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Geospatial Solutions

Obstruction Surveys and Airport Airspace Analysis

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Obstruction Surveys and Airport Airspace Analysis

This presentation will provide an overview of project considerations learned through producing airspace analysis under the new AC150/5300-16A, 17C & 18B Airport GIS requirements.

Project Scoping Considerations discussed will include:

- ✓What detail of mapping is required for your project
- ✓The use of temporary vs. permanent geodetic control
- ✓Imagery resolution (flying heights)
- ✓Use of the data in capital projects
- ✓Data collection, analysis, submittal and acceptance
- ✓GIS Data Attribution, Identify Features and Attributes
- ✓Timeline from NTP to NGS data acceptance
- ✓Challenges and lessons learned

Planning to Assure Appropriate Mapping

Table 2-1. Survey Requirements Matrix

This table is designed for use in two ways. First, it defines in a general fashion the task required to meet a specific objective. Each task listed is generalized and the process to complete it many contain many other pieces. Users should refer to the text of the referenced AC to ensure that all the required subtasks are completed. The second way to use this matrix is as a checklist to ensure all the required data is collected either before leaving the field or submitting the data to the FAA.

Intended End Use of the Data ➤ / Required Tasks ⩛	AC Reference	Category II or III Operations	Navigational Aid Siting			Airport Layout Plan (ALP)	Airport Obstruction Chart	Construction		Instrument Procedure Development	Pavement Design, Construction, Rehabilitation or Roughness	Airport Mapping Database
			Non-Precision	Precision	Visual			Airside	Landside			
Provide a Survey and Quality Control Plan	150/5300-16/17/18	•	•	•	•	•	•	•	•	•	•	•
Establish or validate Airport Geodetic Control	150/5300-16	•	•	•		•	•	•		•	•	•
Perform, document and report the tie to National Spatial Reference System (NSRS)	150/5300-16	•	•	•	•	•	•			•		•
Survey runway end(s)/threshold(s)	150/5300-18	•		•	•	•	•	•[1]		•	•	•
Monument runway end(s)/threshold(s)	150/5300-18	•		•	•	•	•	•[1]		•	•	
Document runway end(s)/threshold location(s)	150/5300-18	•		•	•	•	•	•[1]		•[1]	•[1]	
Identify and survey any displaced threshold(s)	150/5300-18	•		•	•	•	•	•[1]		•	•	•
Monument displaced threshold(s)	150/5300-18	•		•	•	•[1]	•[1]	•[1]		•		
Document displaced threshold(s) location	150/5300-18	•		•	•	•	•	•[1]		•	•	•
Determine or validate runway length	150/5300-18	•				•	•	•[1]		•	•	•
Determine or validate runway width	150/5300-18	•				•	•	•[1]		•	•	•
Determine runway profile using 50 foot stations	150/5300-18			•[2]		•[2]	•[2]	•[1]		•	•[2]	
Determine runway profile using 10 foot stations	150/5300-18	•		•[2]		•[2]	•[2]	•[1]		•	•[2]	•[2]
Determine the touchdown zone elevation (TDZE)	150/5300-18	•		•		•	•			•	•	
Determine and document the intersection point of all specially prepared hard surface (SPHS) runways	150/5300-18	•				•	•					•
Determine and document the horizontal extents of any Stopways	150/5300-18	•				•	•			•		•
Determine any Stopway profiles	150/5300-18	•				•	•			•		•
Determine if the runway has an associated clearway	150/5300-18	•				•	•					
Survey clearway to determine objects penetrating the slope	150/5300-18	•				•	•			•		•
Determine and document the taxiway intersection to threshold distance	150/5300-18					•						
Determine runway true azimuth	150/5300-18	•		•		•	•			•		•
Determine or validate and document the position of navigational aids	150/5300-18	•	•	•	•	•	•			•		
Determine or validate and document the position of runway abeam points of navigational aids	150/5300-18	•		•	•		•			•		
Determine potential navigational aid screening objects	150/5300-18		•	•	•							
Collect and document VOR receiver checkpoint location and associated data	150/5300-18		•								•	
Perform or validate and document an airport airspace analysis	150/5300-18	•	•	•	•	•	•	•[1]		•		
Collect and document helicopter touchdown lift off area (TLOF)	150/5300-18				•	•	•	•		•	•	•
Collect and document helicopter final approach and takeoff area (FATO)	150/5300-18				•	•	•					•
Collect or validate and document airport planimetric data	150/5300-18					•	•					•
Determine or validate the elevation of the Air Traffic Control Tower Cab Floor (if one is on the airport)	150/5300-18	•				•	•					•

[1] Only when runway construction is involved.
[2] All 14 CFR Part 139 airports require 10 foot stations. At all other airports the distance between stations is between 10 and 50 feet to meet local requirements

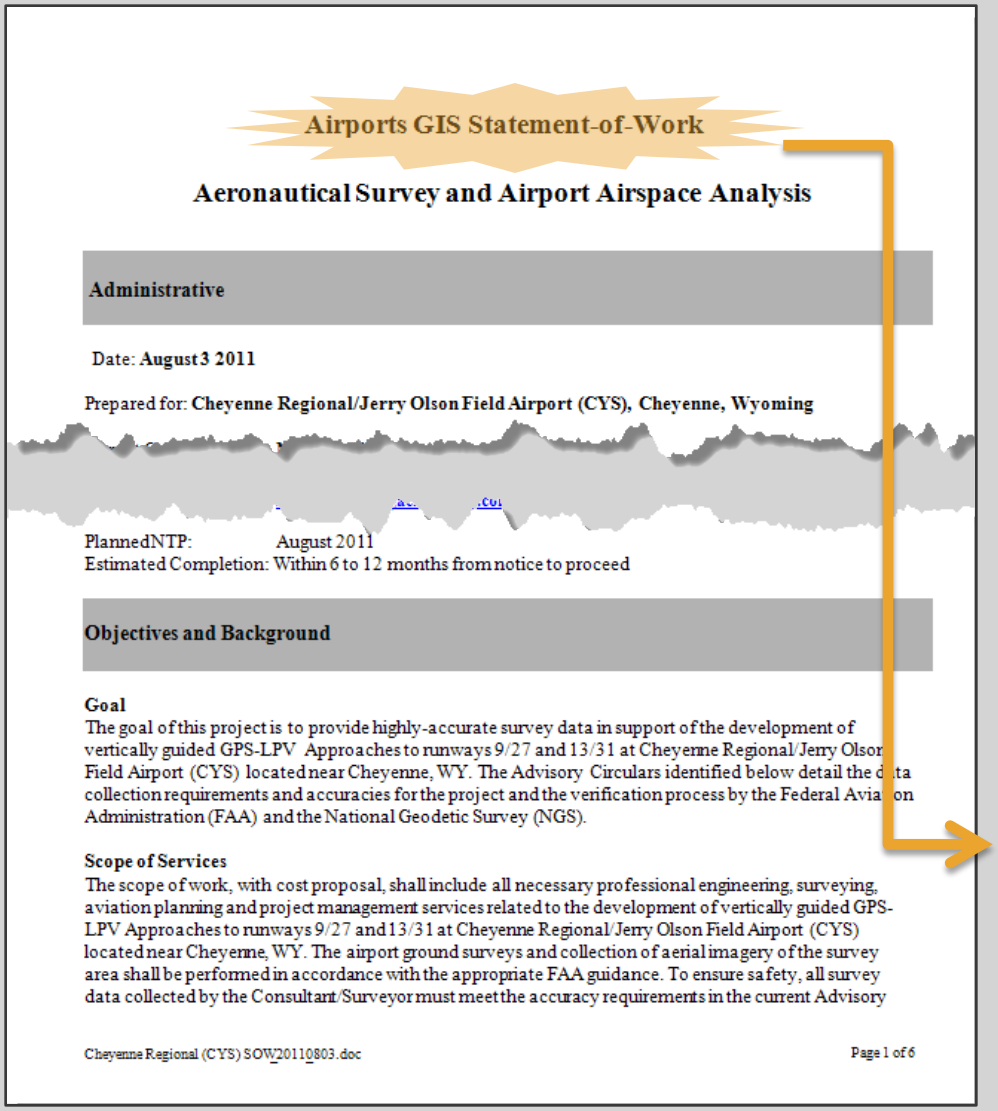
EXAMPLE

Table 2-1 in AC18B, “Survey Requirements Matrix” will help define required information

Participation of all Parties Necessary for Successful Projects

What are the Reasons for Doing the Project?

