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Thru : **MR. PETER SAMOSA**
President, PKII

Subject : **Proposal to Undertake the Lidar Data and mapping for area within Project Areas located at Dalton Pass**

1.0 Introduction:

LiDAR is an acronym for “light detection and ranging. In the mapping industry this term is used to describe an airborne laser profiling system that produces location and elevation data to define the surface of the earth and the heights of above-ground features. LiDAR Mapping produces very-high-resolution three- dimensional point clouds in a wide variety of land cover types at accuracies equivalent to or better than photogrammetry. It can be acquired day or night, in cloudy conditions, leaf on or leaf off and no sun angle limitation. It is able to penetrate to the bare earth in vegetated area better than either IFSAR or photogrammetry.

For your requirement, we’ll be implementing LiDAR Mapping technology and Conventional Topographic Survey works to provide the elevation of the project for the proposed alignments in the map below

Phase I – LiDAR Mapping coverage –

Phase II – Conventional Mapping coverage – to be determined if there are areas not possible for LiDAR

UNMANNED AIRBORNE LASER SCANNING

Laser scanning utilizing high-end unmanned airborne platforms provides the possibility to acquire data in dangerous and/or hard-to-reach areas, while offering an excellent cost-to-benefit-ratio for numerous applications.



2.0 SCOPE OF WORK :

2.1 Establishment of Ground Control Points (GCPs)

Horizontal and vertical control points shall be established in the project area. Pairs of control points shall be established for every 5km radial distance of the project site. Control points shall be marked by a 10mm dia x 1 meter steel bar embedded on a 20cm x 20cm x 100cm concrete monument, marked with the control point name on top.

There is a need to conduct Ground Control (GCP) surveys in order to verify and validate the DEM data and to make sure that the data obtained is of higher accuracy and within the standards. GCP will be used for the Validation of the Digital Elevation Model generate using LiDAR.

COORDINATES (horizontal position) of each benchmark will be established using observation by STATIC GPS RECEIVERS reckoned from nearest available NAMRIA Active Geodetic Network.

ELEVATION (vertical position) NETWORK of project site will be based on nearest available NAMRIA elevation benchmark. Using digital level, elevation will be transferred to a control point on site. GPS-RTK System (H 10mm & V 20mm accuracy) or Total station will be used for transfer of elevation to other control points inside the project site.



