SECTION V

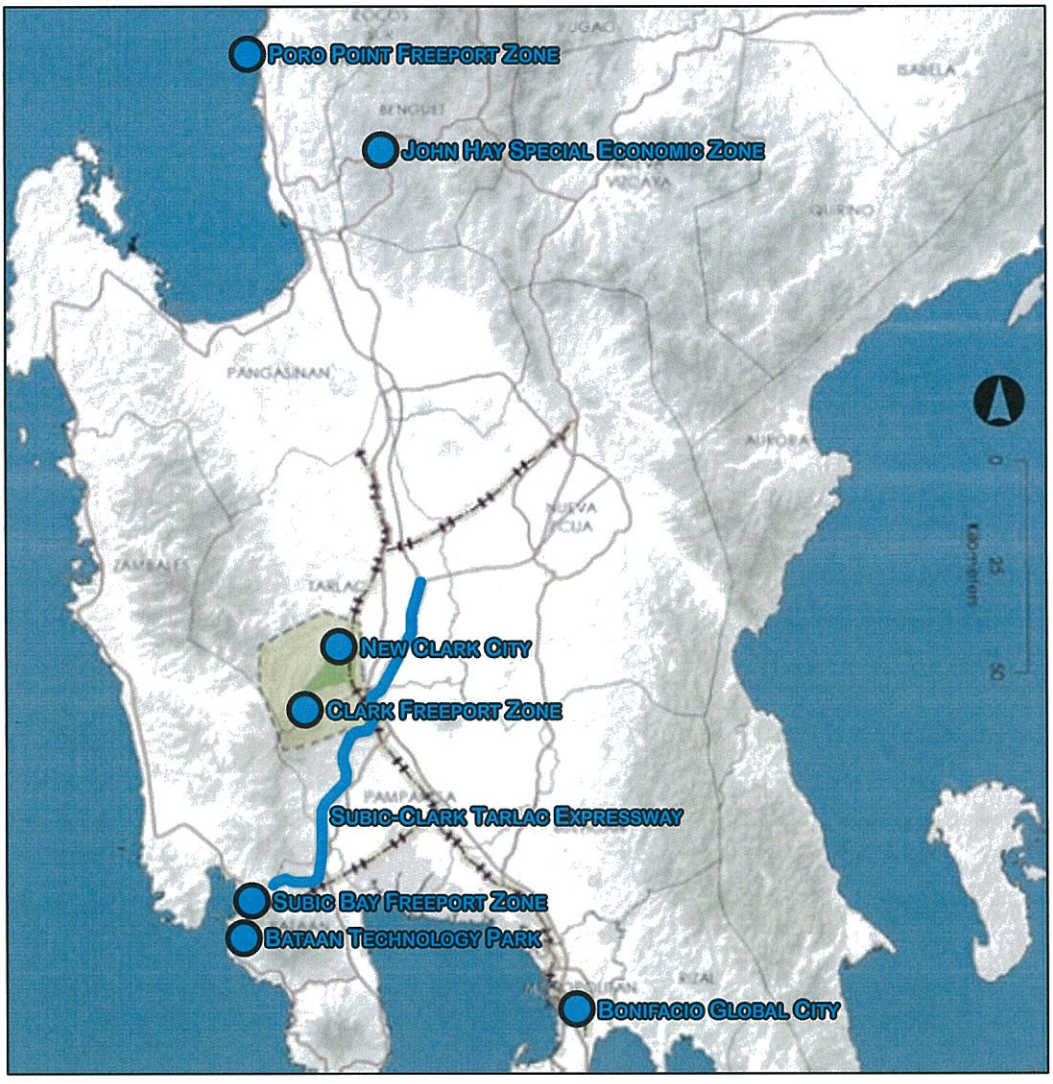
TERMS OF REFERENCE

1. BACKGROUND

1.1. ***BCDA Mandate.*** The Bases Conversion and Development Authority (BCDA) is a government instrumentality vested with corporate powers under Republic Act (RA) 7227 (*Bases Conversion and Development Act of 1992*), signed into law by former President Corazon C. Aquino last 13 March 1992. The BCDA Charter was amended by RA 7917 in 1995, and further amended by RA 9400 in 2007. RA 7227 declared the policy of the government to accelerate the sound and balanced conversion into alternative productive uses of the Clark and Subic military reservations and their extensions covered under the *1947 Military Bases Agreement (MBA)* between the Philippines and the United States (US).

1.2. ***BCDA Economic Zones and Properties.*** BCDA has proven to be one of the most successful government agencies in attracting investments, creating jobs for the community, and upholding proper stewardship and honest governance. This it does as it builds integrated developments, dynamic business centers, and vibrant communities within the former military reservations. With their unique and distinct features, the BCDA-administered economic zones remained to be among the country's prime investment locations (Figure 1).

