This chapter describes the different types of spatial data that NextGen programs utilize, produce, or enhance, and how this data is used.

The NextGen concept of operations (CONOPS) and the FAA’s NextGen Implementation Plan emphasize the important role airports play in airspace redesign and procedure development activities, which are cornerstones of NextGen implementation. With the introduction of NextGen, service improvements such as trajectory-based operations, surface traffic management, MRO, and other net-centric concepts require enhanced and open data sharing. The benefits of achieving enhanced and open data sharing include:

- Greater airport, airline, and airspace efficiencies;
- Support for risk-based decision making;
- Enablement of safety management systems (SMS);
- Greater insights into the environmental effects of noise, emissions, and water quality; and
- Improvements to customer and citizen experiences.

Enhanced spatial data also allows for greater insight, planning, monitoring, and control of assets (i.e., land, utilities, NAVAIDs, and facilities); enables better understanding of the topographical elements of the extensive airport property; and supports both security and event management. It also supports future improvements associated with ideas such as aerotropolis concepts, multi-modal integrated solutions, and overall community planning and zoning.

Spatial data originates from a variety of sources, including federal, state, and local agencies; airports; airport consultants; and private vendors. Spatial data built upon common data standards, categorized by data quality and accuracy, and organized as a single authoritative source for each data element in an accessible database, enables NextGen operational improvements and other airside and landside improvements. Such improvements in spatial data benefit many operational, economic, environmental, political, and customer-experience drivers of growth, as well as regional and community leadership in air transportation.

Overview of Spatial Data Sources and Requirements

The FAA’s AGIS program has been described as an “enabler” of NextGen. Although this is true, NextGen programs also take advantage of other spatial data sets from third parties, as well as existing state and local data and legacy data sets not currently found in AGIS. NextGen initiatives also produce spatial data that other users, such as airports, the local community, or airlines may find beneficial. Some
NextGen programs do not use or produce spatial data but may enhance existing spatial data sets or have applications for airport operations.

In considering spatial data requirements and sources, how the data will be used in certain NextGen programs is an important factor. NextGen programs such as PBN or MRO, which rely on GPS navigation during certain phases of an arriving or departing procedure, require a high level of spatial accuracy and currency for features such as obstacles, runway ends, runway centerlines, and a list of other spatial data features (see Figure 2-1). These programs have accuracy requirements for spatial data features as stringent as 1 ft. horizontally and 0.25 ft. vertically. A majority of the near-airport and on-airport spatial data features used in the development of flight procedures come from AGIS data sets, and are often referred to as “safety critical” features. (Chapter 5 of FAA’s Advisory Circular AC 150/5300-18 lists all of the AGIS features and their associated horizontal and vertical accuracies).

The use and accuracy requirements of spatial data sets used in certain surface operations portfolios may be quite different and may have a lower spatial quality constraint. For example, surface visualization and situational awareness tools employ spatial data and mapping but do not necessarily need survey-grade accuracy. These tools can use a base map that depicts the airfield features and layout, showing where an incoming or departing airplane is on the airfield and where other moving elements (i.e., other planes and vehicles) are in relation to their current position.

Another factor in the consideration of what spatial data source to use in certain NextGen programs is the end user. For users who are developing flight procedures, current and accurate source data is critical. In addition to other supporting data sets, procedure designers use AGIS data extracted from a server at FAA. In certain cases, a new aeronautical survey must be conducted in order to develop a requested new procedure because the high-accuracy AGIS data either is not currently in the system or is out of date. This user community requires high accuracy and current information for analysis and modeling to develop the safest and most efficient procedures possible.

Other users of spatial data are primarily viewers who are not using the data for analysis. For example, viewers may consult a map for information such as location or descriptive information (see Figure 2-2).
A pilot may consult a map to determine where the next taxiway is and where other aircraft are positioned on the airfield relative to the pilot’s own position. From a pilot’s perspective, whether the map information is viewed on a head-up display or via a digital flight bag, the map display should have a consistent look and feel to it. Pilots view airfield map information at up to 15 different airports on any given day. Although the positional accuracy may be off by 10 to 20 ft., being able to quickly read the information on the map display and easily understand the output is equally important, if not more important, than the spatial accuracy. Airlines and Air Traffic Control (ATC) in terminal radar approach control facilities (TRACONs) staff use third-party spatial data for some NextGen programs and applications. Third-party data currently is more readily available and has been configured so that it has the consistent look and feel required for these types of applications. As AGIS continues to expand, the potential exists that the more accurate data developed under AGIS will be incorporated into these programs. However, more airports will need to obtain a completed AGIS data set in order for surface operations program applications to take advantage of this data.

