TEXAS WATER DEVELOPMENT BOARD

PURCHASE ORDER NUMBER: **1800012219**

(Please reference this number on all packages & invoices)

PCC Code: I

INVOICE TO:

invoice@twdb.texas.gov

Texas Water Development Board
P.O. Box 13231
Austin, Texas 78711-3231

AGENCY CONTACT:

Tina Newstrom, CTPM

Phone: (512) 463-7825
Fax: (512) 475-3009

To:	19526619226	HUB Status:	N/A	Ship to:
AECOM Technical Services, Inc. 9400 Amberglen Boulevard Austin, TX 78729				Texas Water Development Board 1700 N. Congress Avenue, **ROOM 610B** Austin, TX 78701

This section for TWDB use only

P.O. DATE	ORDER PLACED BY	DATE EXPECTED	ORDER RECEIVED BY	DATE RECEIVED	ER #
01/09/18	Tina Newstrom	**08/31/18**			B180418

918/88

QTY	UNIT	DESCRIPTION	ITEM #	UNIT PRICE	TOTAL
1	lot	TWDB's portion for the Quality Assurance/Quality Control of the Acquisition and Production of Coastal Lidar Elevation Data from Orange to Matagorda County and the H-GAC Operation Area as described in the attached SOW #580-18-SOW0051		$ 46,400.00	$ 46,400.00
		DIR Contract No. DIR-TSO-3423			

SHIPPING & HANDLING		N/A
SUBTOTAL	$	46,400.00
SALES TAX RATE		EXEMPT
SALES TAX	$	-
TOTAL DUE	**$**	**46,400.00**

Please see PAGE 2 for additional Terms & Conditions

E-MAILED 1/9/18

1/9/18

Authorized Signature Date

STATE SALES TAX EXEMPTIONS CERTIFICATE : *The above signed claims an exemption from taxes under Chapter 20, Title 122A revised Civil Statutes of Texas, for purchase of tangible personal property described in this numbered order, purchased from vendor listed above, as this property is being secured for the exclusive use of the State of Texas. The State of Texas is exempt from all Federal Excise Taxes* (poform rev. 9/02)

TEXAS WATER DEVELOPMENT BOARD TERMS & CONDITIONS

Items stated below apply to and become a part of the purchase order

APPLICABLE FOR ALL PURCHASES

A. **Dispute Resolution** - The dispute resolution process provided for in Chapter 2260 of the Texas Government Code must be used by the Texas Water Development Board and the contractor to attempt to resolve all disputes arising under this contract.

B. **Delinquent Taxes** - Vendor agrees that any payments due under this purchase order will be applied toward any debt, including but not limited to delinquent taxes and child support that is owed to the State of Texas.

C. **General Information** - Vendor agrees to comply with Texas Government Code 2155.4441, pertaining to service contract use of products produced in the state of Texas.

D. **Cancellation of Purchase Order** - Financial obligations of the state payable after each fiscal year are contingent upon funds being appropriated by the Texas Legislature budgeted or otherwise made available. If funds are not appropriated or otherwise made unavailable, any resulting contract shall be terminated without penalty upon agency giving written notice to the vendor.

APPLICABLE FOR INTER-AGENCY PURCHASES

E. **Inter-Agency Purchase** - Legal Cite: Texas Government Code Chapter 771 (IAC) Act

APPLICABLE FOR DIRECT PUBLICATION PURCHASES (as stated in Section 2.14 in the Procurement Manual)

F. **Direct Publication Purchases** – "Not Available from any other source"

APPLICABLE FOR ALL AIS (Automated Information Service) PURCHASES (which includes Catalogue Contract Purchases)

G. **Technology Access Clause** – "The Vendor expressly acknowledges that state funds may not be expended in connection with the purchase of an automated information system unless that system meets certain statutory requirements relating to accessibility by persons with visual impairments. Accordingly, the Vendor represents and warrants to Texas Water Development Board that the technology provided to Texas Water Development Board for purchase is capable, either by virtue of features included within the technology or because it is readily adaptable by use with other technology, of:

1. providing equivalent access for effective use by both visual and nonvisual means;

2. presenting information, including prompts used for interactive communications, in formats intended for nonvisual use; and

3. being integrated into networks for obtaining, retrieving, and disseminating information used by individuals who are not blind or visually impaired.

