On Connector - 4					
1.	0.140	1x1.5x2.0	1 x 24.40	RCC Box	New Construction
2.	0.523	1x1.5x2.0	1 x 24.40	RCC Box	New Construction
3.	0.710	1x1.5x2.0	1 x 24.40	RCC Box	New Construction
4.	0.922	1x1.5x2.0	1 x 24.40	RCC Box	New Construction

Table 0-24: Improvement Proposal for Culverts

Beside above additional culverts on cross roads, siphon aqueduct on canal crossing and longitudinal culvert at the median of separated road has been proposed as listed in Table 7-25.

Sl. No.	Design Chainage (Km)	Span Arrangement (9m)	Structure Width (m)	Structure Type	Remarks
1.	0.120	1x1.5x2.0	2 x 10.00	RCC Box	Culvert on cross road (on both side)
2.	0.450	1x1.5x2.0	10.00	RCC Box	Culvert on cross road
3.	0.550	1x1.5x2.0	2 x 10.00	RCC Box	Culvert on cross road (on both side)
4.	0.608	1x1.5x2.0	10.00	RCC Box	Culvert on cross road
5.	0.890	1x1.5x2.0	10.00	RCC Box	Culvert on cross road
6.	1.680	1x1.5x2.0	10.00	RCC Box	Culvert on cross road
7.	2.861	1x3.0x3.0	10.00	RCC Box on precast pile foundation	Siphon aqueduct on canal crossing
8.	4.100	1x3.0x3.0	20.00	RCC Box on precast pile foundation	Culvert on road for u-turn
9.	5.800	1x3.0x3.0	20.00	RCC Box on precast pile foundation	Culvert on road for u-turn
10.	6.900	1x3.0x3.0	20.00	RCC Box on precast pile foundation	Culvert on road for u-turn
11.	8.500	1x3.0x3.0	20.00	RCC Box on precast pile foundation	Culvert on road for u-turn
12.	9.300	1x3.0x3.0	20.00	RCC Box on precast pile foundation	Culvert on road for u-turn
13.	11.000	1x3.0x3.0	20.00	RCC Box on precast pile foundation	Culvert on road for u-turn
14.	14.000	1x3.0x3.0	20.00	RCC Box on precast pile foundation	Culvert on road for u-turn
15.	15.350	1x3.0x3.0	20.00	RCC Box on precast pile foundation	Culvert on road for u-turn

Table 0-25: Other Structures

Bridge Deck Configuration: The details of carriageway width, overall width and width of other components of bridge structures are as mentioned below:

Sl. No.	Section	Carriageway Width (m)	Deck Width (m)
1.	Main Alignment in Built-up Area	<u>For Bridge:</u>	[7.2 +2.4 (outer shoulder) + 2 x 0.5 (crash barrier)] (Left R/w) +

Sl. No.	Section	Carriageway Width (m)	Deck Width (m)
		7.2 (left C/w) + 7.2 (right C/w)	[7.2 +2.4 (outer shoulder) + 2 x 0.5 (crash barrier)] (Right R/w) = 2 x 10.6
		<u>For Culvert:</u> 7.2 (left C/w) + 7.2 (right C/w)	Width as per overall width of adjacent embankment; but not less than 25.60.
2.	Main Alignment in Green Field	<u>For Bridge:</u> 7.2 (left C/w) + 7.2 (right C/w)	[7.2 +2.4 (outer shoulder) + 1.2 (inner shoulder) + 2 x 0.5 (crash barrier)] (Left R/w) + [7.2 +2.4 (outer shoulder) + 1.2 (inner shoulder) + 2 x 0.5 (crash barrier)] (Right R/w) = 2 x 11.80
		<u>For Culvert:</u> 7.2 (left C/w) + 7.2 (right C/w)	Width of left embankment + Width of right embankment; but not less than 2 x 11.8
3.	Connector 1 & 4 in Green Field	<u>For Bridge:</u> 7.2 (left C/w) + 7.2 (right C/w)	[7.2 +2.4 (outer shoulder) + 2 x 0.5 (crash barrier)] (Left R/w) + [7.2 +2.4 (outer shoulder) + 2 x 0.5 (crash barrier)] (Right R/w) = 2 x 10.6
		<u>For Culvert:</u> 7.2 (left C/w) + 7.2 (right C/w)	Width as per overall width of adjacent embankment; but not less than 24.40.
4.	Connector 2 & 3 in Green Field	<u>For Bridge:</u> 7.2	[7.2 + 2 x 2.4 (outer shoulder) + 2 x 0.5 (crash barrier)] = 13.00
		<u>For Culvert:</u> 7.2	Width as per overall width of adjacent embankment; but not less than 13.00.