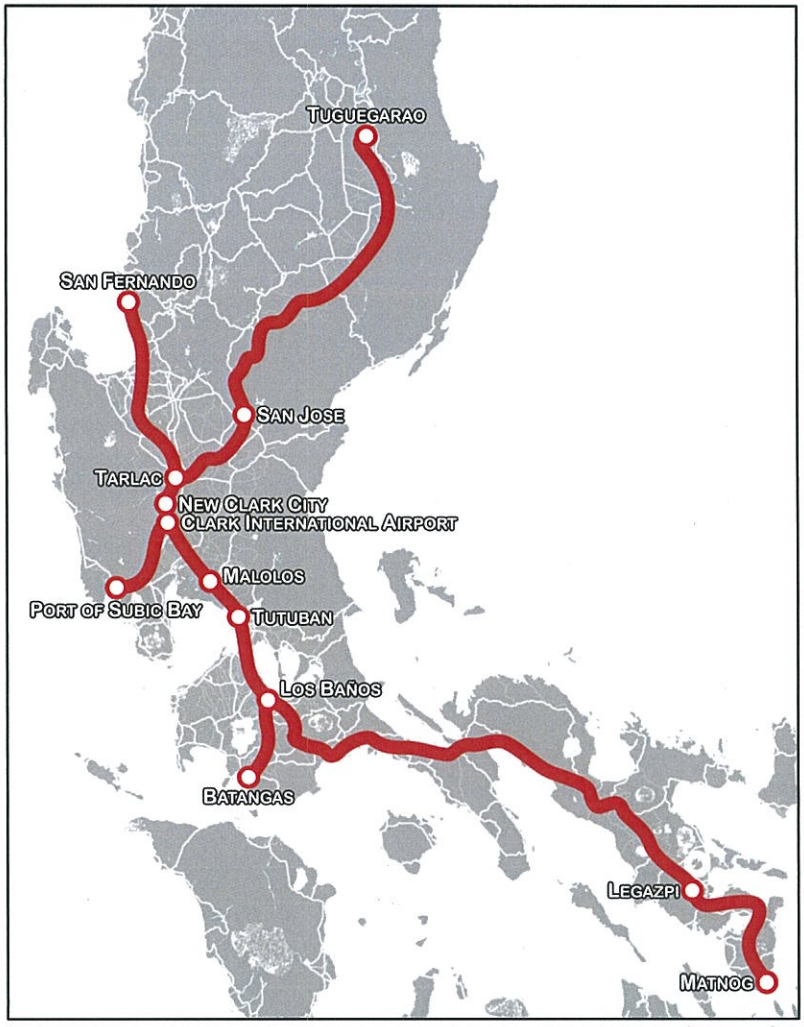
FIGURE 1. BCDA-ADMINISTERED ECONOMIC ZONES AND PROPERTIES



1.3. ***BCDA Projects.*** BCDA engages in public-private partnerships (PPPs) to push forward vital public infrastructure such as tollways, has successfully developed economic centers such as airports, seaports, and also major real estate developments. Driven by the values of integrity, excellence, and stewardship, it completed the world-class Subic-Clark-Tarlac Expressway (SCTEX), developed Bonifacio Global City (BGC) in Taguig City (Metro Manila) into the new modern financial and central business district, and is currently engaged in building the country's new metropolis, New Clark City (NCC).

1.4. ***Subic-Clark Railway Project.*** The Subic-Clark Railway Project (SCRP) forms part of the supporting infrastructure of BCDA's program of promoting the economic and social development of Central Luzon in particular and the Philippines in general, through the sound and balanced conversion into alternative productive uses of former military reservations and their extensions. SCRP is a component of Philippine National Railways (PNR) Luzon System Development Framework (Figure 2 and Table 1). It is a 71-km freight railway (Figure 3) connecting Subic Bay Freeport Zone (SBFZ) and Clark Freeport Zone (CFZ), providing a railway link between the Port of Subic Bay (PSB) and Clark International Airport (CRK). Eventually, the railway will accommodate passenger service and will be extended to NCC.

