ST. VINCENT AND THE GRENADINES

CARIBBEAN DIGITAL TRANSFORMATION PROJECT

TERMS OF REFERENCE

FOR

CONSULTANCY SERVICES

TO CONDUCT GEODETIC SURVEY AND GEODETIC NETWORK ADJUSTMENT, AND GROUND CONTROL POINT MAINTENANCE.

INTRODUCTION

Project Background

The project development objective of the Caribbean Digital Transformation Project (CDTP) is "To increase access to digital services, technologies, and skills by governments, businesses, and individuals in the participating Eastern Caribbean countries. The Caribbean Digital Transformation Program has recognized that the management of land resource is one of the keys in the success of digital government services. The sub-component 2 of the Project includes the Development of a geographic information system and electronic single window for land and property information and transactions for: delimitating unidentified land parcels; digitizing deeds information; procurement of orthorectified high resolution imagery; development of land information system; development of NSDI concept; streamlining land transaction process; and upgrading geodetic reference network. The GIS and a property information management system requires a modern, reliable and up-to-date geodetic reference frame.

Under the ongoing Project, the Government of St. Vincent and the Grenadines (SVG) is planning the upgrade and modernization of its Geodetic Reference Network, which will provide a modern and reliable spatial reference frame for a property information management system and establishment of the national spatial data infrastructure.

To achieve the goal of the modernization of the Geodetic Reference Frame (GRF) the SVG Government seeks to hire a qualified surveying company with relevant experience (furthermore referred to as the Consultant) to provide the consultancy services for the modernization of the GRF including: to undertake the analysis of the existing geodetic network, inspection of the control points, carry out necessary geodetic survey, and adjustment of the network and other services according to the scope of services provided in this ToR below.

The requirements and specifications for the consultancy services and qualification requirements of the consultancy services provider are listed in the following sections. Expected tasks include (but not limited to):

- Pre-field survey on upgrading geodetic network.
- Establishment of geodetic marks and field survey in terms of wgs84 or suitable for realization.
- Processing and adjustment of field survey data.
- The computation of new transformation parameters between the new geodetic survey and the existing map grid.
- Preparing station mark details.
- Assessment of orthometric heights; and
- Geodetic network maintenance training.

The Lands and Surveys Department (LSD) under Ministry of Transport, Works, Land and Surveys, and Physical Planning (the Ministry) has the mandate for providing services on land surveying, cadaster, mapping, and land & geographic information to its customers and stakeholders in SVG.

LSD comprises of three main units: the Land Management Unit; the Cartographic Unit; and the Surveying Unit. Through these units, the LSD will be providing more guidance to the hired survey firm.

STATUS OF EXISTING GEODETIC SYSTEM

The current Mapping Datum in SVG is Saint Vincent 1945. The earliest geodetic survey of SVG was Fort Charlotte (V.1) in 1946 by the Hydrographic Service of the British Admiralty. The SVG geodetic control network dates back to the 1960's and is based on the British West Indies Grid (BWI) whose parameters are shown in Table 1.

Table 1 Parameters for St. Vincent 1945 / British West Indies Grid

	Parameters	Value
Datum	Name	St. Vincent 1945
	Ellipsoid	Clarke 1880
	Semi-major Axis (m)	6,378,249.145
	Flattening	1/293.465
	Primary Meridian	Greenwich (zero longitude)
Map Projection	Name	Transverse Mercator
	Latitude Origin (degrees)	0
	Central Meridian (degrees)	-62
	Scale Factor	0.9995
	False Easting (m)	400,000
	False Northing (m)	0

The geodetic network consists of approximately 22 primary marks, which are assigned Primary (V) and 344 tertiary marks, which are assigned Tertiary (VS). There are additional 365 tertiary level marks, which are assigned Resected (R) or Triangulated (T). Control stations are mainly marked on the ground by monuments/pillars and distributed as shown in Figure 1. Marks are only located in the main island; no mark records are found in other islands - the Grenadines. At present, there are no mechanisms for searching for coordinates online. Surveyors or their representatives must visit the LSD to retrieve information on trig stations or other control markers.