Table 0-26: Deck Configuration- Carriageway Width / Deck Width

0.7.12 Proposal for Road side Drainage

Adequate provisions have been made for road side drainage system.

- I. In built-up areas concrete covered drains have been proposed. These will be rectangular in cross section. Walls and bottom slab shall be of RCC M-20 and monolithically cast. The top cover of the drain shall be cast in situ with M-25 concrete. There will be provisions of Man hole for cleaning at regular interval of 25m. The depth

- of drains shall be 2.0m (average). At every 10 m interval drain off the road water through grit chamber to RCC drain.
- II. Open earthen drains have been proposed on both sides of the roads passing through green field/cane field area. Top and bottom width of the drain has been proposed as 6.0m to 2.0 m and depth will be 1.0m with slope 2H:1V. The earthen drain shall be located at least 10m away from toe of embankment. Drain water will be collected nearby culvers/drain and drain off from median.
 - III. Open earthen drain has been proposed in central depressed median on the main alignment passing through green field/cane field area. Top and bottom width of the drain has been proposed as 6.0m to 2.0 m and depth will be 1.0m (average). The earthen drain shall be located at least 10m away from toe of embankment. Drain water will be collected nearby culvers/drain and drain off from side drain.
 - IV. Stone pitched drain has been proposed on LHS from Railway Embankment Road km 0/400 to km 1/100 on Ogle airport road. Top and bottom width of the drain has been proposed as 6.0m to 2.0 m and depth will be 2.0m (av).

0.7.13 Bus Bay cum Bus Shelter

Provision of public facility is an important aspect to ensure safety of pedestrian and through traffic plying on the road. Bus bay facilitates the bus to stop away from through traffic lane and shelter ensures passengers protection during rains & hot sun. Bus bays cum bus shelters have been proposed on as per project requirement, initially on two locations at start of project road and another near intersection near Ogle Airport road.

0.7.14 Road Safety and Appurtenances

➤ Metal Beam Crash Barrier

Single faced metal beam crash barrier has been proposed at locations where embankment height is above 3.0m from natural ground level on roadway edges.

➤ Crash Barrier

- The concrete crash barriers have been provided on all the bridges and box culverts structures.

0.7.15 Road Signs

Traffic Signs speak language of the road and required for guidance of motorists on the highway. Traffic Signs installed at appropriate locations on the highway controls the motorists driving behaviors on the road. Therefore traffic signs are essential to be placed to enhance safety on

highways. The following provisions have been proposed as per Manual on Uniform Traffic Control Devices (MUTCD-2009 Edition).

It is proposed to provide traffic signs on Main Alignment and Connectors as follows:

- **Regulatory Sign**
- **Warning Signs**
- **Object Markers**
- **Conventional Road Guide Signs**
- **General Service Signs Sizes**

0.7.16 Road Markings

Road markings are also language of road and interact with road users for information and guidance. The co-ordination of pavement markings with road signs is essential to convey definite message to road user and enhance overall safety on the road.