FIGURE 2. PNR LUZON SYSTEM DEVELOPMENT FRAMEWORK



SOURCE: DOTR

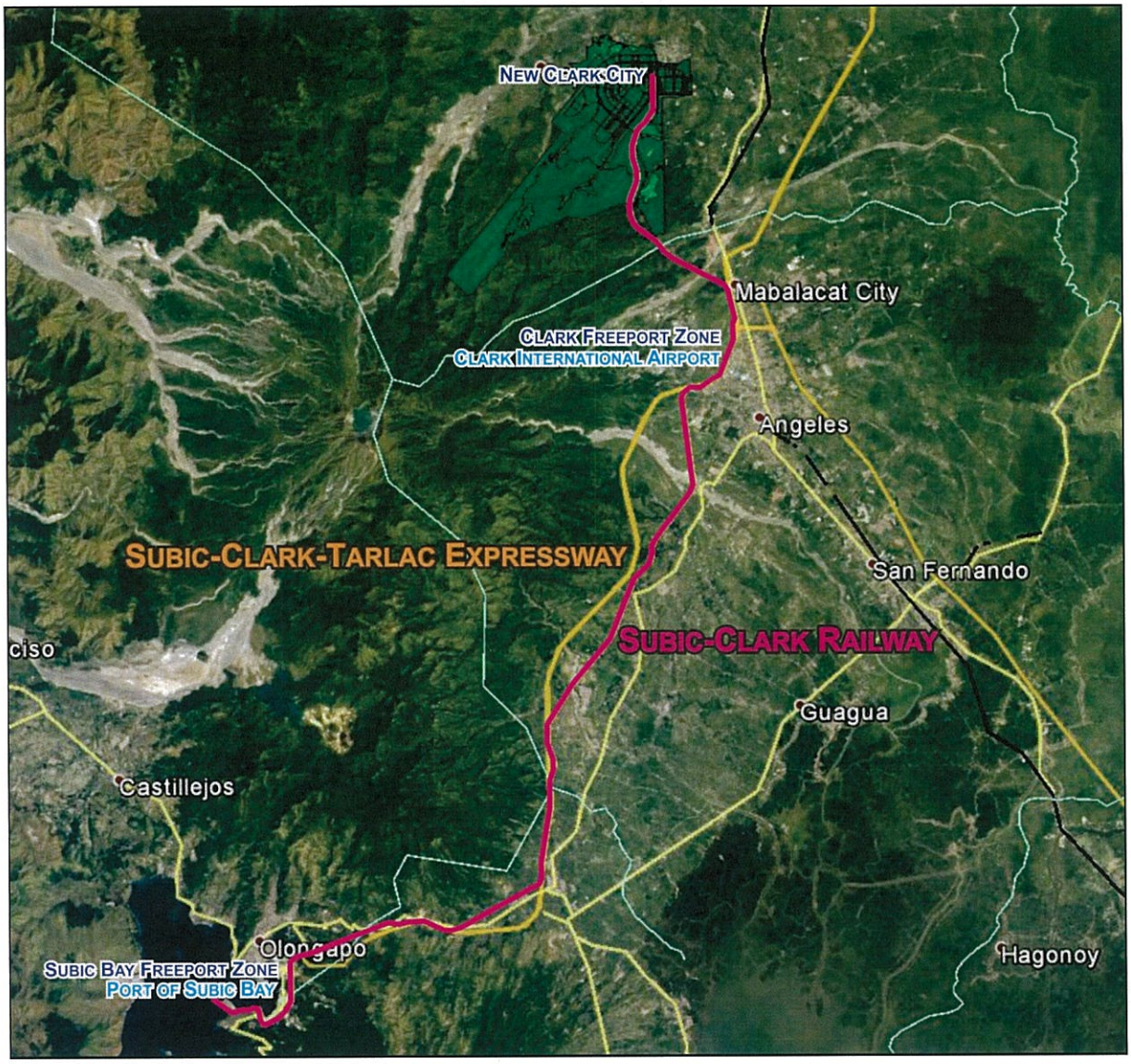
SOURCE: DOTR

TABLE 1. PNR LUZON SYSTEM DEVELOPMENT FRAMEWORK

Line		Alignment	Length (km)
PNR North	PNR North Commuter 1 (aka NSCR Phase 1)	Tutuban-Malolos	38
	PNR North Commuter 2 (aka CMRP)	Malolos-CRK-NCC	69
	PNR North Long Haul	NCC-Tarlac-San Fernando	159
		Tarlac-San Jose-Tuguegarao	309
	Subic-Clark Railway	PSB-CRK-NCC	85
PNR South	PNR South Commuter (aka NSCR Phase 2)	Tutuban-Los Baños	72
	PNR South Long Haul	Los Baños-Legazpi	406
		Legazpi-Matnog	117
		Los Baños-Batangas	58

SOURCE: DOTR

FIGURE 3. SUBIC-CLARK RAILWAY PROJECT



MAP SOURCE: GOOGLE EARTH

1.5. ***SCRP Project Objectives.***

1.5.1. ***Logistics Hub.*** To develop the necessary infrastructure network that would promote the Central Luzon Corridor as a total logistics hub, boosting industrial and commercial activities.

1.5.2. ***Connectivity and Mobility.*** To complement the development of the Luzon Railway System and provide freight and passenger interoperability with PNR Manila-Clark, Manila-Bicol/Sorsogon, and Manila-Batangas.

1.5.3. ***Investing in the Regions.*** To attract investments and spur economic activities outside of Metro Manila.