Scope of Work vs. Statement of Work



Airports GIS Statement-of-Work

Aeronautical Survey and Airport Airspace Analysis

Administrative

Date: **August 3 2011**

Prepared for: **Cheyenne Regional/Jerry Olson Field Airport (CYS), Cheyenne, Wyoming**

PlannedNTP: August 2011
Estimated Completion: Within 6 to 12 months from notice to proceed

Objectives and Background

Goal
The goal of this project is to provide highly-accurate survey data in support of the development of vertically guided GPS-LPV Approaches to runways 9/27 and 13/31 at Cheyenne Regional/Jerry Olson Field Airport (CYS) located near Cheyenne, WY. The Advisory Circulars identified below detail the data collection requirements and accuracies for the project and the verification process by the Federal Aviation Administration (FAA) and the National Geodetic Survey (NGS).

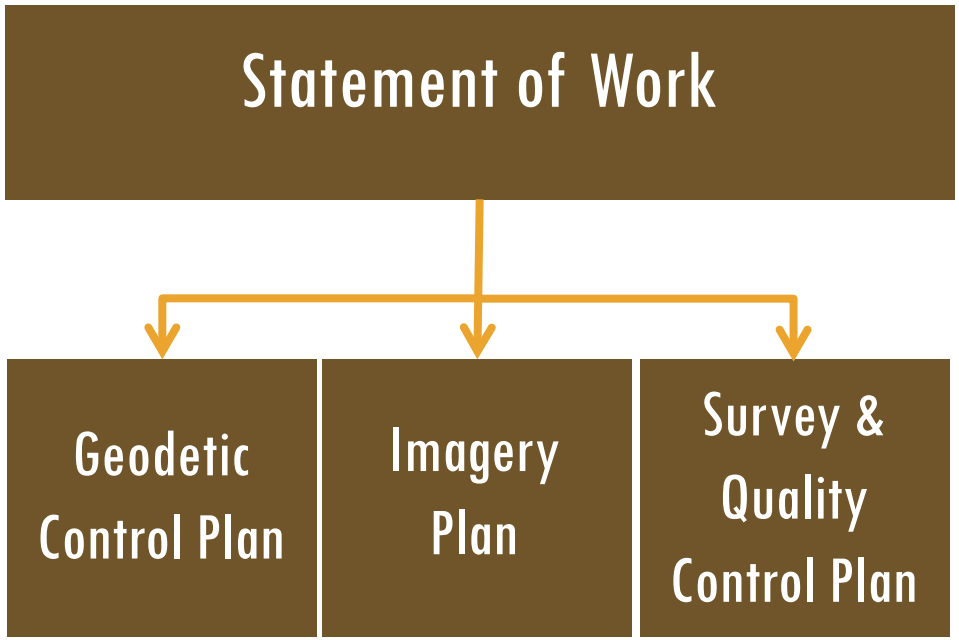
Scope of Services
The scope of work, with cost proposal, shall include all necessary professional engineering, surveying, aviation planning and project management services related to the development of vertically guided GPS-LPV Approaches to runways 9/27 and 13/31 at Cheyenne Regional/Jerry Olson Field Airport (CYS) located near Cheyenne, WY. The airport ground surveys and collection of aerial imagery of the survey area shall be performed in accordance with the appropriate FAA guidance. To ensure safety, all survey data collected by the Consultant/Surveyor must meet the accuracy requirements in the current Advisory

Cheyenne Regional (CYS) SOW20110803.doc Page 1 of 6

Scope of Work: A detailed description of all work involved in the project. The scope is agreed upon between the Airport and the consultant with the knowledge of the **ADO**.

Statement of Work: A detailed description of the work involved in creating the obstruction survey. It must agree with the Scope of Work.

Developing a Statement of Work (SOW)



Overview of Plans

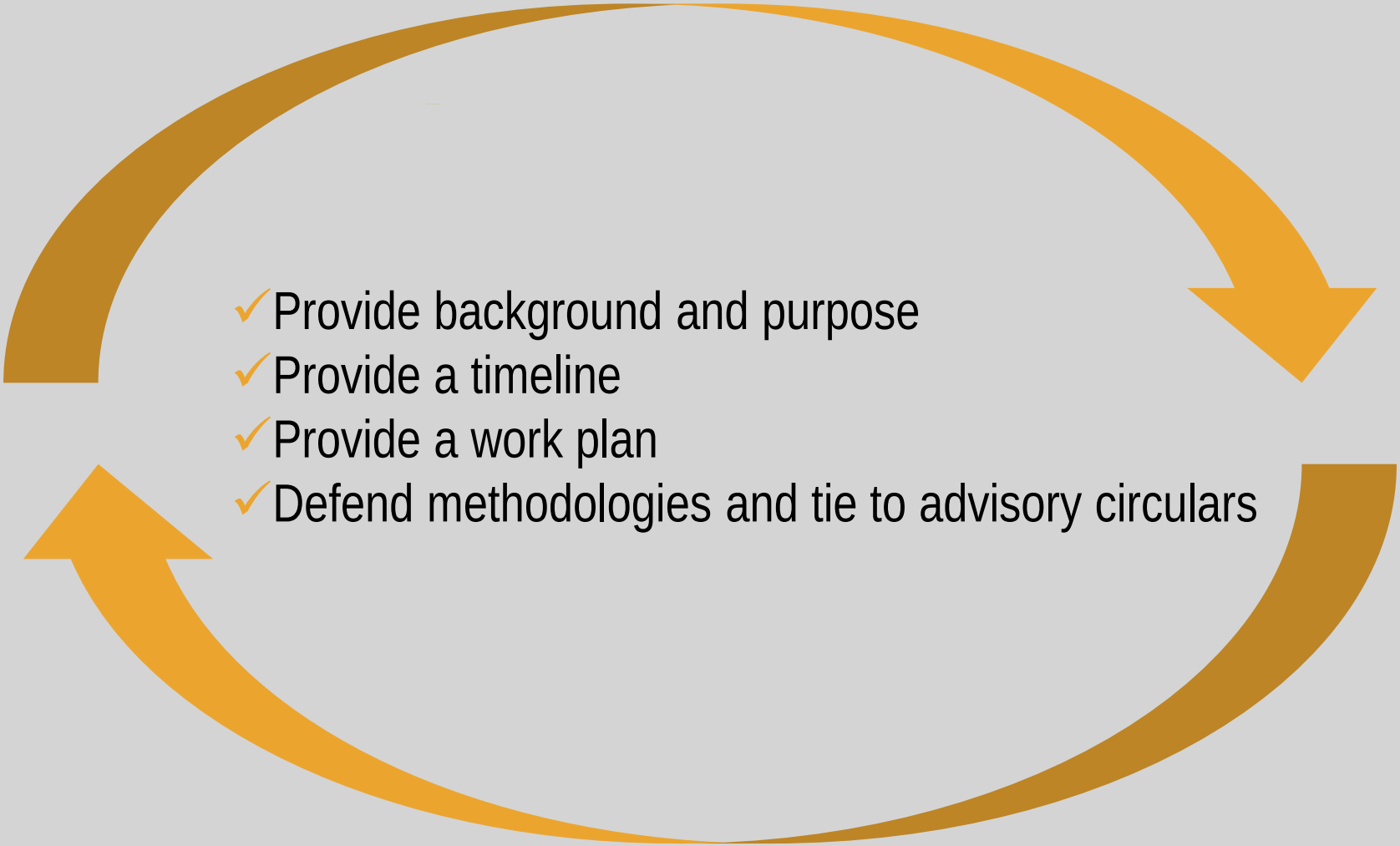
- AC-150/5300-16A - Geodetic Control Plan
  - ✓ Required when establishing new PACS/SACS
  - ✓ Details methodology for establishing PACS/SACS
- AC-150/5300-17C – Imagery Plan
  - ✓ Submission/Approval required before acquisition
  - ✓ Acquisition report if deviating from Imagery Plan
  - ✓ Details methodology for Imagery Acquisition and Use
- AC-150/5300-18B - Survey/Quality Control Plan
  - ✓ Required for any survey project initiated thru AGIS
  - ✓ Submission/Approval required before project commencement
  - ✓ Details methodology for data acquisition and quality control
  - ✓ Outlines GIS Data Attribution and Features Collected