For purposes of this paragraph, the phrase "equivalent access" means a substantially similar ability to communicate with or make use of the technology, either directly by features incorporated within the technology or by other reasonable means such as assistive devices or services which would constitute reasonable accommodations under the Americans with Disabilities Act or similar state or federal laws. Examples of methods by which equivalent access may be provided include, but are not limited to, keyboard alternatives to mouse commands and other means of navigating graphical displays, and customizable display appearance."

rev. 01/16

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TEXAS WATER DEVELOPMENT BOARD

STATEMENT OF WORK (SOW) #580-18-SOW0051

QAQC of Coastal Lidar for Texas from Orange to Matagorda County and the H-GAC Operating Area

Class-Item Codes:
905-05 – Aerial Photography and Videography Services
920-33 – Mapping & GIS Services, Digitized, Cartography
905-10 – Aerial Surveys and Mapping services
918/88 – Quality Assurance/Control Services

TEXAS WATER DEVELOPMENT BOARD
Purchaser: Tina Newstrom
P.O. Box 13231
Austin, TX 78711-3231
Phone: 512-463-7825
Fax: 512-475-3009
Email: Tina.Newstrom@twdb.texas.gov

Statement of Work

Quality Assurance / Quality Control of the Acquisition and Production of High Quality Lidar Data along the Texas Coast

Introduction

This Statement of Work is issued by the Texas Water Development Board (TWDB) in cooperation with the Houston Galveston area Council(H-GAC) for Quality Assurance / Quality Control (QA/QC) of high resolution elevation data products from airborne lidar systems **during the 2017-2018 leaf-off season** in accordance with TWDB SOW #580-18-SOW0050 This document contains specifications and identifies the specific Area of Interest (AOI). The AOI is directly affected by funding availability and interested parties and is subject to change.

The project AOI (9,068 DO4Q tiles) is on the Texas coast covering much of Orange to Matagorda County along with Harris County and the surrounding area. This region is strongly dominated by coastal ecology in addition to the large metropolitan area of Houston and the surrounding urban sprawl.

The data acquired will be used for floodplain management and planning, feature extraction, water quality modeling, stream restoration potential analysis, change detection and emergency management services.

The data acquired will become part of an ongoing geospatial data collection program by the State of Texas to support regional and local mapping needs.

The products acquired by this Contract will be available in the public domain through the Texas Natural Resources Information System (TNRIS) for use by government entities and the public.

Proposals should address local conditions and unique project considerations as well as fully explain project methodology. Please consider when calculating price, that due to the tiling scheme, a large number of tiles along tidal waters will result in delivered tiles with at least 90% of their area classified as water or represented by voids created by water. An innovative and cost-effective project approach is encouraged and TWDB welcomes alternate specifications, suggestions, and pricing.

INVOICES: RECEIPT AND PAYMENT

An invoice schedule and payment proportions will be determined at or before the kick-off meeting and adhered to throughout the life of a project, unless otherwise agreed upon by Contractor and/or Project Partner Point-of-Contact (PPPOC).

Contractor shall submit invoice(s) to each of the PPPOC's identified in the Contract according to the invoice schedule. Each invoice must identify work performed in accordance with the SOW. Contractor shall be paid within thirty (30) days from receipt of invoice, in accordance with the Texas Prompt Payment Act, Government Code, Chapter 2251. However, if any PPPOC disputes payment of an invoice, said PPPOC must notify Contractor of the existence of a bona fide dispute. Upon request by any PPPOC, Contractor shall provide detailed documentation in support of the invoice and to the degree necessary to resolve any dispute. Any PPPOC may take any legally authorized actions for purposes of enforcing a

remedy or obtaining set-off against payments due. Any PPPOC may also limit payments of the proposed Contract.

PAYMENT DISPUTES
If any PPPOC disputes payment of all or any portion of an invoice from Contractor, PPPOC shall not pay any disputed amount before the dispute is resolved. Notwithstanding any such dispute, Contractor shall, unless otherwise notified by PPPOC, continue to perform the Services and produce deliverables in compliance with the terms of the Contract pending resolution of such dispute so long as all undisputed amounts continue to be paid to Contractor.