BY RASA SURVEYING	DATE RE-OBSERVED: SEPTEMBER 1, 2016
	PHOTO / SKETCH

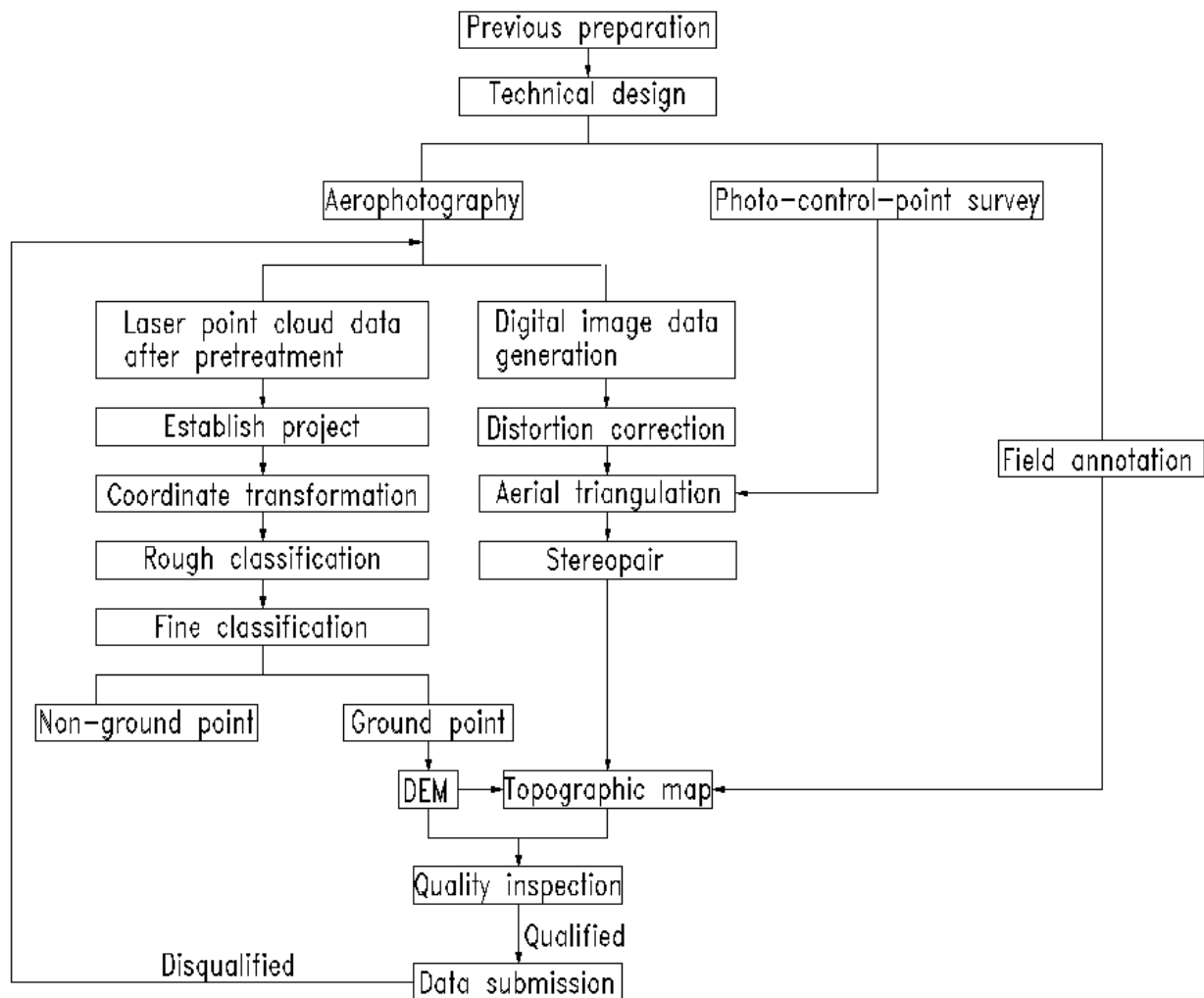
2.2 Data Acquisition

2.2.1 Conventional Topographic Mapping

Topographic survey shall be conducted for the approximate calibration area. Ground points and significant features of the terrain such as houses, trees (30cm diameter & above), manholes, power poles, all surface visible utilities, invert elevations of pipes and storm drains,

roads, trails, creeks, rivers, fishponds, stockpiles, any submerged area and other structures which may be needed in the preparation of development plan shall be surveyed and indicated on the topographic plan.

Topographic map with 1 meter contour interval at any appropriate scale, showing the traverse stations used, structures and features identified above, recovered monuments and established benchmarks will be prepared.

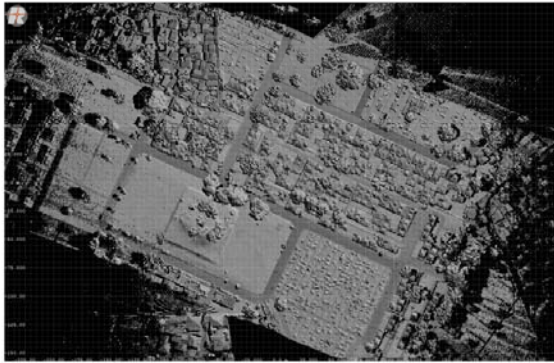


2.2.2 Lidar Mapping

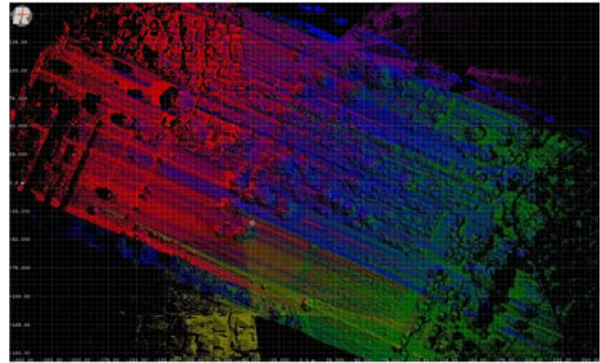
2.2.2.1 Conduct of LiDAR Acquisition

Using ALS50 equipped with High-frequency Laser Ranging Device, together with DGPS, Inertial Measurement Unit (IMU) and an optional Camera we will conduct LiDAR mapping survey at an altitude between 200 m to 900 m (dependent on actual ground status). Acquisition/ scanning of 2 points every 1 square meter or depend on the required point density needed.