The following type of road marking would be provided using road paints as per Manual on Uniform Traffic Control Devices (MUTCD-2009 Edition):

- Yellow Center Line Pavement Marking and Warrants as per section 3B.01 of MUTCD
- No- Passing Zone Pavement Markings and Warrants as per section 3B.02 of MUTCD
- Other Yellow Longitudinal Pavement Markings as per section 3B.03 of MUTCD
- White Lane Line Pavement markings and Warrants as per section 3B.04 of MUTCD
- Other White Longitudinal Pavement Markings as per section 3B.05 of MUTCD
- Edge Line Markings as per section 3B.06 of MUTCD
- Warrants for Use of Edge Lines as per section 3B.07 of MUTCD
- Extension Through Intersections as per section 3B.08 of MUTCD
- Lane –Reduction Transition Markings as per section 3B.09 of MUTCD
- Approach Markings for Obstruction as per section 3B.10 of MUTCD
- Raised Pavement Markers-General as per section 3B.11 of MUTCD
- Transverse Markings as per section 3B.15 of MUTCD
- Stop and Yield Lines as per section 3B.16 of MUTCD
- Do Not Block Intersection Markings as per section 3B.17 of MUTCD

- Crosswalk Markings as per section 3B.18 of MUTCD
- Pavement Word, Symbol and Arrow Markings as per section 3B.20 of MUTCD
- Speed Measurement Markings as per section 3B.21 of MUTCD
- Speed Reduction Markings as per section 3B.22 of MUTCD
- Curb markings as per section 3B.23 of MUTCD
- Chevron and Diagonal markings as per section 3B.24 of MUTCD
- Speed Hump Markings as per section 3B.25 of MUTCD
- Direction arrows/ stop lines at the junctions
- Bus-bay / lane and hazard marking/lane divider marking at the respective locations
- Zebra Crossings at pedestrian crossing locations
- Curb painting have been provided at both side of median Curb

0.7.17 Traffic Signals

Road Signal provisions would be made on at-grade intersections for safe turning movement of intersections. The Signals would be designed and installed as per section 4B of Manual on Uniform Traffic Control Devices (MUTCD-2009 Edition).

0.7.18 Gantry Mounted Road Signs

Gantry sign are Full/Cantilever is proposed to be installed on all intersections and U-Turn.

0.7.19 Highway Lighting and High Mast Light

Highway Street Lighting is proposed at Built-up area in median as per Typical Cross Section A & B for main alignment and Connectors (1 & 4). The total length of street lighting is 5.095 km shown in typical cross sections and High masts light have been provided at Major Junctions such as East Coast Road Junction, Railway Embankment Road Junction, Ogle Airport Road Junctions, Joining of all Connectors (4 Nos.) and U- turn locations (7 nos.).

0.8 Environmental and Social Impact Assessment Screening (Scoping Report)

0.8.1 A separate report on Environmental and Social Impact Assessment Screening (Scoping Report)

This will be prepared in collaboration with EPA and submitted as part of the feasibility report. MoPI has to forward it to EPA for further approval and finalization of scope.

The Project will hardly affect the environment because most of the construction work will be carried out in GUYSUCO abandoned fields, However, considering that part of the water in the EDWC where the road will be passing through and the fact that is used as a source of drinking

water, the Project should consider frequent monitoring of the EDWC near the project site. The socioeconomic aspect of the project seems to be on the positive side, thus, we recommend that EPA Authorization be granted since the negative Social Impacts (SI) would be minimal requiring negligible input of the Social Impact Assessment (SIA).

0.9 Preliminary Cost Estimate

0.9.1 Rate Analysis

The Consultant has requested Ministry of Public Infrastructure for providing schedules of rates of Government of Guyana on different occasions vide by means of meetings and through officials communications also. However, it was informed by Ministry of Public Infrastructure that Standard Schedule of Rates has not been published as it is not a standard practice followed in Guyana.

The Rate Analysis for different items of construction have been carried out using methodology described in Standard Data Book for Analysis of Rates for Roads and Bridges published by Indian Roads Congress for Ministry of Road Transport and Highways Government of India. All Project Cost Estimates are prepared utilizing guidelines provided in this Standard Data Book for Highway sector in India.