1.5.4. ***Decongesting Manila.*** To reduce congestion in the Port of Manila and cargo traffic in Metro Manila.

1.6. ***SCRP Implementation.*** SCRP will be a joint undertaking of the Department of Transportation (DOTr) and BCDA. Funding for the Project will be Official Development Assistance (ODA) from China (85% of the project cost) and through General Appropriations Act (GAA) allocations (15% of the project cost).

1.7. ***SCRP ROW Acquisition.*** Except for the alignment within SBFZ and CFZ, the Project will traverse through private properties, mostly farm lots. Delays in infrastructure projects are generally attributed to delays in the right-of-way (ROW) acquisition. Hence, there is a need to start this activity at the earliest time possible if construction for SCRP is to start in 2019. The DOTr had allocated from its FS Fund for the preliminary works for the ROW acquisition of SCRP, including the securing of Environmental Compliance Certificate (ECC) for the Project.

2. Description of the Consulting Services

The Consulting Services are for the Advance Preliminary Works of SCRP, which will mainly involve the acquisition of the ROW for SCRP and the securing of the ECC for the Project, hereinafter referred to as the "Works". The Works include: (a) the conduct of topographic/hydrographic and geological/geotechnical surveys in order to firm up the metes and bounds of the ROW to be acquired, (b) census of affected persons, structures, and crops/trees, (c) preparation of documents needed in securing the ECC for the Project, including Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS), and Environmental Management Plan (EMP) for the Project, (d) land appraisal of ROW to be acquired, and (e) parcellary survey including the subdivision of affected lots and its approval by the Department of Environment and Natural Resources (DENR). Data on affected lot parcels will be provided by DOTr.