Supplemental Information

The following datasets are provided with this solicitation at:
http://lt.tnris.org.s3-website-us-east-1.amazonaws.com/580-18-SOW0050/

- Areas of Interest: 58018SOW0050_TexasCoast_AOIs.shp.zip
- USGS_Geiger_recommendations.docx & 2008 NUSA Lidar Executive Summary.pdf - Supporting-documents.zip

Texas Strategic Mapping Program Goals

It is the intent of the Texas Strategic Mapping Program (StratMap) to purchase geospatial data products that will provide direct savings, efficiencies, and cost duplication avoidance through inter-governmental collaboration and partnerships. The StratMap Contract is instrumental to these goals. Both the StratMap Program and the StratMap Contract are administered by the Texas Natural Resources Information System (TNRIS), a division of the Texas Water Development Board (TWDB).

Accuracy and Quality of Products

The StratMap Program, through the StratMap Contract, uses prequalified commercial data providers to collect and process geospatial data and separately selects third party quality assurance consultants, as needed, to review products and processes. Each participant in the program is expected to maintain internal quality controls and assurances to minimize errors and document procedures to ensure the data will meet or exceed requirements.

Project Phase Overview

		Lidar Vendor	QA/QC Vendor
Phase I	PRE-FLIGHT PLANNING		
	Kick-Off Meeting		
	Lidar Tasks	*Develop flight operations plan*	
		System calibration and geodetic control validation	
	Lidar Deliverables	**Schedule**	Review and comment
		Flight plan	
		Ground control plan	
		Sensor calibration reports	
Phase II	DATA ACQUISITION		
	Lidar Tasks	*Perform flight setup and geodetic control process*	*Collect QA/QC checkpoint survey*
		Fly project area to collect data	
		Verify data after each flight mission	
		Collect checkpoint survey	
	Lidar Deliverables	**Flight trajectories (lidar only) and GPS report**	Review and comment
		Checkpoint table and survey report	
		Data acquisition status updates	
Phase III	DATA PROCESSING		
	Lidar Tasks	*Boresight/calibration*	
		Point classification	
		Intensity image production	
		Generate hydro-flattening breaklines	
	Lidar Deliverables	**PILOT**	**Review Pilot and comment**
		All-return point cloud	Review data deliverables and comment
		Hydro-flattening breaklines	
		Intensity images	
		Re-submit Phase III deliverables as necessary	Approve or reject deliverables
Phase IV	FINAL PRODUCT DEVELOPMENT		
	Lidar Tasks	*Create bare-earth DEM*	
		Generate metadata	
	Lidar Deliverables	**DEM Raster**	Review and comment
		Metadata	
		Re-submit Phase IV deliverables as necessary	Approve or reject deliverables
			Deliver whole QA/QC checkpoint table to TWDB
			Submit final QA/QC report
		Data processing status updates	
	Project Closeout Meeting		