SAMPLE OUTPUT



RIPROCESS BLACK AND WHITE



RIPROCESS COLORED

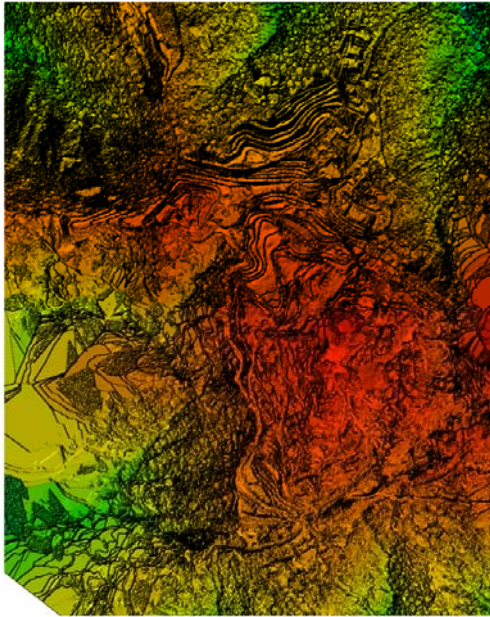
SAMPLE OUTPUT



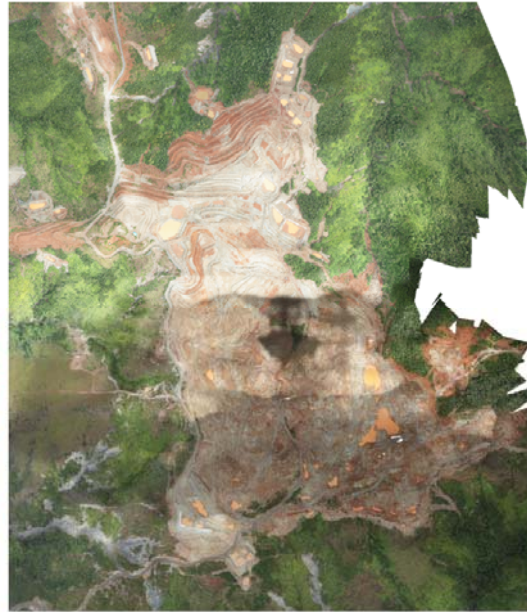
RIPROCESS COLORED

2.2.2.2 Post Processing of LiDAR Point Cloud

Data acquired will be process and adjusted. Using the interpolated geoid Model EGM 2008 (1' x 1') to reduce the ellipsoidal height computed from the LiDAR system to orthometric height. The converted LiDAR derived orthometric height will be adjusted and corrected to the heights above the MSL using the GCPs acquired and referring to the nearest benchmarks. LiDAR Data (.LAS) using the adjusted position (vertical and horizontal) will then be process using a LiDAR processing software.



DSM



Orthophoto

COST AND MANNER OF PAYMENT:

SURVEY WORKS				
Work Items	Unit	Quantity	Unit Rate	Amount
Mobilization/Demobilization Establishment of Project Control Points <i>Horizontal Control and vertical Control benchmark to the Project site</i> Project Control Horizontal Project Control Vertical <i>1GCPs for every 500 m or 50 hectares to be surveyed by GPS-RTK with reflective panels</i>	Point	26	17,500.00	455,000.00
	Point	26	17,500.00	455,000.00
Flight Mission / Actual Lidar Acquisition <i>2 points every 1 square meter acquisition min</i>	has	500	4,000.00	2,000,000.00
Post-processing / Generation of 1-m interval Contours GCP and Constrained Network adjustment <i>generation of DSM and DEM</i> <i>Topographic Map vectorization/ digitization</i>	has	500	2,200.00	1,100,000.00
Topographic Survey of partial area by ground method Tunnel Portal at 4 hectares each Spot elevations as points spread in the area Tidal Observation / river bathymetry	has	8	15,000	120,000
	points	50	2,500	125,000
	LS	0	25,000	0
CAAP Coordination costs will be by client			SubTotal	4,255,000.00
			12% VAT	510,600.00
<i>Note: Unit rates will apply for additional survey works in excess of assumed and approximate values</i>			TOTAL	4,765,600.00

Area estimated at 25km x 200m

5,000,000.00 sq.m.

Deliverables:

1. **Raw Data (Lidar Point Cloud) in CD, DVD or HDD whichever is appropriate**
2. **Topographic Plan (generated contours) on A1-size tracing paper at appropriate scale duly signed by the Licensed Geodetic Engineer.**
4. **Digital Elevation Model in digital form**
5. **Tabulation of Ground Control Points Coordinates and Elevations in Microsoft Excel format**
6. **Certification of NAMRIA benchmarks**
7. **Survey reports and findings**
8. **Electronic copy of all files (Autocadd, reports, etc.)**

3.1 MODE OF PAYMENT:

- ❖ **Forty Percent (40%)** down payment and mobilization fee upon signing of contract agreement
- ❖ **Thirty Percent (30%)** upon completion of survey field works
- ❖ **Thirty Percent (30%)** upon submittal of final plans and images

3.0 DURATION OF WORK:

The survey will commence based within two weeks, upon receipt of down payment or Notice to Proceed and will be completed **within Ninety (90) working days** from start of fieldwork, including preparation of plans and reports.

Days marred by force majeure, increment weather or other fortuitous events that may endanger the survey crew, equipment or the public in general or may otherwise hamper the execution of the survey work shall not be included in the work duration.

4.0 RESPONSIBILITY OF THE CLIENT:

To ensure the completion of the SERVICE within the given performance period, client shall, immediately upon signing of the agreement and issuance of the written Notice to Proceed, be responsible for the following:

- 5.1 Providing RASA with approximate location of boundary.
- 5.2 Providing RASA with full information of project site safety status.
- 5.2 Providing RASA with a client representative to whom RASA will coordinate with.