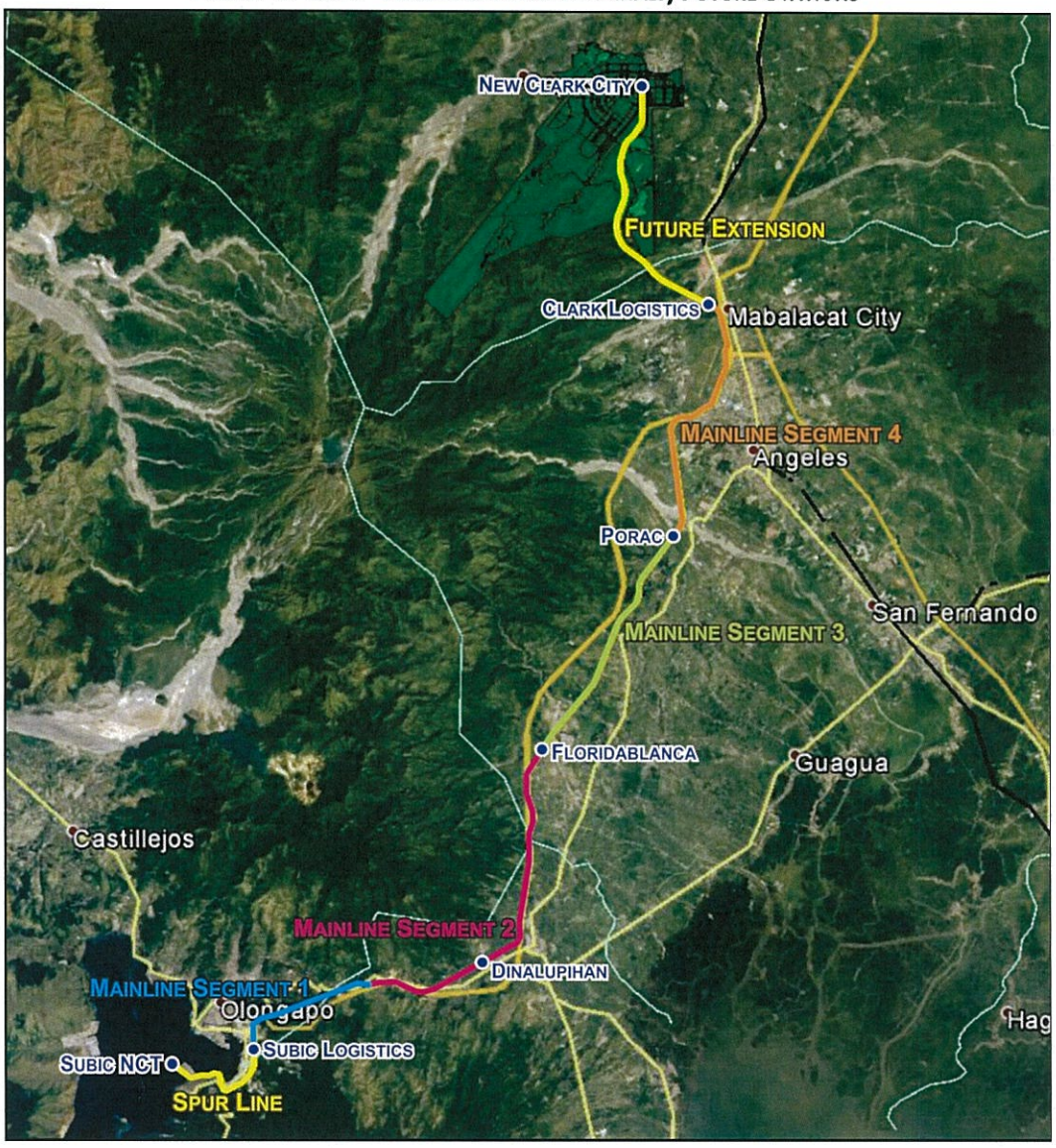
3. Objectives of the Works

The main objectives of the Works are (a) to firm up the metes and bounds of the ROW to be acquired and start acquisition early, and (b) to secure the ECC for the Project. The Consultant for the Works, hereinafter simply referred to as the "Consultant", will perform the Works as described above.

4. Description of the Railway

4.1. ***Alignment.*** The alignment is 71.13 kilometers long and is located in the western section of Central Luzon running on an exclusive ROW parallel to SCTEX with some sections adjacent to it (Figure 4). It is divided into two (2) major sections:

FIGURE 4. SCRP ALIGNMENT AND TERMINALS/FUTURE STATIONS



MAP SOURCE: GOOGLE EARTH

4.1.1. ***Mainline.*** This is a 64.19-km single track railway connecting SBFZ and CFZ and serves as the backbone of the railway system. The alignment starts at Subic Logistics Terminal in SBFZ and ends at Clark Logistics Terminal in CFZ. Between the two (2) terminals, it will run across Dinalupihan (Bataan), Floridablanca (Pampanga), and Porac (Pampanga). It is divided into four (4) segments (measured as end-of-track distances):

a. *Mainline Segment 1* – Subic Logistics Terminal to Dinalupihan Portal of Tipo Tunnel (10.30 kilometers),

b. *Mainline Segment 2* – Dinalupihan Portal of Tipo Tunnel to Floridablanca Station and Passing Loop (22.20 kilometers),

c. *Mainline Segment 3* – Floridablanca Station and Passing Loop to Future Porac Station (15.60 kilometers), and

d. *Mainline Segment 4* – Future Porac Station to Clark Logistics Terminal (16.09 kilometers).

4.1.2. ***Spur Line.*** This is a 6.94-km single track railway connecting the PSB New Container Terminals (NCTs) to the Mainline. From the Subic Logistics Terminal, the alignment will pass underneath Cubi Point towards the PSB NCTs, which are located just across Runway 07/25 of Subic Bay International Airport (SFS).

4.2. ***Railway Configurations.*** SCRP will utilize three (3) major railway configurations along its alignment: (a) at-grade (cut or embankment), (b) elevated (bridge or viaduct), and (c) depressed (tunnel or cut-and-cover) (Table 2).

TABLE 2. SCRP RAILWAY CONFIGURATION

	Total Length (km)					
	Mainline Segment				Spur	
Configuration	1	2	3	4	Line	Total
At-Grade	2.90	19.00	11.20	11.79	4.94	**49.83**
Elevated		3.20	4.40	4.30		**11.90**
Depressed	7.40				2.00	**9.40**
Total	**10.30**	**22.20**	**15.60**	**16.09**	**6.94**	**71.13**

4.2.1. ***At-Grade Configuration.*** 49.83 kilometers of cut and embankment sections will be constructed along the alignment. Majority of these at-grade sections can be found in Segment 2 of the Mainline (19.00 kilometers) where the topography is flat (Dinalupihan flatlands). Segment 3 and Segment 4 also have considerable at-grade sections, 11.20 kilometers and 11.79 kilometers, respectively.

4.2.2. ***Elevated Configuration.*** 11.9 kilometers of bridges/viaducts, particularly between Mainline Segments 2 to 4, will be constructed along the alignment to traverse major river systems and land depressions. The viaduct section in CFZ will use slab track to minimize vertical height requirements which may affect aerodome clearances of CRK. The alignment will cross several rivers, including major river systems, namely: (a) Pinulot River in Dinalupihan, together with Cui River, (b) Gumain River in Floridablanca, and (c) Pasig-Potrero River in Porac. Waterways, including land depressions along the alignment, will require construction of bridges and culverts.

4.2.3. ***Depressed Configuration.*** Two (2) tunnels in SBFZ will be constructed to traverse the rolling terrain at the base of Bataan Mountain Ranges: (a) Tipo Tunnel (7.40 kilometers) in Segment 1 of the Mainline, and (b) Cubi Point Tunnel (1.80 kilometers) in the Spur Line.