QAQC Specifications

Lidar Independent Quality Assurance and Quality Control	
Checkpoint Acquisition	
Checkpoint planning, acquisition and testing methodologies must follow the 2014 ASPRS Accuracy Standards for Digital Geospatial Data.	
Number of checkpoints	Number of checkpoints for vertical accuracy testing of lidar should follow ASPRS recommendations in Table C.1 of the 2014 ASPRS Accuracy Standards for Digital Geospatial Data unless otherwise specified by TWDB.
Checkpoint distribution	Checkpoint distribution shall be recommended by the QA/QC contractor in consultation with TWDB. Checkpoints may be located in either vegetated or non-vegetated areas depending on land cover characteristics of the AOI. Ideally checkpoints will be located in accessible public lands or right-of-way.
Elevation	The most recent NGS-approved geoid shall be used to convert GPS ellipsoid heights (NAVD88) into orthometric heights for each checkpoint.
Checkpoint table	**Deliverable 1:** The surveyor will provide TWDB and the QA/QC team with all checkpoints collected including (at a minimum) UTM coordinates (X,Y,Z) to three (3) decimal places, point ID and land cover type. Point data must be in electronic format. Required formats include: .csv, .shp
Checkpoint survey report	**Deliverable 2:** Along with checkpoint table, QA/QC contractor shall submit associated survey report including at a minimum selected GPS network (i.e. RTK) and spatial parameters (i.e. coordinate system, geoid model) as well as reference site photos. Acceptable formats include: .doc(x), .pdf,
Lidar Accuracy Assessment	
Non-vegetated vertical accuracy (NVA)	The QA/QC contractor will follow the 2014 ASPRS Accuracy Standards for Digital Geospatial Data to compute the vertical $RMSE_z$ and $Accuracy_z$ at a 95% confidence interval ($RMSE_z$*1.96) in centimeters for **checkpoints located in non-vegetated open terrain.**
Vegetated vertical accuracy (VVA)	The 95th percentile method shall be used to determine vertical accuracy for **checkpoints located in vegetated terrain**, regardless of vegetation type. The least accurate 5% of checkpoints shall be discarded and the $RMSE_z$ and $Accuracy_z$ will then be calculated and reported.
Lidar accuracy assessment report	**Deliverable 3:** If the 95th percentile $RMSE_z$ and $Accuracy_z$ calculation passes the accuracy criteria listed for the lidar vendor (under GPS Procedures and Accuracy), the QA/QC team will prepare a Lidar Accuracy Assessment Report declaring the data have passed. The official report will include statistics, compared with the relevant accuracy standard.
Project Review and Final Report	
Phase I: Pre-Flight Planning	Review Phase I parameters and deliverables from lidar vendor including: project parameters; timeline; flight plan; sensor calibration report and provide comments/feedback to vendor and TWDB. See requirements listed above for details.
Phase II: Data Acquisition	QA/QC vendor will be available to lidar vendor or TWDB for input or advice regarding data acquisition.
Phase III: Pilot	Review pilot area submitted by lidar vendor to ensure all requirements in this specification are met. Provide comments/feedback to lidar vendor and TWDB. An accuracy check and formal reporting are not required.

Phase III: Data Processing	Review Phase III deliverables (LAS, intensity images, hydro-flattening breaklines), check accuracy and provide comments/feedback to lidar vendor and TWDB. If the data are rejected for any reason, notification to TWDB and the lidar vendor should occur as soon as possible for corrective measures. Phase IV shall not commence until Phase III data meet specification.
Phase IV: Final Product Development	Review Phase IV deliverables (DEM raster, metadata) and provide comments/feedback to lidar vendor and TWDB. Approve or reject deliverables based on compliance with project specification in consultation with TWDB.
Final QA/QC report	**Deliverable 4:** Document all workflow processes as well as quantitative and qualitative findings in a detailed report which will also include Checkpoint Survey Report and Lidar Accuracy Assessment Report. Screenshots and other graphics are encouraged. Acceptable formats include .doc(x), .pdf
Intellectual Property Rights	
The contracting agency shall have unrestricted rights to all delivered reports and data. All QA/QC products will become the property of H-GAC and TNRIS. All QA/QC products will be put in the public domain and be accessible from the **Texas Natural Resources Information System**, a division of the Texas Water Development Board.	

REFERENCES

American Society for Photogrammetry and Remote Sensing. 2013. ASPRS Accuracy Standards for Digital Geospatial Data. *Photogrammetric Engineering & Remote Sensing* 79, no. 12: 1073-1085.

American Society for Photogrammetry & Remote Sensing. ASPRS Guidelines Vertical Accuracy Reporting for Lidar Data. 24 May 2004. http://www.asprs.org/a/society/committees/lidar/Downloads/Vertical_Accuracy_Reporting_for_Lidar_Data.pdf

American Society for Photogrammetry & Remote Sensing. LAS Specification Version 1.4-R6. 10 June 2012. http://www.asprs.org/a/society/committees/standards/LAS_1_4_r12.pdf

Federal Geographic Data Committee. Geospatial Positioning Accuracy Standards Part 3: National Standard for Spatial Data Accuracy. 1998. http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3

Maune, David F. Digital Elevation Model Technologies and Applications: The DEM User's Manual, 2nd Edition. 2007.