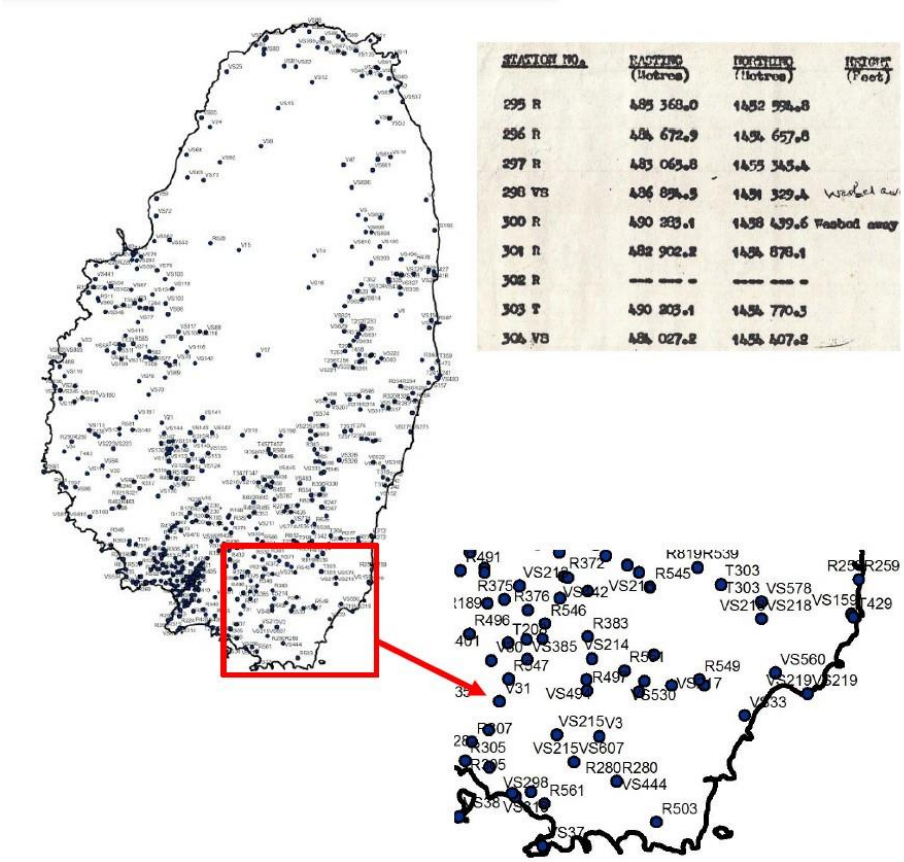

Figure 1 SVG Trig Station Location Map and Sample Coordinates

Many control marks are damaged, missing or placed at inaccessible locations, making surveyors difficult to locate the control marks. All survey plans submitted to the LSD are required to show national grid coordinates for at least one survey mark on the plan. The method of choice for conducting surveying and connecting to the national network is the use of modern traversing utilizing a total station and prism pole.

The transformation parameters available between the Saint Vincent 1945 datum and WGS84 are imprecise despite previous transformation attempt(s). Land Surveyors in SVG do not currently use GNSS/GPS techniques for establishing control stations or connecting land surveys to the national grid. In case of GNSS survey, the coordinates are transformed to BWI by tools available in GIS software. Without further adjustments, this transformation is not adequate for survey and mapping purposes and has to be recomputed.

SVG has never had an island wide integrated orthometric height network established based on spirit-levelling. Few tide gauges established in the past from which localized levelling has been surveyed, but these are currently not operating. So the best available orthometric heights across the island are those computed via the vertical angles observed when Saint Vincent 1945 datum was established.

OBJECTIVES OF THE SERVICES

The objective of this consulting services is to engage a suitably qualified and experienced Surveying Firm to provide technical surveying services to the Ministry **in carrying out a new geodetic survey of SVG and to compute accurate transformation models from GPS/GNSS based observations (WGS84/ITRF) to the Saint Vincent 1945 Datum.**

SCOPE OF WORK

DESCRIPTION OF THE ASSIGNMENT

The scope of work includes conducting the Geodetic Survey and reporting on the quality of the results. The following components must be addressed by the Supplier of the consulting services.

a. Design of the measurement approach - Planning and Inception Stage

Planning Requirements

The Consultant shall in coordination with the Land Survey Department finalize:

i) detailed design and the methodology of the geodetic control network modernization and upgrade; ii) proposed field observations and data processing methodology; iii) methodology of computation of transformation parameters; iv) reporting approach that will to be used during the surveying work; v) training needs assessment and brief training program as per requirements below; vi) detailed work plan (with timeline), resource allocation and usage including equipment and survey crew.

The detailed work plan shall include the establishment of control marks for damaged/missing geodetic control points as well as may suggest new design schemes to improve the current geodetic reference network. The proposed methodology should detail/show the plan for eliminating errors and ensuring the accuracy requirements as prescribed will be achieved.