4.3. ***Road Crossings.*** Several roads will cross the SCRP alignment. Among the major roads affected are: (a) J.A. Santos Avenue or Olongapo-Gapan Road (Dinalupihan), (b) Porac Access Road (Porac), (c) SCTEX (CFZ), (d) M.A. Roxas

Highway (CFZ), and (e) Gil Puyat Avenue (CFZ). The total number of affected roads and approaches to be used is shown in Table 3.

TABLE 3. TOTAL NUMBER OF AFFECTED ROADS

Road Crossing Type	Mainline Segment				Spur Line	Total
	1	2	3	4		
Level	1	3	4	4	2	14
Grade-Separated (Overpass)		3	1	1	1	6
Grade-Separated (Underpass)	1	14	5	1	1	22
For Closure	2	1	1			4
Total	**4**	**21**	**11**	**6**	**4**	**46**

5. SCOPE OF THE WORKS AND DELIVERABLES

5.1. ***Topographic and Hydrographic Surveys.***

5.1.1. ***General Requirements.***

5.1.1.1. ***Corridor.*** The Consultant shall conduct Topographic and Hydrographic Surveys along the centerline of the proposed SCRP as identified in the Feasibility Study and attached as Annex A in this Terms of Reference (TOR). The Survey will cover about 71 kilometers in length with a required corridor width of 150 meters.

5.1.1.2. ***Coverage.*** The Consultant shall provide all labor, instruments/equipment (i.e. Global Positioning System (GPS), Electronic Total Station (ETS), Automatic Level Instrument, etc.), materials, supplies, and vehicles necessary to perform satisfactorily the survey works. The conduct of the Topographic and Hydrographic Surveys, as well as the ROW Improvements and Parcellary Surveys, shall conform in accordance with the *Department of Public Works and Highways (DPWH) Design Guidelines, Criteria and Standards, Volume I – Part 1: Manual on Technical Requirements for Surveying and Investigations* and all applicable provisions of existing laws, codes, or department orders to minimize changes/modifications and other delays in the preparation of final plans.

5.1.1.3. ***Outputs.*** In the preparation of plans, the Consultant shall use computer-aided design and drafting (CADD) software. After completion of the survey works, all hard copies and electronic files of survey computations/report/data, plans, and other relevant documents shall be turned over by the Consultant to BCDA.

5.1.2. ***Common Surveying and Mapping Requirements.***

5.1.2.1. ***Establishment of Horizontal Ground Control.***

5.1.2.1.1. ***Horizontal Ground Control.*** Horizontal ground controls shall be established at or near an acceptable location within the vicinity of the Project using at least secondary traverse precision and accuracy. Control points existing and/or previously established by National Mapping and Resource Information Authority (NAMRIA) or Bureau of Land Location Monuments (BLLM) shall be made part of the project controls.

5.1.2.1.2. ***GPS Network.*** The GPS network for the Project shall be tied to existing national triangular network established by NAMRIA, which is integrated to the Philippine Traverse Mercator (PTM) System. New GPS station should be established at 3-kilometer interval along the acceptable location of the Project. It should be marked by a 40cm × 40cm × 100cm concrete monument with a 10mm diameter of 100cm long steel bar embedded at the center of the monument with the following inscriptions:

GPS No.	**Date Established**
Coordinates	
Elevation	
Name of Project	**BCDA – SCRP**

5.1.2.1.3. ***Primary Traverse.*** Primary Traverse shall be tied to the new GPS station established in the project site. Primary traverse station shall be established using an ETS and should be marked by a 20cm × 20cm × 60cm concrete monument with a 10mm diameter of 60cm long steel bar embedded at the center of the monument with the following inscriptions:

Traverse Station No.	**Date Established**
Coordinates	
Elevation	
Name of Project	**BCDA – SCRP**

5.1.2.2. ***Establishment of Vertical Ground Control.***

5.1.2.2.1. ***Vertical Control System.*** The vertical control system shall be established for the project area which will be connected and referred to at least two (2) existing benchmarks (BMs). It shall be referred to a reference datum plane, either the Mean Sea Level (MSL) or the Mean Low Low Water (MLLW) established by NAMRIA. In all cases, the datum shall be clearly indicated in the survey plans.