**Types of Data Sources**

**Spatial Data Comes from Multiple Data Sources**

NextGen largely focuses on the safe and efficient operation of aircraft during all phases of flight. Much of the spatial data required for or produced by NextGen programs is operational by nature. For example, aircraft positional data, approach procedures, obstructions, and NAVAID locations all have a spatial component that supports the safe and efficient operation of aircraft. Data that is not directly related to the operation of aircraft, such as land parcels or land use, also is relevant to airports and
to NextGen. These varying, and sometimes overlapping, spatial data sets can be broken into various source group types (see Figure 2-3). This section provides an overview of how these data sets currently are applied to NextGen programs and where the data comes from. It also provides some historical context for AGIS data in particular.

Airport Data

Airports develop spatial data for many different reasons, primarily to fulfill their own needs and support their own operations, but also as required by the FAA for federally funded projects (see Figure 2-4). These projects may include the development of new flight procedures, new master plans.
and ALPs, various airfield projects such as runway extensions, and other large capital improvements to the airfield. The data developed in support of and as a result of these many different federally funded airfield projects typically must comply with FAA ACs 150/5300-16, 17, and 18. This data is often referred to throughout these documents as AGIS data. (For additional information, see the FAA's Airport Geographic Information System Transition Policy memorandum dated August 23, 2012.) An overview of these two core sets of airport-produced spatial data is provided in the next two sections.

**FAA’s AGIS Program—Its Origin and Current Use for NextGen Programs**

Historically, airport spatial data has been collected by at least three separate organizations.

1. Airport sponsors have surveyed airports in order to support development and planning initiatives, including updating ALPs.
2. The FAA has conducted surveys to install NAVAIDs to support instrument landings.
3. In 1941, the **U.S. Coast and Geodetic Survey (CGS)** began conducting aeronautical surveys of airports and obstacles to improve flight safety. Subsequently, the National Geodetic Survey (NGS) conducted aeronautical surveys in order to create obstruction charts (OCs) and to provide data to the FAA for use in developing instrument approach and departure procedures.

Each of these surveys was available only to the specific organization that developed it. The surveys were developed according to varying standards and in different coordinate reference systems:

- NGS surveys were in spatial coordinates (initially following a technical service order and then, beginning in 1968, following FAA No. 405, Standards for Aeronautical Surveys and Related Products).
- Airport surveys often used a local coordinate system.
- FAA surveys that used the state plane coordinate system often were in differing state plane zones, which affected how the coordinates were defined.

Although the data could be transformed between differing coordinate systems, identifying the specific person with access to the data was difficult and time consuming, and the data was of unknown reliability.

Furthermore, the FAA did not provide specific survey standards to airports to develop FAA-mandated ALPs. Each time the ALP was updated, an additional survey was conducted by the airport. The ALPs were approved by the FAA, and then typically maintained in hardcopy format, which meant they were not readily available outside of the local ADO.

With the initiation of area navigation (RNAV) approaches, NGS lacked sufficient human and financial resources to conduct the number of surveys now needed. To meet the aggressive RNAV development schedule, third-party surveyors were contracted directly through the FAA and by airports that received Airport Improvement Program (AIP) funding. NGS transitioned from being the prime originator of aeronautical data for procedure development to focusing on quality control of aeronautical data, ensuring third-party surveyors were collecting and organizing the data accurately in order to meet FAA needs. FAA No. 405 defined these third-party surveying requirements. The data collected in FAA No. 405 was limited to elements critical to flight safety, including runway profiles and end coordinates, instrument landing equipment, and obstacles. The surveys did not include other airport infrastructures such as taxiways, aprons, terminals, or other buildings.

The FAA recognized the inefficiencies and impact on data quality caused by a lack of uniform standards and the use of multiple surveying coordinate systems. In 2006 the FAA canceled FAA No. 405 and published AC 150/5300-18, Survey and Data Standards for Submission of Aeronautical Data Using Airports GIS, thus initiating AGIS. AC 150/5300-18 provided a comprehensive set of standards for
collection for all features associated with an airport. A companion circular, AC 150/5300-17, established requirements for imagery collection. The collection of airport features utilizing photogrammetry, including obstacles, greatly enhanced the ability to efficiently and accurately collect aeronautical data. Photogrammetry also materially assisted in validating coordinate data.

AGIS reflected a move toward a data-centric environment in which organizations concentrate on integrating data from multiple sources and provide data management that enables the FAA to deliver airport aeronautical information across the NAS, automating tasks such as survey project oversight, processing airport data changes, and creating aeronautical charting products. A primary motivation for developing AGIS was to create common standards for delivering airport aeronautical data to the system’s users through enterprise web services.