The Different components of construction cost include cost of machinery, labour and materials. Cost of machinery w.r.t. output rates are predefined as per standard data book taking into account for efficiency, fuel, labour etc. The Equipment Cost indices are generally equivalent all around the World; accordingly the same has been adopted for rate analysis. The rates of labour are taken from the Official Gazette (Legal Supplement – B) for minimum wages in Guyana. The rates of materials are obtained from different suppliers in Georgetown

Further, the Consultant has requested Ministry of Public Infrastructure for providing unit rates for different road construction items quoted by construction contractors in recent past. Accordingly, the MPI has provided Bill of Quantities of five contractors.

S. No.	Description	Unit	Rates for (in US \$) (1 US \$ = 210 GUY \$)					
			RITES Rate	Hugh Ghani Park East Coast Demerara Region 4	Dennis Street George town	Duncan Street	UG Parallel Road	Middleton Street
A	Length	km	25.3	0.707	0.4	1.07	0.85	0.2
B	Carriageway Width	m	14.4 & 7.2	3.66	4.27	6.1	4.27	6.1

C	Total Project Cost in million US \$			0.11	0.24	0.56	0.36	0.33
D	Construction Items							
1	Scarification / Planting	cum	1.0	1.43	-	1.43	-	-
2	Roadway Excavation	cum	1.0	-	1.43	1.43	2.38	1.43
3	Aggregate Base	cum	98.0	104.76	95.24	95.24	95.24	95.24
4	Tack Coat	sqm	1.0	1.43	1.43	1.43	1.43	1.43
5	Asphaltic Concrete	cum	298.0	261.90	595.24	595.24	595.24	595.24
6	Cleaning and Shaping of Existing Ditches	m	1.0	1.19	1.43 & 3.33	1.43	1.43	-
7	Solid Centre Line Markings	m	9	-	-	9.52	9.52	9.52
8	Stop Sign R1-1 (600 mm x 600 mm)	No.	250	-	238.10	238.10	238.10	238.10
9	One Way R6-2 (600 mm x 600 mm)	No.	250	-	238.10	-	-	-
10	Do not Enter R5-1	No.	250	-	238.10	-	-	-
11	Structural Concrete with M 30	cum	267.0	-	-	-	-	285.71
12	Cleaning and Shaping Existing Ditches	m	1.0	-	-	-	-	1.43
13	Structural Concrete Grade 40	cum	270	-	285.71	-	-	-
14	Painting of Existing and New Culvert Headwalls	sqm	10	-	-	-	-	12.38
15	Steel Reinforcement for Bridge Deck, Approach Slab, Pile Caps, Abutment Retaining Wall, Wing Wall, Pedestrian Barrier Posts, Pedestrian Barrier Curb, Concrete Barrier Curb, Concrete Barrier Beam,	kg	1.5	-	-	-	1.67	-

Concrete Barrier Posts, Concrete Barrier Ends							
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As shown above, the units' rates of various construction items calculated as per Standard Data Book MoRTH, GOI methodology are at par with the rate quoted by the Contractors in the Georgetown.

0.9.2 Summary of Preliminary Project Cost

The preliminary cost estimate has been determined. The quantities of various items of works has been estimated and multiplied by rates to arrive at preliminary project cost.

<i>Description of Items</i>	Amount (US \$)
Site Clearance	281,101
Earthwork	26,227,618
Sub-base & Base Courses	22,844,522
Bituminous Courses	9,806,519
Bridges & Structure	24,768,027
Drainage & Protective Works	1,347,780
Improvement of Junctions	6,605,817
Traffic Signs and Road Appurtenances	1,686,681
Road Side Amenities	1,24660
Slope Turfing	7,54660
Lighting	1,46,999
Diversions	1,07,400
Total	94,701,665
10% of total cost for Miscellaneous Item (US\$)	9,470,166
Grand Total	104,171,831
Total Project Cost US Dollar (US\$) 104 Million	