Design and methodology requirements.

The Consultant, developing the design of the modernization of the geodetic reference frame and methodology should together with the LSD consider the establishment of new datum, based on the ITRF and modern coordinate system for the country. **The analysis of the existing reference system and frame shall be carried out and proposals regarding a new coordinate system should be developed as per requirements below and provided to the LSD for the decision making**.

The consultant must establish the adequacy of network of permanently monumented GNSS observed passive base stations, before the beginning of survey, that will serve as zero order geodetic control network and establish a new reference frame for the country. These stations will

serve as the reference for the observation of all legacy network for computation of the transformation parameters and for the densification of the geodetic control network and establishment of new geodetic control points as necessary.
The stations should be built mainly in the built-up areas, at the locations that shall comply with the requirements for the GNSS observations, ensure easy access for the observations, security of the monuments and observations process. The estimated distance between the Base Stations should be such that will allow that the distance from any new surveyed points to the Base Station should not exceed 15 km. The estimated number of required Base Stations is up to 4 including the station that may be installed in some of the most populated islands.

The GNSS observation program for such stations shall ensure the determination and computation of the coordinates and ellipsoidal heights of the stations with the reference to nearest IGS stations. The proposed methodology of observations of such stations shall ensure the achievement of positional accuracy of the stations.

The Consultant can propose the methodology of the observations to achieve required accuracy, based on his experience of similar projects and depending of the distances to selected IGS CORS sites. However, it would be recommended to consider at minimum 3 daily sessions of simultaneous observations of the Base Stations. The determination of the height of the instruments at each station ***should*** be done at the start, middle and end of each daily session.

The methodology of the observations of legacy geodetic control points as well as newly established geodetic points shall ensure the accuracies required, using as the reference the established Base Stations. In general, the observation shall be done using the static method with dual frequency modern GNSS receivers and should include at minimum 30 min of observations and the reoccupation of the points at different visible constellation of the satellites for the points to achieve required accuracy of the determination of ellipsoidal heights. The determination of the highs of the GNSS receiver at each station shall be done at the start and at the end of session observations.

The methodologies, workplan and other documents listed above should be, at the end of the inception stage, submitted to the Purchaser's Project Manager for approval and then proceeding to the next stage.

New coordinate system and projection recommendations

The Consultant in cooperation with the LSD should also carry an assessment of actually in the country geodetic datum, coordinate system and cartographic projection from the perspective of the Resolution of the UN General Assembly 69/266 of 26 February 2015 "A global geodetic reference frame for sustainable development" and considering the requirements of modern land and cadastral surveys and establishment of the land information system and the SDI for support of the land administration and land management.

The benefits of the establishment of the new modern coordinate system based on the ITRF that will allow easy integration of the spatial data and information with regional and international data sets and system as well as required steps forward should carefully analyzed and recommendation provided for the decision making.

The use of the TM projection with 6 deg zones and 62 deg central meridian should be also carefully analyzed from the perspective of the country territory and location and a potential benefit of using the TM of 3 deg zone with a central meridian of the zone passing though the center of the country to reduce the distortions of currently used projection should be carefully considered and relevant proposals provided for the decision making.

b. Establishment of Geodetic Points and Field Survey

Field Reconnaissance and GNSS observations

The Consultant in cooperation with the LSD shall carry out the field reconnaissance and the establishment of geodetic marks according to the approved detailed design and the methodology in the suggested locations under LSD's guidance, make the monumentation of the geodetic points and undertake a GNSS field survey and observations of the following stations and geodetic points:

- Up to 4 Base Stations (new monumentation and GNSS observation)
- Up to 20 of the existing 22 Primary prefixed marks as listed in Appendix F
- Up to 30 of the existing 709 Tertiary level prefixed marks as listed in Appendix F
- tide gauge reference benchmarks indicated by the LSD

The GNSS observations will be undertaken with modern geodetic quality dual frequency GNSS antennas and receivers, with results processed using geodetic quality software.

The field data collection and processing methodology shall ensure that the final results for all of the above marks meet the accuracy specifications as stated in the Chapter 0 below.