All Plans must be submitted to the FAA through the FAA GIS/TPSS Website

Purpose of Plans – FAA's Expectations

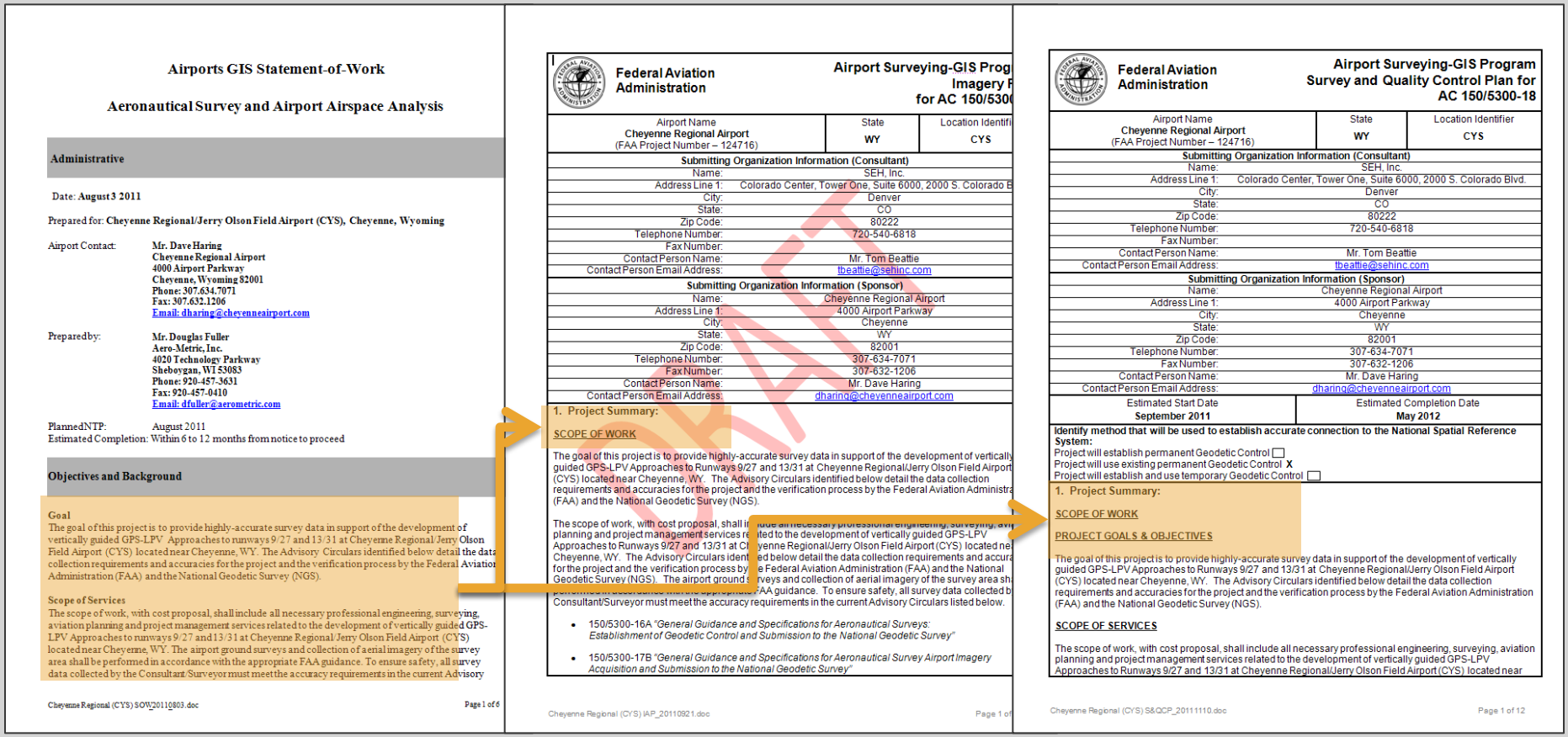
- The Statement of Work (SOW) sets up the plot of the story
  - ✓ SOW explains WHAT you are going to do
  - ✓ FAA is requiring more detail to be added to SOW
- The plans expand on the "What" and explain the "How"
  - ✓ Explains in further detail what you are going to do
  - ✓ Explains your methodologies in detail
- Advisory Circular Requirements
  - ✓ What are the AC requirements for your particular project?
  - ✓ How do your methodologies ensure required accuracies?

Together, project plans tell the story from beginning to end. They:



- ✓Provide background and purpose
- ✓Provide a timeline
- ✓Provide a work plan
- ✓Defend methodologies and tie to advisory circulars

Objectives from the Statement of Work are Repeated in the FAA Imagery Plan and also the Survey/Quality Control Plan



Airports GIS Statement-of-Work

Aeronautical Survey and Airport Airspace Analysis

Administrative

Date: **August 3 2011**

Prepared for: **Cheyenne Regional/Jerry Olson Field Airport (CYS), Cheyenne, Wyoming**

Airport Contact: **Mr. Dave Haring**
Cheyenne Regional Airport
4000 Airport Parkway
Cheyenne, Wyoming 82001
Phone: 307.634.7071
Fax: 307.632.1206
Email: dharing@cheyenneairport.com

Preparedby: **Mr. Douglas Fuller**
Aero-Metric, Inc.
4020 Technology Parkway
Sheboygan, WI 53083
Phone: 920-457-3631
Fax: 920-457-0410
Email: dfuller@aerometric.com

PlannedNTP: August 2011
Estimated Completion: Within 6 to 12 months from notice to proceed

Objectives and Background

Goal
The goal of this project is to provide highly-accurate survey data in support of the development of vertically guided GPS-LPV Approaches to runways 9/27 and 13/31 at Cheyenne Regional/Jerry Olson Field Airport (CYS) located near Cheyenne, WY. The Advisory Circulars identified below detail the data collection requirements and accuracies for the project and the verification process by the Federal Aviation Administration (FAA) and the National Geodetic Survey (NGS).