5.1.2.2.2. ***Benchmarks.*** BMs shall be established using Automatic Level Instrument in closed-circuit differential leveling method and three (3) wire reading having an accuracy of less than 8.44mm square root of k, where k is the distance or length of line in kilometers. The line of levels shall begin and end on the previously established first order BM. The BMs shall be established at every 500-meter interval and should be marked by a 30cm × 30cm × 100cm concrete monument with a 10mm diameter of 100cm long steel bar embedded at the center of the monument with the following inscriptions:

BM No.	Date Established
Coordinates	
Elevation (m)	
Name of Project	BCDA – SCRP

5.1.2.2.3. ***Intermediate Benchmarks.*** Intermediate benchmarks (IBMs) shall be established between BM at 250-meter interval using the method and accuracy of establishing BM and should be marked by a 20cm × 20cm × 60cm concrete monument with 10mm diameter of 60cm long steel bar embedded at the center of the monument with the following inscriptions:

IBM No.	Date Established
Elevation (m)	
Name of Project	BCDA – SCRP

5.1.2.3. ***Alignment Survey.*** The Alignment Survey shall be established in the ground using the alignment established in the Feasibility Study. It should be undertaken using ETS at 20-meter interval including sudden change in terrain, road crossings, drainage

structures, bridge structures, and waterways. The stations shall be marked on the ground with a 2cm × 2cm × 50cm wooden studs and painted.

5.1.2.4. ***Profile Survey.*** The Consultant shall conduct Profile Survey tied to the established BMs and IBMs at 20-meter interval including sudden change in terrain, road crossings, drainage structures, bridge structures, and waterways. The elevations gathered shall be used in preparation of centerline ground profile of the Project.

5.1.2.5. ***Cross-Section Survey.*** The Consultant shall conduct Cross-Section Survey using ETS or GPS (RTK or Real-Time Kinematic) instrument and should be undertaken at 20-meter interval including sudden change in terrain, road crossings, drainage structures, bridge structures, and waterways, indicating the elevation and coordinates of each point in xyz format. The cross-section shall be extended up to the 150-meter corridor. The data shall be used in establishing the ground contour lines at 1-meter interval.

5.1.2.6. ***Topographic Survey.*** Topographic Survey shall be undertaken using ETS making use of the established horizontal and vertical controls. The Topographic Survey shall cover all the existing features within the railway alignment corridor: buildings/ structures, utility facilities (electric, water, drainage, etc.), crops/trees, water bodies, roads, etc.

5.1.2.7. ***Hydrographic Survey.*** Hydrographic Survey shall be undertaken using ETS or GPS (RTK) instrument to gather precise position of the existing river, tributaries, structures, and other features needed. Direction of flow, observed flood level, and ordinary flood level shall be recorded based from information gathered in the locality or nearby residents. River profile shall be undertaken at 50-meter interval for straight sections and 20-meter interval for sharp bend sections up to 250 meters upstream and downstream from the centerline of the proposed bridge structure. River cross-sections shall be undertaken at 50-meter interval for straight sections and 20-meter interval for sharp bend sections and shall be extended 50 meters beyond the river banks and will be taken facing downstream to check the riverbed/channel configuration of the existing river/waterways. The maximum and ordinary water level shall be recorded.

5.1.3. ***Report.*** The Consultant shall prepare a Topographic and Hydrographic Surveys Report compiling all required deliverables for this Scope of Works, as well as detailing all activities done, problems encountered, and resolutions to problems encountered.

5.2. ***Geological and Geotechnical Surveys and Investigations.*** The Consultant shall coordinate with BCDA during the conduct of Geological and Geotechnical Surveys and Investigations along the entire alignment of SCRP, specifically at locations with observed slope failures, tension cracks, landslide scars, and areas with settlement and subsidence.

5.2.1. ***Geological Survey and Investigation.*** The Consultant shall be responsible for the following:

a. Collection of geological information of the project area with the aid of aerial photographs, satellite imagery, relevant geological study reports, documents, and maps;

b. Geological mapping of the existing ground formation along the project alignment, specifically at slope disaster areas by conducting site ocular inspection;

c. Conduct geological survey for improvement/rehabilitation of the Project; and

d. Identify areas with geological problems and difficulties, and water bearing stratum causing subsurface discharge/seepage which could affect the stability of the Project.

5.2.2. ***Geotechnical Survey and Investigation.*** The Consultant shall undertake the Geotechnical Survey and Investigation consisting of, but not limited, to the following:

a. Undertake detailed soil investigations along the rail alignment with the purpose of identifying the type of subgrade soils. This should not be confined to the centerline but may include side cut sections affected by the improvement within the ROW.

b. Auger boring and/or test pits, whichever is deemed appropriate, shall be carried out at the centerline at an interval of 500 meters. The maximum depth of exploration for areas of light cut/fill and deemed not to pose special problems shall be 2 meters below the proposed subgrade. For sections with where deep cuts or tunnels are involved or when subsurface information indicates weak strata, the depth shall be extended based on the topography and nature of subsoil.

c. All test pits and boreholes shall be properly logged and drawn in A1 size plans showing the thickness of each layer, color, type, and visual description of each layer, depth below the surface, depth of water table (if encountered), etc. The following laboratory test and analyses shall be made on the samples taken: Mechanical Analyses, Natural Moisture Content, Particle Size Distribution by Sieving, Soil Classification, Specific Gravity, Atterberg Limit, Moisture Density Relationship, California Bearing Ratio (CBR), and Consolidation Test. All

laboratory test shall be in accordance with American Society for Testing and Materials (ASTM).