Preparing Station Mark Details

The Consultant shall prepare the station mark details for each of the survey points/marks that was occupied during the observations. The information is to be provided in a tabular format, and with the sketches of the location, close-up and location photos of each mark, as well as horizon cover panorama in the final survey report and also as separate electronic text files (e.g. Microsoft Excel). Details of the requirements for each mark are contained in Appendix E.

c. Data Processing and Adjustment

Assessment of Geoid Model and Orthometric Heights

The Consultant shall undertake an assessment of the existing orthometric heights at the points surveyed if any and provide the new GNSS observed ellipsoidal heights of the points. The Consultant shall also analyze the EGM08 geoid model based on the results of the GNSS observations and available orthometric heights of the existing legacy geodetic points and benchmarks and estimate the accuracy of the EGM08 geoid model for the SVG.

The Orthometric Heights should be also computed for all observed legacy points and stations using the EGM2008 geoid model and the estimation of the accuracy of the obtained height should be also estimated and provided in the report.

The report will list the differences at each point, include a "contour diagram" of the differences, comment on any trends in the data, and provide an electronic file of the differences in a format suitable for interpolating values at any point within the island of Saint Vincent and the Grenadines.

Observation Data Processing and Network Adjustment

The Consultant shall carry out:

1. Processing of Base Stations Network GNSS observation data, adjustment and computation of the coordinates and ellipsoidal heights with the reference to the IGS continuously operating reference stations in agreed ITRF epoch.
2. Processing the field survey and observations of the legacy survey marks and geodetic points listed above, using the internationally recognized geodetic quality software.
3. Compute ITRF based coordinates by processing the local survey marks data with permanently operating GNSS stations which are recognized internationally, regionally and locally.
4. Provide a minimally constrained least squares adjustment of the complete network to show the accuracy requirements as specified in the Chapter 0 below have been achieved.
5. The data processing techniques to be used are to be in accordance with recommended international best practice.

To provide a suitable tie to the ITRF and the processing of the GNSS data in terms of ITRF is to include:

1. IGS Final Orbit products
2. Appropriate international permanently operating CORS stations used in the realization of WGS84/ITRF (e.g. as shown in ITRF solutions: https://network.igs.org/?_gl=1*2r6qa3*_ga*NTI4NTgyOTQ1LjE3MTg5NjQzMDU.*_ga_Z5RH7R682C*MTcxODk2NDMwNC4xLjEuMTcxODk2NDQ1My41Ny4wLjA.&_ga=2.35472929.100233710.1718964309-528582945.1718964305
3. At minimum 3 IGS CORS reference stations in neighboring countries for the processing and computation of the coordinates
4. The data of 2 GNSS CORS stations in SVG operated by COCOnet and NEMO as available should be also used in the processing. (There are three (3) Continuously Operating Reference Stations (CORS) intended for the use of monitoring volcano activity and densification of Caribbean network system, not for land survey: 1 operational by COCOnet, 1 operational by NEMO, and 1 non-operational by UNGGIM)
5. Data of the Tide Gauges reference benchmarks observations

WGS84/ITRF Coordinates computation requirements:

The final coordinates of the geodetic points are required to deliver in terms of the IGS realization of ITRF reference frame and at an epoch within the survey period which is clearly stated in the

reports (the final epoch to be agreed at the inception stage). Currently there are no plans to formally publish these coordinates, though they will be used within the LSD of the Ministry to facilitate further analysis of the survey infrastructure with GNSS technology.

The ITRF based coordinates are to be supplied in the final survey report and also as separate electronic text files (e.g. Microsoft Excel):

- XYZ Cartesian values (m)
- Geodetic values in terms of the GRS80 ellipsoid of Latitude (DMS), Longitude (DMS) and Ellipsoidal Heights (m)
- UTM (North) Zone 20 Northings (m), Eastings (m) and Orthometric Heights (m) of the points derived in terms of EGM2008.

d. Computation of Transformation Parameters

The Consultant shall compute a new 7 parameter transformation model between the existing Saint Vincent 1945 datum and the new WGS84/ITRF based datum and coordinate system.

Document the new parameters with an explanation of how the parameters should be used along with examples of transformed coordinates for at least 4 points (being in the North, East, West, and South of Saint Vincent). Report on the accuracy achieved through using the parameters (e.g. range of differences and the average size) and also report any marks which were removed from the solution due to discrepancies.

Develop or propose the customized open-source software application for the conversion of the coordinates between two coordinate systems, based on the obtained transformation parameters and train the staff of the LSD in the use of such application for practical purposes.

e. Training and capacity building

The Consultant shall also provide a training for at least three (3) staff from within the Surveying Department in the areas of planning, field survey, post-processing, and transformation and reporting of GNSS based surveys.