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Cheyenne Regional (CYS) SOW20110803.doc Page 1 of 6

Federal Aviation Administration

Airport Surveying-GIS Prog
Imagery F
for AC 150/530

Airport Name	State	Location Identifi
Cheyenne Regional Airport (FAA Project Number – 124716)	**WY**	**CYS**

Submitting Organization Information (Consultant)	
Name:	SEH, Inc.
Address Line 1:	Colorado Center, Tower One, Suite 6000, 2000 S. Colorado B
City:	Denver
State:	CO
Zip Code:	80222
Telephone Number:	720-540-6818
Fax Number:	
Contact Person Name:	Mr. Tom Beattie
Contact Person Email Address:	tbeattie@sehinc.com
Submitting Organization Information (Sponsor)	
Name:	Cheyenne Regional Airport
Address Line 1:	4000 Airport Parkway
City:	Cheyenne
State:	WY
Zip Code:	82001
Telephone Number:	307-634-7071
Fax Number:	307-632-1206
Contact Person Name:	Mr. Dave Haring
Contact Person Email Address:	dharing@cheyenneairport.com

1. Project Summary:

SCOPE OF WORK

The goal of this project is to provide highly-accurate survey data in support of the development of vertically guided GPS-LPV Approaches to Runways 9/27 and 13/31 at Cheyenne Regional/Jerry Olson Field Airport (CYS) located near Cheyenne, WY. The Advisory Circulars identified below detail the data collection requirements and accuracies for the project and the verification process by the Federal Aviation Administra (FAA) and the National Geodetic Survey (NGS).

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- 150/5300-16A *"General Guidance and Specifications for Aeronautical Surveys: Establishment of Geodetic Control and Submission to the National Geodetic Survey"*
- 150/5300-17B *"General Guidance and Specifications for Aeronautical Survey Airport Imagery Acquisition and Submission to the National Geodetic Survey"*

Cheyenne Regional (CYS) IAP_20110921.doc Page 1 of

Federal Aviation Administration

Airport Surveying-GIS Program
Survey and Quality Control Plan for
AC 150/5300-18

Airport Name	State	Location Identifier
Cheyenne Regional Airport (FAA Project Number – 124716)	**WY**	**CYS**

Submitting Organization Information (Consultant)	
Name:	SEH, Inc.
Address Line 1:	Colorado Center, Tower One, Suite 6000, 2000 S. Colorado Blvd.
City:	Denver
State:	CO
Zip Code:	80222
Telephone Number:	720-540-6818
Fax Number:	
Contact Person Name:	Mr. Tom Beattie
Contact Person Email Address:	tbeattie@sehinc.com
Submitting Organization Information (Sponsor)	
Name:	Cheyenne Regional Airport
Address Line 1:	4000 Airport Parkway
City:	Cheyenne
State:	WY
Zip Code:	82001
Telephone Number:	307-634-7071
Fax Number:	307-632-1206
Contact Person Name:	Mr. Dave Haring
Contact Person Email Address:	dharing@cheyenneairport.com

Estimated Start Date	Estimated Completion Date
September 2011	**May 2012**

Identify method that will be used to establish accurate connection to the National Spatial Reference System:
Project will establish permanent Geodetic Control ☐
Project will use existing permanent Geodetic Control **X**
Project will establish and use temporary Geodetic Control ☐

1. Project Summary:

SCOPE OF WORK

PROJECT GOALS & OBJECTIVES

The goal of this project is to provide highly-accurate survey data in support of the development of vertically guided GPS-LPV Approaches to Runways 9/27 and 13/31 at Cheyenne Regional/Jerry Olson Field Airport (CYS) located near Cheyenne, WY. The Advisory Circulars identified below detail the data collection requirements and accuracies for the project and the verification process by the Federal Aviation Administration (FAA) and the National Geodetic Survey (NGS).

SCOPE OF SERVICES

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Cheyenne Regional (CYS) S&QCP_20111110.doc Page 1 of 12

DRAFT

Statement of Work

The consultant will coordinate with the Airport Traffic Control Tower (ATCT) Management for the flight mission and access to the ATCT and FAA Technical Operations for access to NAVAID facilities.

Geodetic Control

This project will use existing PACS CYSA (DH3524), SACS CYSB (DH3525) and CYSC (DH3526). If existing PACS/SACS are determined to be damaged the project will establish temporary geodetic control as required. Geodetic data will be tied to the National Spatial Reference System. A Geodetic Control Plan is not required for this project since PACS and SACS will not be established.

Project Datums:

Wyoming State Plane Coordinate System, East Zone
North American Datum of 1983/2007 (NAD83 (NSRS2007))
North American Vertical Datum of 1988 (NAVD88) Feet
United States Survey Feet
GEOID09

Imagery

Per AC 5300-17B, imagery will show full leaf coverage.

Color Film to be used: Kodak 2460 or AGFA X-100.

The following Flight Missions will be performed:

Flying Height	Area	Photo scale	Ground Sample Distance
7,998' AGL	A	1"= 1,333'	12 inch
1,800' AGL	B	1" = 300'	3 inch

Area – Entire project area to include all Object Identification Surfaces (OIS) as defined in AC 150/5300-18B, Sections 2.7.1.1 and 2.7.1.3

Orthorectified imagery will be submitted for both the 1"=1,333' and 1"=300' flight missions. Deliver data and information to NGS per 150/5300-17B, Paragraph 20. Data will be delivered to FAA per 150/5300-17B, Paragraph 22

FAA Survey/Quality Control Plan

Airport Feature Data:

The airport feature and obstacle collection will primarily be collected using the photogrammetric remote sensing data. All of the feature and obstacle data have minimum positional accuracy requirements of 5-feet vertical and 3 feet horizontal which is easily obtainable from the imagery. GPS or conventional control surveys would only be used for this data if it is required to validate the accuracy of an object that is too small to see on the imagery. All feature and obstacle data will be collected to the AC 150/5300-18B accuracy requirements.

3. Geodetic Control:

Airport control stations to be used during the survey:

The airport currently has existing PACS CYSA (DH3524), SACS CYSB (DH3525) and CYSC (DH3526). If recoverable these stations will be utilized for the base airport control. The control ties would be completed during the photo and runway control surveys and would include at least two independent observation sessions of at least 10 minutes between the PACS and two SACS stations. The geodetic control surveys will follow all field, adjustment and reporting specifications as stated in AC 150/5300-16A. The station locations and survey efforts will be discussed with the airport manager prior to any field activities and it will then be decided if these control stations can be utilized.

If these stations can not be recovered, then temporary control stations will be installed on the airport property at locations agreeable with the airport manager. The control for the newly installed stations will be tied to the NSRS through the NGS Online User Positioning System (OPUS). Two independent four hour GPS observations will be completed using LEICA dual-frequency geodetic GPS receivers. The GPS observation data will be submitted to the NGS OPUS web-site for processing relative to the NSRS. The geodetic control surveys will follow all field, adjustment and reporting specifications as stated in AC 150/5300-16A.

Airport photo-ID point survey:

The Photo-control points will be clear, well defined and identifiable locations. All photo ID points will be surveyed by static or R/T GPS methods. Static survey points will be tied to two base control points. R/T GPS points will be tied radially with ties to other control points. Check points will be surveyed by static GPS methods

and computed using the PACS and SACS and the CORS Data. All check points will be submitted to OPUS for adjustment.

During the survey, photographs will be taken at each location and a GPS Observation Log sheet will be completed. A Location Sketch and Visibility Diagram form will be filled out for each location also.