Table 0-27: Summary of Preliminary Project Cost

0.8 Proposed ESHS management measures and monitoring programs

Topic	Potential Impact	Phase	Mitigation and management measures	Execution responsibility	Verification (as necessary)	Monitoring and Reporting
Climate	Air Quality	Construction	Ensure construction vehicles and equipment are properly maintained. Limit idling for construction vehicles. Use water spray trucks for dust suppression.	Construction Contractor	Site Inspection by a third party	Daily inspection reports and corrective action directives
Soils	Erosion	Construction	Schedule construction activities to avoid periods of heavy rainfall; contour and minimize length and steepness of slopes; employ silt fencing as necessary.	Construction Contractor	Site Inspection by a third party	Daily inspection reports and corrective action directives
Noise	Noise, vibration	Construction	Limit idling of construction vehicles and equipment. Limit construction activities to daylight hours.	Construction Contractor	Site Inspection by a third party	Daily inspection reports and corrective action directives
Livelihoods	Economic displacement	Construction/ Operation	When details of the Program interventions in Project area become available, develop a Livelihood Restoration Plan (LRP) identifying all potentially affected individuals and businesses, and establishing measures for avoidance, compensation, and/or restoration activities as required. Incorporate requirements for local Employment in construction and maintenance contracts.	Borrower/ Executing Agency	Inspection/assessment by a third party	Monitoring of LRP indicators by third party
Transportation	Traffic Circulation, parking	Construction/ Operation	Develop a Traffic Management Plan for the Program Area. The plan may include methods for notification due to road closure, scheduling of deliveries to avoid peak traffic hours, identification of preferred transport routes, and measures to limit congestion and parking.	Construction Contractor/ Ministry of Transport		Monthly inspection and corrective action directives

Topic	Potential Impact	Phase	Mitigation and management measures	Execution responsibility	Verification (as necessary)	Monitoring and Reporting
Drainage	Increased effluent loads, increased blockage of canals	Construction/ Operation	Consider implementation of a drainage canal maintenance program as part of the Program intervention to maintain maximum capacity of canals. Consider implementation of a community-wide solid waste management program to reduce the amount of waste in drainage canals. Ensure proper management of Program-generated wastes. Reduce Program-related risk of erosion and sedimentation that could compromise drainage canal integrity.	Borrower/Ministry of Public Infrastructure/ Neighborhood Democratic Councils/Construction Contractor/		Daily inspection and corrective action directives
Public Spaces and Facilities	Restricted access	Construction/ Operation	Implement an access management plan that maintains spaces for critical community facilities for pedestrians and vehicles through careful sequencing of construction activities.	Construction Contractor		Monthly inspection reports and corrective action directives
Utilities	Interrupted service	Construction	Provide advance notification of any planned interruptions to water and power service as a part of construction activities. If interruptions are of more than momentary duration, provide alternative water and power sources.	Construction Contractor		Daily inspection reports and corrective action directives
Waste	Waste Generation	Construction	Develop and implement a Waste Management Plan that outlines appropriate handling, storage and disposal protocols for solid, hazardous and human wastes.	Construction Contractor	Site Inspection by a third party	Daily inspection reports and corrective action directives

Topic	Potential Impact	Phase	Mitigation and management measures	Execution responsibility	Verification (as necessary)	Monitoring and Reporting
Hazardous Materials	Environmental Contamination	Construction	Provide adequate secondary containment for fuel storage tanks. Use impervious surfaces for refueling areas and other fluid transfer areas. Provide portable spill containment and cleanup equipment on site. Prepare plans and procedures to respond to the discovery of contaminated media to minimize or reduce risks to health, safety and the environment.	Construction Contractor	Site Inspection by a third party	Daily inspection reports and corrective action directives

Table 0-28 - Proposed ESHS management measures and monitoring program

**Consultancy Services for Preparation of Detail Project Report for
Construction of East Bank (Diamond) - East Coast (Ogle) Road Linkage Project,
Georgetown (Guyana)**