Maune, David F. FEMA's Mapping and Surveying Guidelines and Specifications. 2003. http://w.psadewberry.com/Libraries/Documents/FEMAs_Mapping_and_Surveying_Guidelines_and_Specifications_ASPRS_Fall2003.pdf

National Digital Elevation Program. Guidelines for Digital Elevations Data (Version 1.0). 10 May 2004. http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf

The National Geodetic Survey. The NGS Geoid Page. 11 December 2012. http://www.ngs.noaa.gov/GEOID/

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AREA OF INTEREST MAP

PRICING TABLE

Pricing Table for Lidar QAQC							
TWDB 580-18-SOW0051							
Company Name: AECOM Technical Services, Inc.							
Square miles				9068			
Nominal Point Density				≥ 4 Points per Square Meter			
$RMSE_z$				10 cm			
Acquisition Time Period				Leaf-off 2017-2018			
Lidar QA/QC							
QA/QC Deliverables							
Checkpoint Survey and Report Lidar Accuracy Assessment Report Final QA/QC Report							
				With DIR Discount			10%
List appropriate checkpoint information below.				List appropriate checkpoint information below.			
LAND COVER	UNIT COST	QTY	TOTAL	LAND COVER	UNIT COST	QTY	TOTAL
Non-Vegetated	$262.78	197	$51,767.66	*Non-Vegetated*	$236.50	197	$46,590.89
Vegetated	$262.78	137	$36,000.86	*Vegetated*	$236.50	137	$32,400.77
Data Review and Deliverables			$107,423.65	Data Review and Deliverables	$96,681.29		
Total Cost			$195,192.17	Total Cost	$175,672.95+DIR Admin Fee(0.75%)=$176,990.50		

Federal funds will be paid through TWDB

Agency	Cost
TWDB	$ 46,400.00
HGAC	$ 58,175.58
USGS	$ 72,414.92
Total	$ 176,990.50

Proposed Schedule

Project Phase	Phase Name	QA Review Tasks	Review Duration
I	PRE-FLIGHT PLANNING	Kick-Off Meeting	Same day
		Review: Schedule Flight plan Ground control plan Sensor calibration report Provide report to TNRIS	2 business days
		Establish Survey Checkpoints	25 business days
II	DATA ACQUISITION	Review: Flight trajectories (LiDAR only) GPS Report Review Delivery checkpoint table and survey report Provide report to TNRIS	3 business days
III	DATA PROCESSING	LIDAR PILOT	4 business days
		Provide report to TNRIS	
		LIDAR Review: All-return point cloud Accuracy assessments Hydro-flattening breaklines Intensity images	20 business days per production block*
		Provide report to TNRIS	
		Data Back Check	5 business days
IV	FINAL PRODUCT DEVELOPMENT	LIDAR Review: DEM Raster Accuracy assessments Metadata	15 business days per production block*
		Provide report to TNRIS	
		Data Back Check	5 business days
		LiDAR Final Report	7 business days

*for estimating purposes AECOM assumes production blocks covering approximately 2,500 square miles

Schedule is dependent on deliveries from vendor on partner SOW for lidar acquisition (580-18-SOW0050). See below proposed schedule from acquisition vendor.

Schedule

Ground Control	December 15, 2017 - January 19, 2018
Acquisition	January 3, 2018 to February 28, 2018
Production	March 1, 2018 to September 24, 2018
QA/QC and Repair	September 25, 2018 to November 23, 2018
Delivery	November 26, 2018

*This represents the proposed schedule. Actual schedule is dependent on weather conditions

This Statement of Work (SOW) is executed to be effective immediately upon the date of the last signature. This SOW is submitted under the terms and conditions of DIR Contract **DIR-TSO-3423** dated 5/20/2016.

Vendor Name: AECOM Technical Services

Signature: Cydney Schwarzlose

Name and Title: Vice President

State Agency: Texas Water Development Board

Texas

Signature:

Name and Title: Deputy Executive Administrator
Richard Wade

Department of Information Resources

SOW ID# TWDB-000025

Signature: DocuSigned by: Hershel Becker 7F04C0B913D547B...

Name and Title: Hershel Becker Chief Procurement Officer

Date: 12/18/2017 | 9:37 AM CST