Project Horizontal Control Datum:
North American Datum of 1983/2007 (NAD83 (NSRS2007))
Wyoming State Plane Coordinate System, East Zone
United States Survey Feet
Project Vertical Control Datum:
North American Vertical Datum of 1988 (NAVD88)Feet

4. Imagery:

Aerial Photography

Statement of Work

The consultant will coordinate with the Airport Traffic Control Tower (ATCT) Management for the flight mission and access to the ATCT and FAA Technical Operations for access to NAVAID facilities.

Geodetic Control

This project will use existing PACS CYSA (DH3524), SACS CYSB (DH3525) and CYSC (DH3526). If existing PACS/SACS are determined to be damaged the project will establish temporary geodetic control as required. Geodetic data will be tied to the National Spatial Reference System. A Geodetic Control Plan is not required for this project since PACS and SACS will not be established.

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FAA Imagery Plan

Federal Aviation Administration

Airport Surveying-GIS Program Imagery Plan for AC 150/5300-17

Airport Name	State	Location Identifier
Cheyenne Regional Airport (FAA Project Number – 124716)	**WY**	**CYS**

Submitting Organization Information (Consultant)	
Name:	SEH, Inc.
Address Line 1:	Colorado Center, Tower One, Suite 6000, 2000 S. Colorado Blvd.
City:	Denver
State:	

collection method.

The Airport Airspace Analysis Surfaces that will be surveyed:

The obstruction analysis will include all of the Airport Airspace Survey Surfaces associated with the Runways with Vertical Guidance analysis criteria for both ends of Runways 9/27 and 13/31. Obstacle data will be collected for all of these surfaces as outlined in AC 150/5300-18B, section 2.7.

Surfaces:
- Vertically Guided Runway Primary Surface (VGRPS)
- Vertically Guided Primary Connection Surface (VGPCS)
- Vertically Guided Approach Surface (VGAS)
- Vertically Guided Protection Surface (VGPS)
- Vertically Guided Approach Transitional Surface (VGATS)
- Vertically Guided Horizontal Surface (VGHS)
- Vertically Guided Conical Surface (VGCS)

2. Collection Methods:

AIRPORT IMAGERY

The geo-referenced imagery of the survey area will meet the accuracy requirements specified in AC150/5300-17B, *"General Guidance and Specifications for Aeronautical Survey Airport Imagery Acquisition and Submission to the National Geodetic Survey"*.

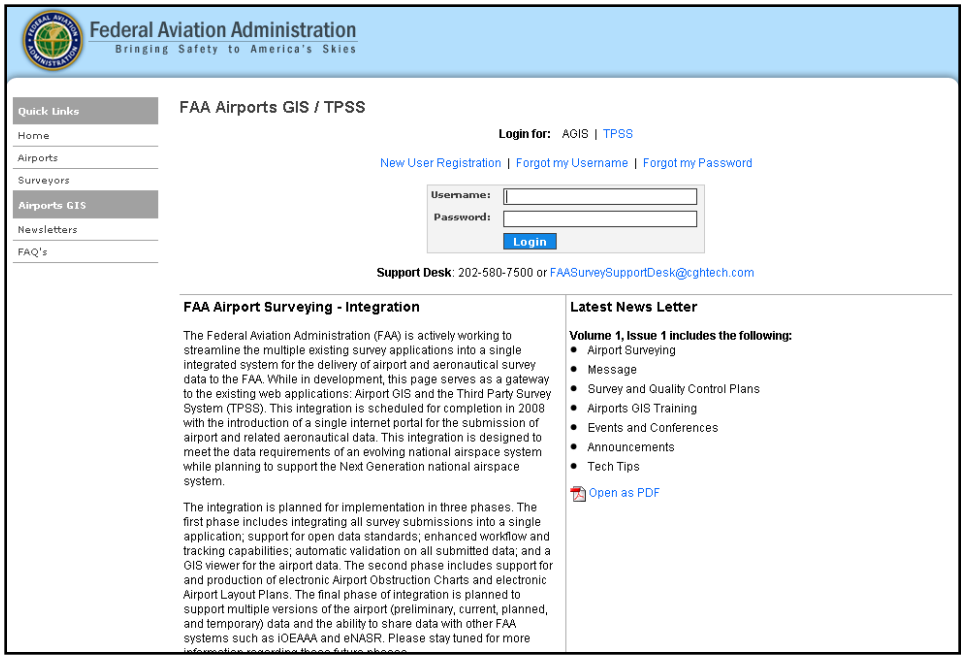
Aerial Photography

Vertical color aerial photography will be acquired in the summer of 2011 during full leaf conditions. The imagery will be obtained using Kodak 2460 AeroColor IV or Agfa X-100 color negative film emulsion. The photography will be captured at two flight altitudes.

A flight scale of 1"=1,333' (7,998' above mean terrain) to cover the entire airspace analysis surface area for obstacle collection. There will be a total of 6 lines of imagery with a total of 71 exposures for this flight scale. This photography will be captured with the flight lines having a 60 percent forward overlap and 30 percent sidelap.

DRAFT

Data Upload Process
Airport Sponsor or Consultant Roles



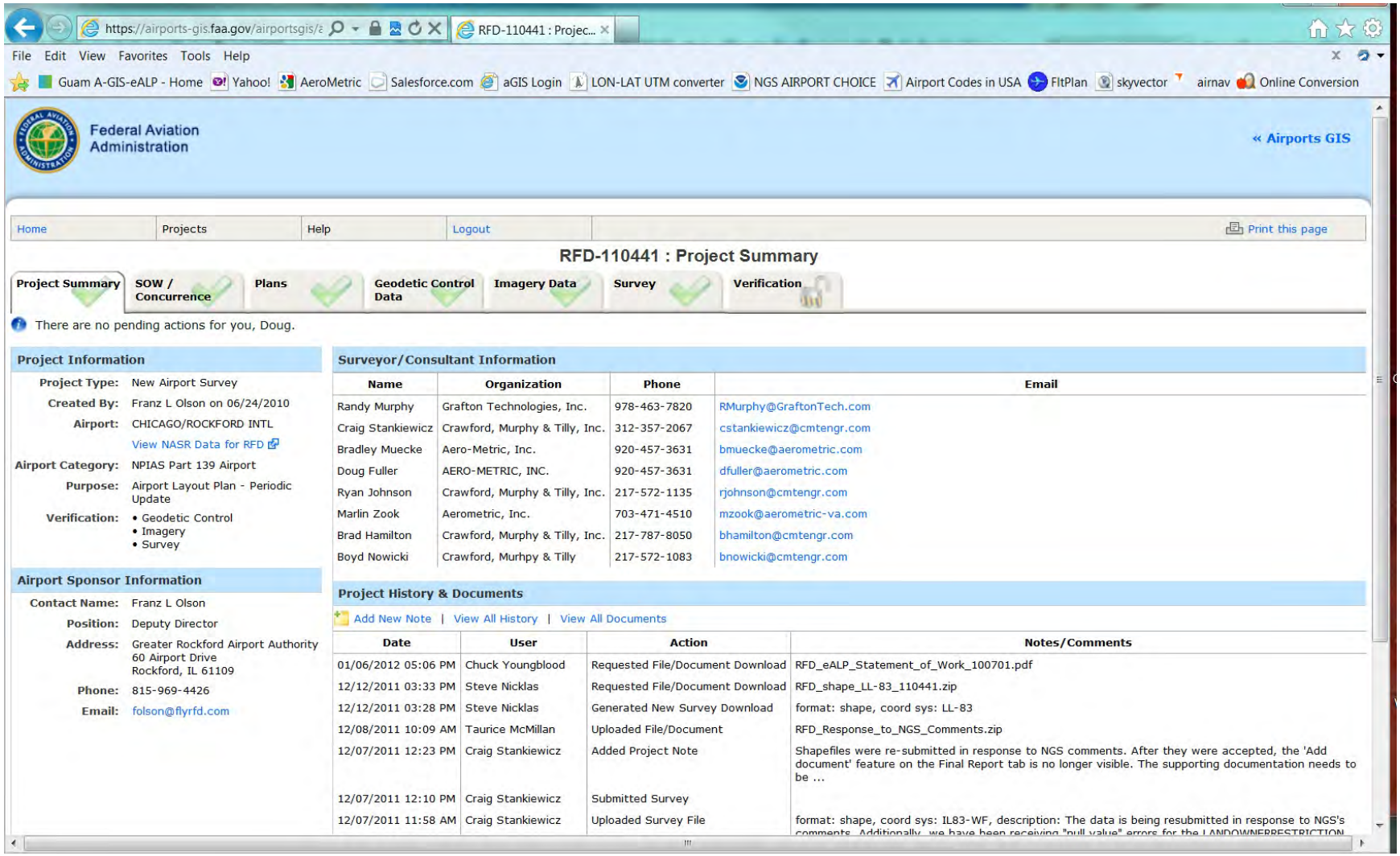
- Create Log In for Airport Project on the FAA GIS/TPSS Systems
- Allows for Project Tracking by FAA, Sponsor & Consultants
- All Data must be uploaded through System
- Data remains on system to allow future use of existing data