AGIS’s primary objective is to collect, collate, validate, store, and disseminate airport aeronautical information to the NAS. Besides the collection of survey data and the integration of this data with FAA systems and products, this objective includes the management of airport data to ensure that the most up-to-date information is available. Spatial data—collected according to AC 150/5300-18, submitted to AGIS, validated by NGS, and then distributed throughout the NAS—enables the development of NextGen RNAV approaches and numerous products, including airport diagrams and electronic ALPs. AGIS improves airport productivity by increasing the throughput of survey data, and provides users with a single portal for accessing airport data. According to the FAA, AGIS also leads to long-term reductions in the overall costs associated with data collection, as well as a reduction in the need to use other systems to identify reliable sources or validate data. AGIS data quality is sufficient for use across the NAS, thereby reducing overall costs associated with data management. The FAA has indicated the following expected benefits to the NAS, the FAA, and airports, from use of AGIS:

- **Productivity**
  - Single Internet portal streamlines the collection and distribution of airport survey data;
  - Consolidated view of the current status and availability of data for a given airport supports the identification of gaps in data and the planning of future survey data collection efforts; and
  - Coordinated workflow is associated with reduction in manual processes and streamlined data validation and verification.

- **Economic efficiency**
  - Reduced costs associated with resurveying and duplicate collection of survey data;
  - Data collected is usable for multiple purposes, including analysis, planning, engineering, procedure development, and charting; and
  - Reduced overhead required to use other systems to research, identify, and manage airport data or airport data sources.

- **Data quality**
  - Data standardization;
  - Increased data accuracy; and
  - Availability of metadata.

- **Process standardization**
  - Common data standards and standardized processes for performing airport and aeronautical surveys;
  - Automation of data collection and verification processes; and
  - Defined business rules ensure that FAA offices are notified of changes and next actions as required.
• **Safety**

  - Increased safety, consistency, and efficiency of operations within the NAS.

Like NextGen overall, AGIS has realized multiple successes; yet NextGen and AGIS continue to evolve as their programs and capabilities are implemented in segments. Not all NextGen programs have been fully implemented for the entire NAS; similarly, not all airports—particularly the largest U.S. airports—are in the AGIS system. Approximately one-third of the top 30 airports in the United States do not have a complete (“all-airfield”) AGIS project in the system. Although some of these airports have initiated a program, it will still be a minimum of 2 years (and probably longer) before all of the airports that support the majority of the air traffic in the country are in the AGIS database. While these new projects are being finalized, airports already in the system must maintain their current AGIS data for it to remain relevant to NextGen. The importance of data maintenance is discussed in more detail in Chapter 3 of this guidebook.

**Airport-Developed Data Sources**

Most airports that have computer-aided design (CAD) and GIS programs develop spatial data for their own needs. These airports may have developed a complete AGIS data set, but much airport-developed data extends beyond that required by the FAA as defined in AC 150/5300-18. Airport-developed data may include spatial data collected at a higher level of detail than that required by AGIS, data found on the landside, and spatial data that is related to the inside space of terminal buildings. Although it is not part of AGIS, some of this data still may be of benefit to the FAA and specifically to NextGen. For example,

- **AC 150/5300-18 provides a mechanism to exchange basic information about utility assets.** This information includes the geographic location of utility assets represented as points, lines, and polygons, as well as an attribute to indicate the type of utility. Name, description, status fields, and user-definable fields provide a basis to exchange additional details as desired. Some airports have been asked to include utility infrastructure data as a part of the electronic ALP submittal to the FAA; other airports volunteer this data, but there is no requirement that all airports do so. Also, the data definitions available in AC 150/5300-18 are rudimentary and do not accommodate all of the details airports typically record about their utilities, such as material, size, and ownership information. This data could be invaluable to the FAA, and specifically to NextGen programs that install NAVAIDs, communications facilities, and other equipment at or near airports. A complete and accurate understanding of an airport’s utility infrastructure can help FAA projects avoid costly design changes or utility breaks. The same is true for airports that desire greater information about utility assets that the FAA has installed; by exchanging information about the utilities they install, maintain, or discover, airports and the FAA can help each other to more efficiently install and maintain this critical infrastructure.

- **Another important spatial data set describes airfield pavement,** one of the more expensive assets on an airport that is paid for mostly or in part by federal funds. Both airports and the FAA need information on pavement condition, pavement type, pavement dimensions, and other specifics about pavement features (e.g., taxiway, runway, or a safety area). The basic data can be found in an AGIS deliverable. To qualify for federal grant dollars and, most importantly, to keep the pavement maintained at a level of quality that ensures safety, airports collect additional data through regular pavement condition assessments. These condition assessments identify the condition of the pavement at a project level and sometimes at a panel level of detail. The detailed data collected in these pavement studies is well beyond the standards and specifications defined in AGIS. Even though a lot of this highly detailed pavement condition information may make its way to the FAA
through individual reports, spreadsheets, and documents sent in support of AIP grant requests, it is not currently provided in the consistent way that would be most useful to the FAA.