d. For structures, the Consultant shall conduct deep drilling to prescribed depth at bridge abutments and piers in accordance with the *DPWH Design Guidelines, Criteria and Standards*. For tunnels, the Consultant shall conduct deep drilling up to 2 meters beneath the subgrade level at 500-meter interval.

e. At proposed bridge sites, conduct depth drilling at the abutments only with a minimum depth of 20 meters below the river bed in ordinary soil. Standard Penetration Test (SPT) shall be made at maximum interval of 1.5 meters and at every change of soil layer. Boring will be terminated when 5 meters of penetration into hard rock (strata) is encountered. For the two (2) long bridges in Pinulot River, three (3) additional boreholes will be drilled. Likewise, two (2) additional boreholes will be drilled for the viaduct over SCTEX.

f. At proposed tunnel sites, conduct depth drilling from the original ground up to 2 meters beneath the subgrade level of proposed tunnel. The boreholes shall be taken at 500-meter interval and SPT shall be made at maximum interval of 1.5 meters.

g. At proposed overpasses and underpasses, conduct depth drilling with a minimum depth of 10 meters below the original ground. The borehole shall be taken on one side of the abutments and SPT shall be made at maximum interval of 1.5 meters.

h. For sections where there have been observed mass and ground movements, boring shall be deep enough to provide information on depth to slip plane, materials which may cause problems to stability settlement and drainage. Disturbed and undisturbed soil and rock samples obtained shall be subjected to physical and mechanical test and soil mechanics analysis to include shear strength test.

i. The Geological and Geotechnical Surveys and Investigations reports/plans shall be submitted to BCDA for review and approval. The Consultant shall not be relieved from responsibility of determining the sufficiency and appropriateness of the geological/geotechnical investigation works including the laboratory test and evaluation results.

5.2.3. ***Report.*** The Consultant shall prepare a Geological and Geotechnical Surveys and Investigations Report compiling all required deliverables for this Scope of Works, as well as detailing all activities done, problems encountered, and resolutions to problems encountered.

5.3. ***Alignment Study.*** The Consultant shall conduct the Alignment Study to firm up the metes and bounds of the ROW to be acquired based on the topographic,

hydrographic, geological, and geotechnical survey data and on the following technical specifications for SCRP:

5.3.1. ***Track Gauge.*** Track gauge is 1,435 millimeters (standard gauge), following the decision of the National Economic and Development Authority (NEDA) Infrastructure Committee (InfraCom) to adopt standard gauge for all future railway projects in the Philippines.

5.3.2. ***Number of Tracks.*** The railway will initially be single track, but the ROW to be acquired will already accommodate future upgrade to double track.

5.3.3. ***Design Speed.*** The railway will be designed to allow maximum speed of 160 kilometers per hour.

5.3.4. ***Design Criteria for Alignment.*** The design criteria for the alignment for SCRP are shown in Table 4.

5.3.5. ***Rolling Stock.*** SCRP will adopt the UIC (*Union Internationale des Chemins de fer* or International Union of Railways) universal loading gauge standard for all rolling stock. The maximum width allowed is 3,150 millimeters while the maximum height allowed is 4,280 millimeters. Allowances for future electrification of the system will be considered.

TABLE 4. DESIGN CRITERIA FOR ALIGNMENT

Horizontal/Vertical Alignment	Mainline	Secondary	Terminal
Minimum Horizontal Radius - recommended	800m	300m	
Minimum Horizontal Radius - absolute	500m	150m	150m
Maximum Cant		90mm	0mm
Maximum Cant Deficiency		110mm	110mm
Maximum Non-Compensated Lateral Acceleration	$0.70\ m/s^2$		
Maximum Gradient - absolute	1.00%		0.10%
Maximum Change in Gradient - absolute	2.00%		
Maximum Compensated Gradient	0.55% at R=150m		
Maximum Vertical Acceleration	$0.22\ m/s^2$		

5.3.6. ***Vertical Clearance.*** Vertical clearances above roadways will be followed for roads and highways crossing under SCRP tracks (road under rail). As per *DPWH Department Order No. 53, Series of 2016*, minimum clearance of 4,880 millimeters with an additional allowance of 150 millimeters (for future additional road surfacing) will be followed.

5.3.7. ***Consultation with Turnkey Contractor.*** Inasmuch as the Turnkey Contractor is already on board by the time this Works will be awarded, the Consultant is enjoined to consult the Turnkey Contractor on the alignment for SCRP and take into account any deviations from the feasibility alignment.

5.3.8. ***Report.*** The Consultant shall prepare an Alignment Study Report compiling all required deliverables for this Scope of Works, as well as