The staff may be either survey graduates or experienced survey technicians with limited exposure to GNSS surveys. The concise training program based on the training needs assessment should be developed and agreed with the LSD.

The training should be for at least 40 hours and cover a period of at least 10 days. In conducting the field survey work the Survey Firm will provide practical hands-on training as well as individual separate training sessions for reinforcement and to ensure that staff have acquired the necessary skills.

The expected outcome from the training is that the trained staff will have the necessary knowledge, skills and practical experience to undertake GNSS based surveys on their own. The main form of their future GNSS surveys immediately after their training will be to provide further densification to the primary survey network.

f. Accuracy requirements

GNSS passive Base Stations accuracy requirements:
The proposed methodology of the observations and data processing should ensure obtaining of a positional accuracy of the GNSS passive Base Stations better than 20 mm CE at 95% confidence interval horizontal component and better that 30 mm CE at 95% confidence interval vertical component (ellipsoidal heights)

1st Order Marks Absolute Accuracy
It is anticipated that the new GNSS survey observations will be undertaken in such a way that some of the more suitable marks will be occupied for longer durations and more times than the rest of the marks.

The absolute accuracy within terms of appropriate latest version of ITRF or 1st Order marks shall be 0.05m at the 95% confidence interval for their XYZ/ENU components.

2nd Order Marks Absolute Accuracy
The absolute accuracy within terms of appropriate latest version of ITRF for 2nd Order marks shall be 0.10m at the 95% confidence interval for their XYZ/ENU components.

Relative Accuracy for 1st and 2nd Order Marks
Within the network of geodetic points/marks surveyed all surveyed marks must meet the following relative accuracy between each neighboring mark irrespective if they are classified as 1st or 2nd Order Marks.

The relative accuracy between any 2 marks within the new GNSS observation network on SVG shall be not exceed at the 95% confidence interval for their XYZ/ENU components.

OUTPUT / DELIVERABLES

Specific Responsibilities and Duties for the Ministry
To support the responsibilities and duties of the Survey Firm, the Survey and Mapping Section of the Ministry shall be responsible for the following:

- Selecting marks to be surveyed and to install any new stations required to provide better spatial distribution of the new geodetic network.
- Visiting each selected mark before the survey to ensure the mark still exists, the clearing of the site so as to be suitable for GPS observations, making the marks suitable for occupying with standard surveying tripods and providing information to the landowners and public about the field survey campaign.
- Providing three (3) field staff to assist in guiding the Survey Firm's staff to the location of the survey marks and being able to provide survey equipment security (these staff will not necessarily be able to assist in setting up or operating equipment). They will be available Monday to Friday (excluding public holidays) from 8am at the LSD office and need to be back by 4pm to the same office.

- Undertaking field and office inspections of the Survey Firm activities while they are in SVG to help ensure that the final accuracy standards for the contract will be achieved.

PERIOD OF PERFORMANCE

It is anticipated that the Field Survey including the data processing, reporting and training can be completed within about one hundred calendar days of duration. The timing of the survey will be discussed and coordinated with the timing of availability of personnel in the Land Surveyor's Department.

The contract period shall be Twelve (12) months to accommodate for proper scheduling, pre survey analysis work and clarifications with **an anticipated total effort of about 150-170 person days spent during the entire contract period**. However, the survey is expected to be completed within a duration as per the project plan to be discussed at the inception stage of the project with the same amount of person-day effort mentioned here. **SVG expects the Supplier to complete the work within 6-7 months of duration of contract signing**, **but an extended contract duration of 12 months is provided to accommodate any unforeseen situations.**

The Supplier may consider the breakdown for the key activities for estimation purposes:

- Field Survey - The estimated level of effort to undertake the field survey is thirty (30) days with about 2 survey crews.
- Training, Processing and Reporting - The estimated level of effort to undertake the data processing, analysis, training, and reporting is thirty (30) days.

In addition to the above, efforts for planning, analysis, design and project management may be considered.

QUALIFICATIONS OF THE SURVEY FIRM

1. Potential Supplier for this assignment shall be a consulting surveying company with the main registered business as the consultancy services in the geospatial industry, including the geodetic, land and cadastral surveys, GIS and mapping.
2. The company should be presented on the market for at minimum 10 years and during this time should have a practical experience in the areas indicated above in the country of origin and internationally.
3. At minimum 5 years of the experience in the implementation of the international projects of similar scope and magnitude in the developing countries, including in the projects in the areas of assessment, establishment, computation and adjustment of geodetic reference frames, computation of transformation parameters, analysis of geoid models, and base mapping for the countries as well as a capacity building and training of the personnel in the surveying and GNSS observations.
4. The Company shall be financially sound and able to organize and implement the project according to the requirements.