Federal Aviation Administration

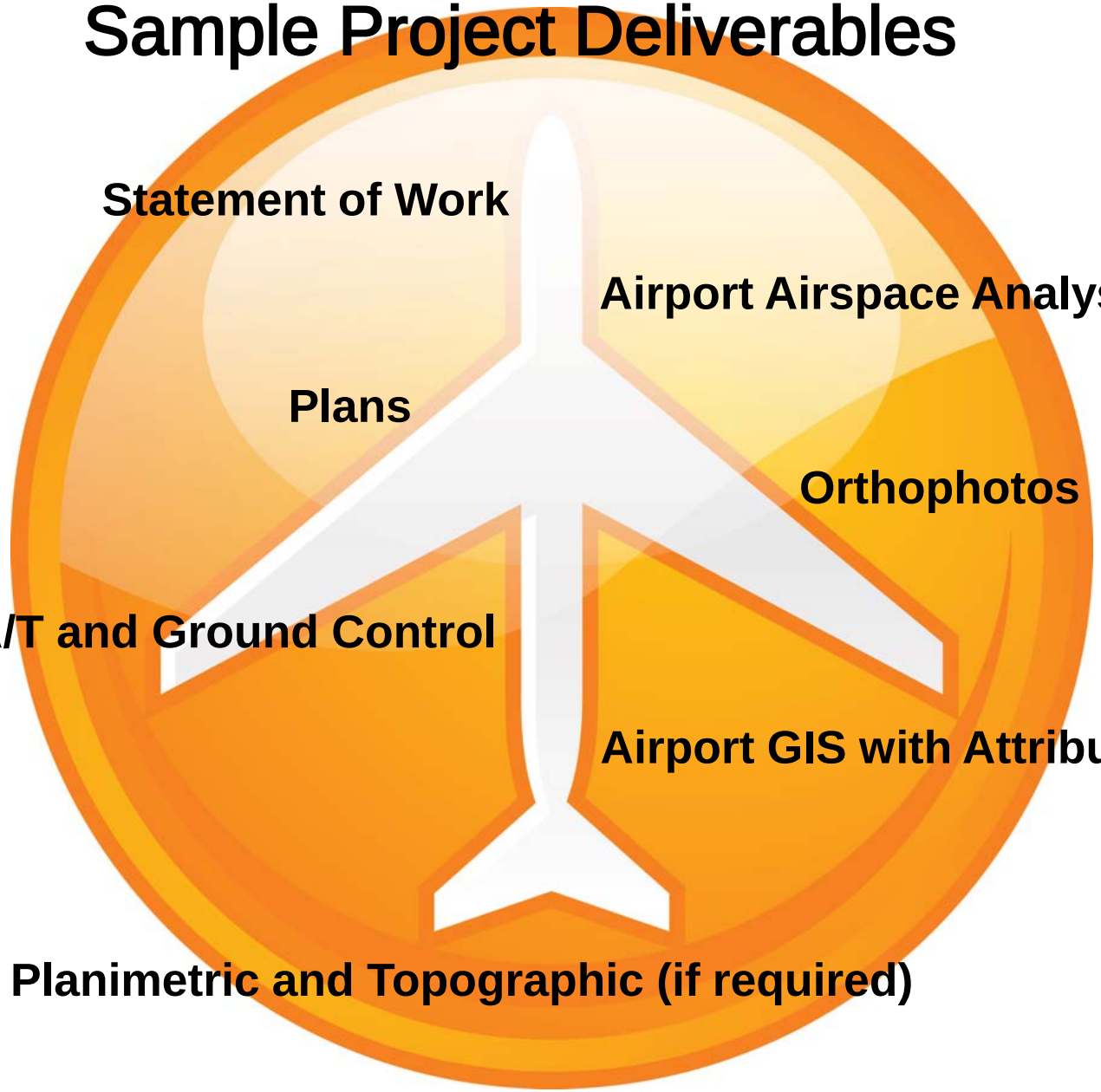
https://airports-gis.faa.gov/airportsgis/