5. The company shall be able to provide the team of the high-level international consultants, as the key experts for this assignment, according to the qualification requirements listed below.
6. The company must have and should be able to provide for the use during the project time at minimum 3 (three) sets of geodetic grade dual frequency, multichannel GNSS receivers and antennas for required field surveys, have licensed professional software for the GNSS data computation and processing as well as have other surveying equipment required for the project.
7. The evaluation of the Supplier will take into consideration the qualification of the key experts as well as the company profile.

The Supplier shall provide qualified consultants including the Project Manager and Technical Experts necessary to complete the project tasks in time and professional level.

Project Manager/Team Leader (Resume must be provided)

The Project Manager/Team Leader minimal qualification requirements are as follows:

1. The Team Leader should be geodesy specialist, as the key expert, shall have at minimum Master of Science or equivalent university degree in the area of the geodesy or surveying, mapping;
2. Minimum of 15 years of work and practical experience in the geodesy and mapping industry, after the graduation from the university, including at management positions;
3. At minimum 5 year of the experience of the international projects on geodesy, GNSS networks establishment and mapping and GIS from different counties, as well as the experience of the team leader of similar scope and magnitude international projects;
4. Proven experience of analysis of the geodetic reference frames status, assessment and the design for the modernization and upgrade of geodetic reference frames in developing countries, design of new coordinate system for the country;
5. Practical experience of the geodetic control networks computation and adjustment, computation of the transformation paraments for different coordinate systems;
6. Familiar with the geoid modelling and EGM08 geoid model analysis and potential use;
7. Must show proven experiences of successfully executing of similar assignments and have an experience in organizing and providing of the capacity building and training of personnel in subject areas;
8. Good knowledge and understanding of the trends of the development in the geospatial industry including the international terrestrial reference frame and its status;
9. Good computer skill and experience in the use of professional software for GNSS data processing, adjustment and computation of geodetic networks, data modelling, , project management and other software required for assignment.
10. Must have extensive international experience and have good English and writing and speaking skills.
11. Good reporting, presentation skills and communication skill working in multicultural environment

Key Technical experts (Resumes must be provided)

The Key Technical Experts minimal qualification requirements are as follows:

1. The as the key expert, shall have at minimum Master of Science or equivalent university degree in the area of geodesy or related disciplines.
2. Minimum of 10 years of work practical experience in the geodesy and mapping, after the graduation from the university, including experience of the design and implementation of the projects on the establishment/update of national geodetic reference frames in the country and internationally.
3. At minimum 3 year of the experience of the international projects on the establishment or upgrade of the geodetic reference networks in developing countries.
4. Experience of detailed assessment of the status of the national geodetic refence system and frame from different countries.
5. Proven practical experience of the establishment of GNSS national geodetic control networks, GNSS observation, data processing and computation.
6. Familiar with the geoid modelling and assessment process, including assessment of the EGM08 geoid model and its potential use;
7. Must show proven experiences of successfully executing of similar assignments.
8. Good computer skill and experience in use of professional geodetic software for the Global Navigation Satellite System (GNSS) observations computation, data modelling, business process mapping and other software required for assignment.
9. Must have extensive international experience and have good English writing and speaking skills;
10. Good reporting, presentation skills and communication skill working in multicultural environment.

Supplier may also provide Resumes of other non-key specialists involved in the project but they will not be used for evaluation.

RESPONSE REQUIRED

1. A brief technical proposal indicating a plan of action and the approach and methodology taking into consideration the survey requirements.
2. Company Profile, registration document and the necessary information to prove the company experience and qualifications according to the requirements above and demonstrate the ability to undertake the services according to the requirements.
3. List of projects completed or in progress and case studies of similar exercises undertaken demonstrating the Supplier relevant experience.
4. Valid contact details of the previous Clients of the services provided to prove the project experience to enable validation of provided information.
5. Resumes of the Project Manager and Key Experts proposed that should prove their experience and qualifications.

6. Price Proposal of the assignment, providing an inclusive cost of the services as well as the breakdown of the cost.

The fee proposal submitted shall state the Total Fees and Costs in United States Dollars (USD)

At the start of the project one of the key surveyors must visit Saint Vincent and assess the available information and develop a plan for the next stages of the survey (inception of the project). The duration of the completion of the survey period will be mutually agreed during the planning session.

TECHNICAL EVALUATION CRITERIA

The responses provided will be evaluated with the following. It is **required** that the Supplier must provide detailed responses as indicated below.

Table 1: Technical Evaluation

Supplier Response	Weightage (Score) for evaluation	Notes
1. Technical proposal indicating a plan of action and the approach and methodology taking into consideration the survey requirements listed in the document.	**Response Set 1:** Technical approach for carrying out the survey based on the requirements provided above. The approach must describe the design of the survey and demonstrate the Supplier's depth of understanding of the scope of work (and corroborated with case studies and Resumes of key personnel separately) **(20%)** **Response Set 2:** Project plan, detailed activities, and deliverables (**10%**). Please refer to Table 2 below. Section 4a-4e under Description of the Assignment must be referenced.	Supplier must consider the requirements and demonstrate their understanding of the technical requirements and the subject matter knowledge. The proposal must reflect details including but not limited to **techniques, tools (software, HW, templates) designs (or design principles), methods,** (indicative) plan, schedules and tasks to be used to fulfil the technical requirements. Inadequate descriptions may impact the scoring. The supplier also must indicate clearly the data required from Land Surveyor's Department The Supplier must provide the list of deliverables as per Table 2 below and indicative templates of the deliverables, if desired.

2. Background information about the Firm's ability to undertake the geodetic survey	**Response Set 3:** Company profile and strength to carry out this assignment **(20%)** **Response Set 4:** Case studies of similar exercises undertaken **(20%)**	The company provided must demonstrate specifically their geodetic survey experience. The Company must demonstrate the availability of necessary geodetic equipment hardware and software to carry out the services as per requirements and demonstrate the ability to implement the project according to the requirements at the highest professional level. It is expected the supplier must have robust experience in this domain. Five (5) case studies by the firm (or the by proposed consultants) is expected, and they must be detailed and referenceable. The supplier is encouraged to indicate at least two references for verification independently and in confidence. Well referenced implementation carries additional weights within the allotted scoring.
3. Resumes of Key personnel involved	**Response Set 5:** Resumes. (**30%)**	All proposed specialists must have specific experience in carrying out geodetic survey work.

Note: a scoring range of 0-3 will be used [0=does not meet the requirement; 1=somewhat meets the requirement; 2= meets the requirement (adequate) and 3=exceeds the requirement (exceptional)].

Anticipated timelines are provided below; but Supplier may propose alternatives timelines considering payment schedules (provided separately) of the contract.

Table 2: Services and Deliverables

No	Description of services	Anticipated Completion in weeks	List of deliverables to be provided with details
a	Inception Stage deliverables (Milestone 1)	8	
b	Establishment of Geodetic Points and Field Survey (Milestone 2)	12	
c	Data Processing and Adjustment (Milestone 3)	4	

d	Computation of Transformation Parameters (milestone 3)	4	
e	Training and capacity building (Milestone 3)	6	
f	Final report and project closure (Milestone 3)	4	

APPENDIX

Appendix: Information to be used and Information to be furnished at the time to of survey are listed below.

1. **Diagram of the datum network** – Supplier must indicate their requirements or if they will be able to obtain it during implementation. Land Surveyor's Department will furnish necessary information.

2. **Background on Projections**

From Clifford Mugnier, Photogrammetric Engineering & Remote Sensing, 2 (2004), 172
https://www.asprs.org/wp-content/uploads/2012/05/02-2004-stvincentgrenadines.pdf

From KEITH M. MILLER, Caribbean Journal of Earth Science, 37 (2003), 1-10.
http://caribjes.com/CJESpdf/CJES%2037-1%20-%20Miller.pdf

Another reference https://georepository.com/datum_6607/St-Vincent-1945.html

Appendix C. Existing Transformation Parameters
Supplier must indicate their requirements or if they will be able to obtain it during implementation. Land Surveyor's Department will furnish necessary information.

Appendix D. Continuously Operating GNSS Reference Stations (NEMO, COCOnet)
Supplier must indicate their requirements or if they will be able to obtain it during implementation. Land Surveyor's Department will furnish necessary information.
Available CORS information is provided below:

- Reference Latitude: 13°16'28.58023"N
- Reference Longitude: 61°15'01.14971"W
- Antenna type: Zephyr Geodetic 2
- Receiver: Netr9
- A data sharing agreement is yet to be in place. Also, possible access from UNAVCO file server website. Subject to confirmation from UNAVCO.
- Data is recorded in 1 second and 30 second intervals.
- IGS14 reference frame (http://acc.igs.org/igs-frames.html)

Supplier is responsible identifying and collecting the required information. SVG will provide necessary support to obtain the required information.