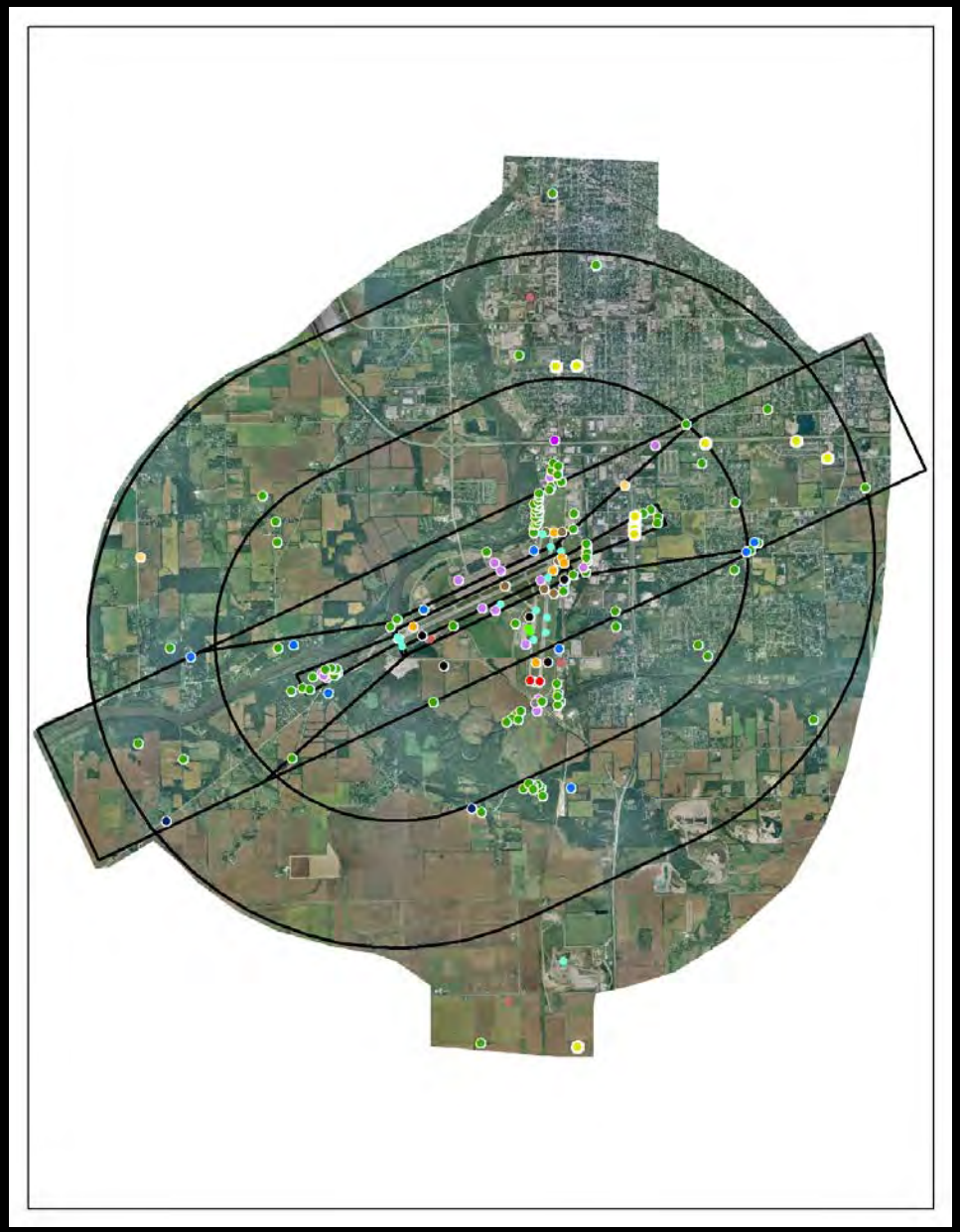
aerometric

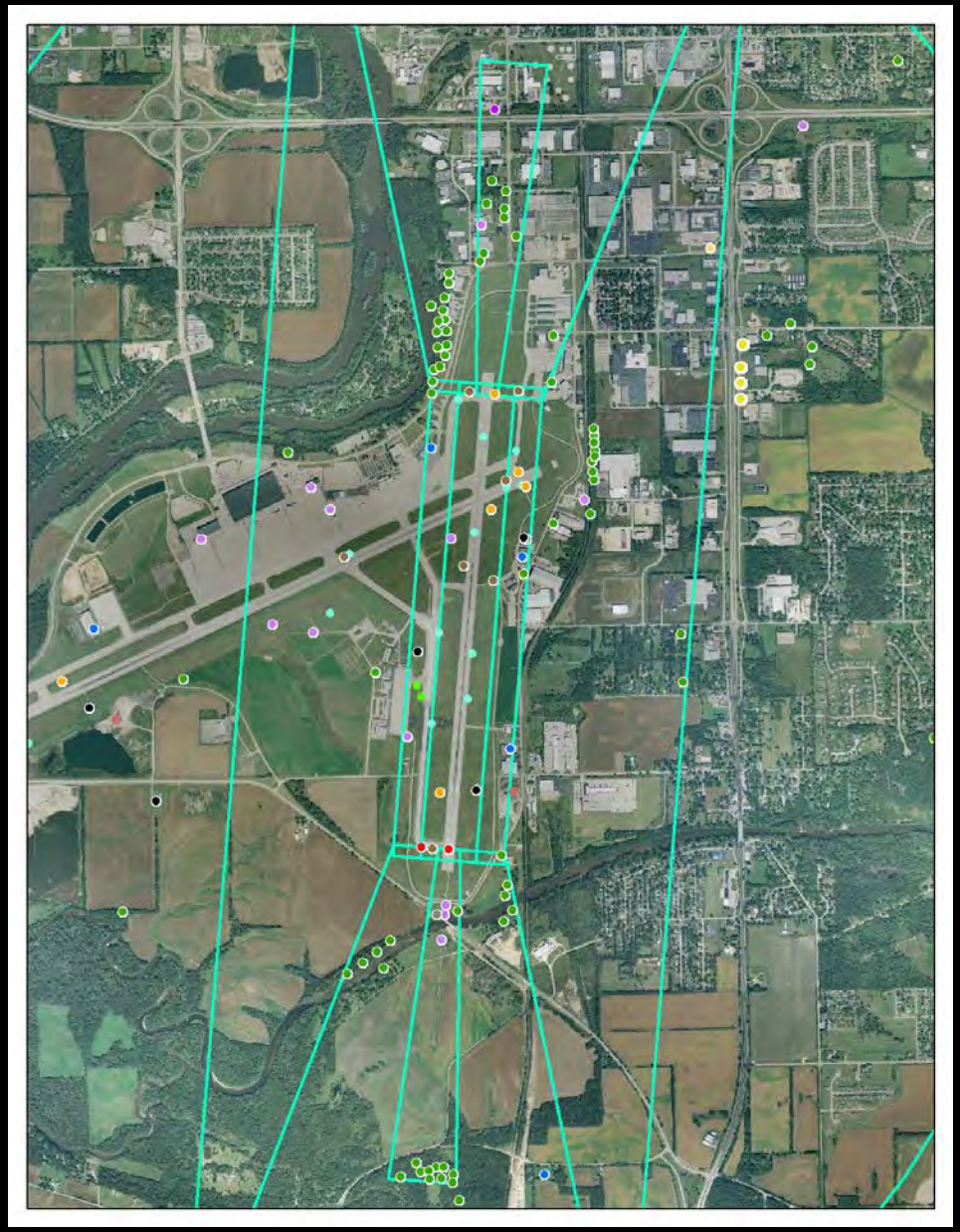
Airport GIS Website – Project Portal



Sample Project Deliverables







Planning Airport Imagery Acquisition & Ensuring Usability for Future Purposes

Sponsors must consider project requirements:

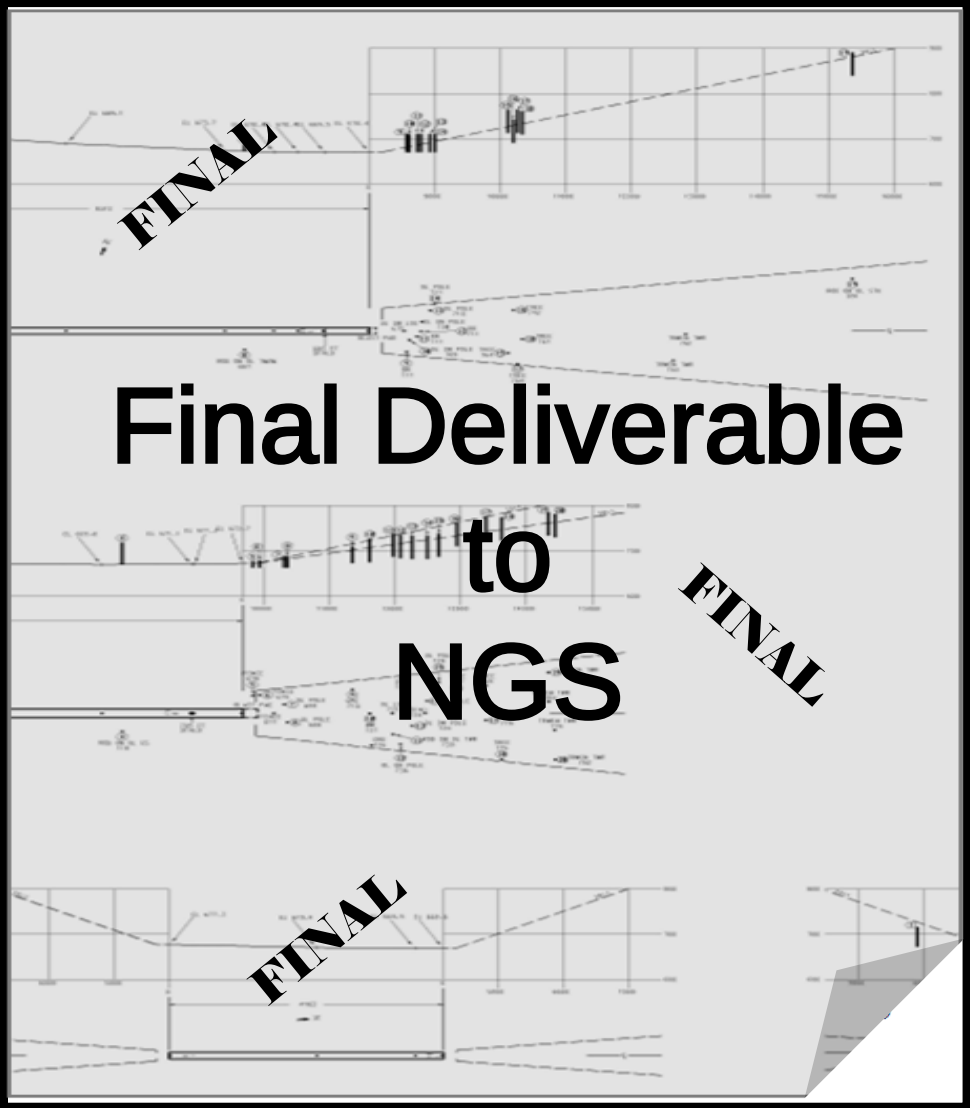
- Minimum of 1’ pixel resolution quality required
- Higher accuracy is typically necessary
- Does your project require topography?
  - ✓1’ Contours
  - ✓2’ Contours
- Does your project need engineering quality planimetric mapping?
- Imagery limits for obstruction analysis may not cover other project parameters

Once the plane is in the air, extra imagery is not expensive

NGS Review of Imagery and Survey Data

Completed Aerial Imagery and Survey Data Submission

- Imagery Approval
  - ✓ Consultants must provide scanned imagery on portable media for NGS review and acceptance
  - ✓ Completed Aero-Triangulation Report
- Survey Control Approval
  - ✓ Completed Survey Report


FINAL
Final Deliverable
to
NGS
FINAL
FINAL

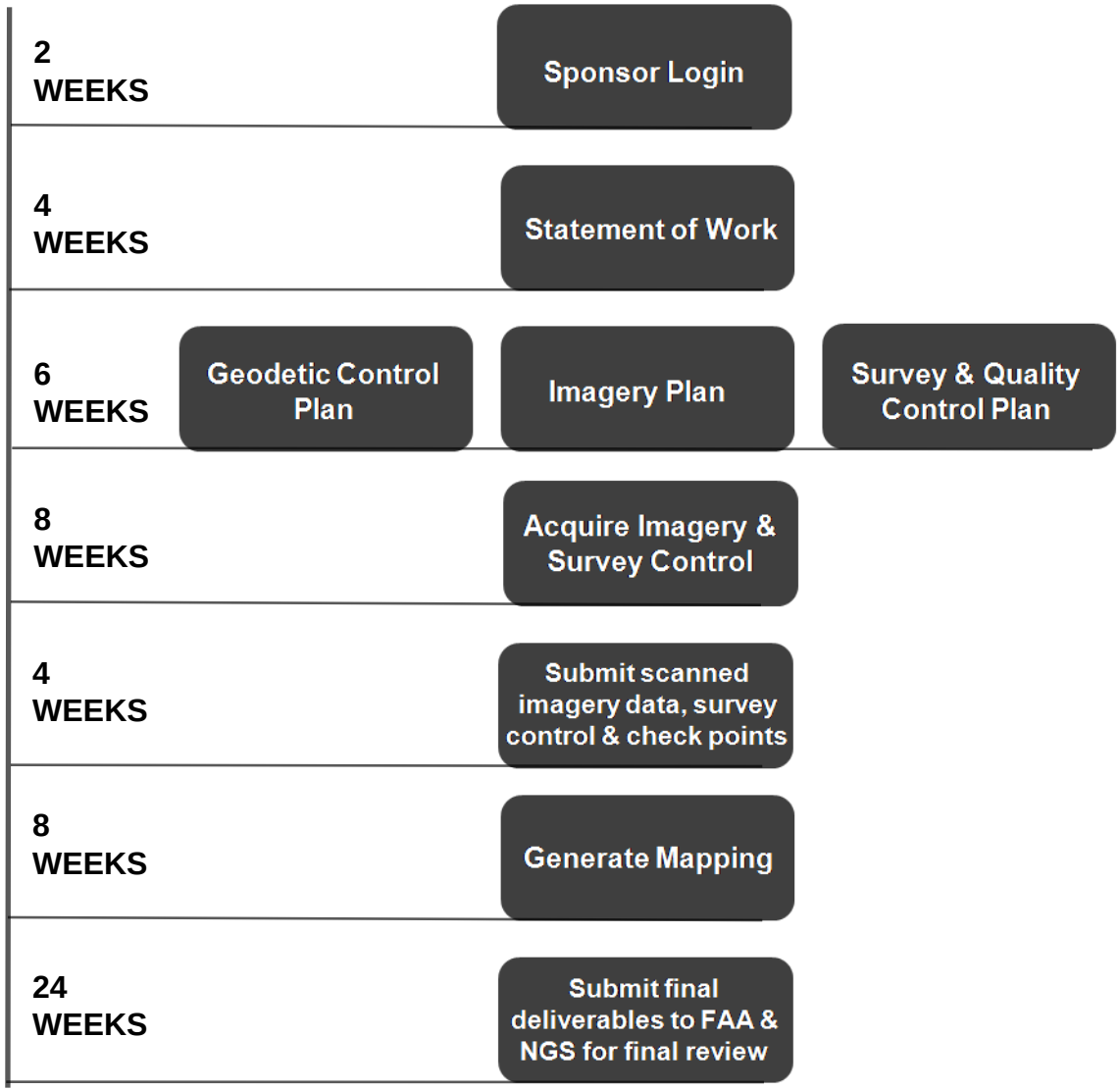
FAA's AC 150/5300-18B Data Submission

Airport Obstruction Survey Completion and Submission to FAA/NGS

Consultant must provide the following:

- Complete Photogrammetric Mapping
- Complete Field Survey including Runway Profiles & Nav Aid Surveys
- Complete Field Verification of all survey data
- Submit completed survey to FAA's GIS Website for Approval

Schedule – After Notice to Proceed



Lessons Learned

Project Scope & SOW

- This is a project between, FAA, NGS, Sponsor & Consultants
- Communication is *Key*
- Scope of Work should provide specific project goals
- FAA is requesting more & more detail in both the SOW and the Project Plans
- Project Plans are your road map to success

Plans Submission

- Sooner is better than later
- Get your imagery plans in early for fall flight season
- NGS work volume is ever increasing
- Plans could take several months to get approved
- Plan ahead

What's Next???

Division of Work

- Clear division of work between consultants is essential
- Translation and Validation of existing data if appropriate
- Attribution of data is a huge cost, who is doing it?
- Who will assure data is properly formatted for upload?

aerometric

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Thank You!