Appendix E. Station Mark Details

For each of the survey marks that the Consulting Survey Firm occupies as part of the survey they shall **prepare station mark details as described in the following table.** The information is to be provided in a tabular format in the final survey report and also as separate electronic text files (e.g. Microsoft Excel).

Field Header	
Mark Name	Name of the name. E.g. "V139"
Mark Locality	Local name of village, town, mountain or bay that the mark is located near.
Approximate Coordinates	ITRF/WGS84 coordinates as Latitude (DMS) and Longitude (DMS) to the nearest 0.1"
Mark Description	Type of mark and construction. E.g. "2" Diameter metal pipe in concrete"
Beacon Type	Description of the beacon over the mark. E.g. "2m long removable Red and White Sitting pole with inverted bucket on top".
Ground Relationship	The relationship of the mark to the ground level in meters. The mark is above, below or at ground level. E.g. "0.8m Above G.L.", "0.5m Below G.L." or "Ground level". The measurement shall ideally be measured to the nearest 0.01m
Land Ownership	Description of who may own or occupy the land that the mark is located on. E.g. "Within the Marine Police compound"
Contact Details	Name and Phone number of person to contact to obtain access to the mark
GNSS Suitability	The site suitability for GNSS observations shall be assessed as being good, poor or unsuitable. (a) A 'Good' site shall: (i) have at least 70% clear sky visibility above 15 degrees from the horizon in all directions, (ii) be at least 5 metres clear of obstacles such as fences and buildings that may cause multipath, and (iii) be at least 20 metres clear of sources of radio interference such as radio transmitters, cell-phone transmitters and high-tension power lines. (b) A 'Poor' site shall: (i) have less than 70% clear sky visibility above 15 degrees from the horizon in all directions, or (ii) be less than 5 metres clear of obstacles such as fences and buildings that may cause multipath, or (iii) be between 20 – 10 metres clear of sources of radio interference such as radio transmitters, cell-phone transmitters and high-tension power lines. (c) An 'Unsuitable' site shall: (i) have less than 40% clear sky visibility above 15 degrees from the horizon in all directions, or (ii) be less than 10 metres clear of sources of radio interference such as radio transmitters, cell-phone transmitters and high-tension power lines.

Cellphone coverage	Is there cellphone coverage at the mark? If Yes also state the service provider.
Access Method	A text description of how to Access / Find the mark. As a minimum, the description shall include: (a) location of the mark, with respect to topographical, or nearby permanent features, (b) directions to the mark, from the most direct road, and (c) time to walk to the mark if drive on access is not possible

Appendix F. Survey Marks

At the time of preparing these Description of Services a number of the existing survey marks had been selected as being suitable for inclusion in the field survey. However, investigations are continuing to complete the list. Prior to signing a final contract an updated list will be provided to the Consulting Survey Firm.

A file containing the approximate WGS84 position of the survey marks is available as both an Excel file and Google Earth KML file.

The Land & Surveys Department of Saint Vincent & the Grenadines uses the BWI 45 Grid as its coordinate system. It's based on the transverse Mercator projection, where the Central Meridian $\lambda o = 62^{o}$ W, the Scale Factor at Origin mo = 1999/2000 = 0.9995, and the False Easting is 400 km.

Note that the unit of measurement for this BWI Grid is the meter where 1 meter = 3.2828456 feet. Preliminary estimated transformation St. Vincent Datum of 1946 to WGS 84 is $\Delta X = +196$ m, $\Delta Y = +332$ m, and $\Delta Z = +275$ m.

Station Identifier	**Current Status**	**Sky Coverage**	**Road Access**	**Notes**
V1	Ok	Yes	Yes	Fort Charlotte
V2	Ok	Yes	Yes	Sion Hill (See Survey plan G43/133)
V3	Removed	N/A	N/A	Harmony Hall (See Survey plan G70/42 & G2481)
V7	Ok	Yes	Private Property	Sans Souci (See Survey plan C1872)
V8	Ok	Ok	Access blocked with trees which are the habitat for parrots	Grand Sable (See Survey plan G43/133)
V9	Still needs verification	N/A	N/A	Orange Hill (See Survey plan C1161)