- Airports are constantly changing because of capacity enhancement needs, changes to the airfield to improve safety, new construction, or temporary situations, such as a need for maintenance to a portion of pavement or changes to lighting systems. An airport’s AGIS data is just a snapshot in time; that is, it is accurate as of the date on which the imagery was collected and the data was surveyed and converted to an AGIS format. Although data about projects funded through AIPs are ultimately populated into AGIS, data about many smaller or temporary projects and situations most likely does not make its way to an AGIS database. For example, temporary airfield issues that affect departures and arrivals are conveyed to ATC, the airlines, and ultimately to pilots through the issuance of Notices to Airmen (NOTAMs). A lot of this information has a spatial component to it and could easily be portrayed on a map through a digital flight bag, a map interface as part of the in-cockpit avionics, or a map-based application in the ATC tower or at the TRACON facility. The FAA is currently working on map-based digital NOTAM applications; as new avionics with map displays become more common and digital flight bag applications continue to evolve, this temporary data that is critical to ensuring flight safety will become another spatial data source and application.

Local Public-Sector Spatial Data Sources

Spatial data from local agencies has been documented in ACRP Synthesis of Airport Practice 59: Integrating Airport Geographic Information System (GIS) Data with Public Agency GIS. This synthesis report found that airports require spatial data “from surrounding communities to support planning and development, airspace analysis, property acquisition, noise mitigation, environmental protection, customer service, and other procedures.” Conversely, the study found that “public agencies require geographic information from airports for transportation planning, compatible land development, emergency response, and zoning” (Murphy and Bannura 2014).

Although some of this data describes features within the property boundaries of an airport, a majority of the data collected from local agencies relates to off-airport features. Features such as terrain and land parcels and data about land use and utilities (often stopping right at the airport property boundary), as well as light detection and ranging (LiDAR) data all are important spatial data sets that can be used to benefit airports and NextGen initiatives, specifically in the development of new PBN flight procedures.

The FAA uses data from local agencies in developing new flight procedures in an application called the airport environmental design tool (AEDT). AEDT is a GIS-based software application “that models aircraft performance in space and time to estimate fuel consumption, emissions, noise, and air quality consequences” (FAA n.d.a). In its analysis of these environmental impacts, AEDT also draws upon local zoning and land use data, as well as information about other local features on the ground, to evaluate and model the impacts of noise.

Third-Party Sources

Airports and aircraft operators also use spatial data developed and provided by third-party sources (Figure 2-5). Spatial data (e.g., maps) developed and provided by third-party sources is often done through a mass production process, utilizing satellite- or aircraft-based digital cameras that can collect a wide area of data. These third-party providers play an important role in NextGen programs in that they can provide spatial data that is updated on a regular basis, is readily accessible, and has a consistent look and feel. The spatial data developed by third-party sources does not meet the level of accuracy or completeness of AGIS data, but most applications that use third-party data do not require that level of accuracy. Third-party vendors involved in the production, maintenance, and distribution.
of data with applicability to NextGen are encouraged to comply with RTCA DO-272, User Requirements for Aerodrome Mapping Information, a standard developed by that organization’s Special Committee 217.

**User Requirements for Aerodrome Mapping Information (DO-272/ED-99)**

RTCA’s Special Committee 217 focuses on the standardization and exchange of aeronautical databases. Aerodrome (or airport) mapping databases (AMDBs) are now sold by a variety of vendors to aircraft operators, air traffic controllers, airports, and other aeronautical users worldwide.

RTCA DO-272 is similar to FAA AC 150/5300-18 in that it defines feature classes, attributes, and domain values that depict airport features. The documents differ slightly in that DO-272 is designed specifically for aeronautical use, whereas AC 150/5300-18 is designed to support aeronautical, planning, and other purposes. Despite these differences, DO-272 and AC 150/5300-18 have aligned many of their definitions at various milestones in their development.

The organized set of user requirements in DO-272 has evolved over the past 15 years, and the document is currently in its fifth revision. The objective of the requirements is for developers to structure the data they provide to aeronautical system designers and other end users in a consistent way. DO-272 complements RTCA DO-276, User Requirements for Terrain and Obstacle Data (eTOD). It also is supported by RTCA DO-342, Guidelines for Verification and Validation of AMDB Aerodrome Surface Routing Networks (ASRN) for Routing Applications, and RTCA DO-291, Minimum Interchange Standards for Terrain, Obstacle, and Aerodrome Mapping Data. These standards are also compatible with Eurocontrol and FAA’s aeronautical information exchange model (AIXM), flight information exchange model (FIXM), and the weather information exchange model (WXXM). These data exchange standards are being used to support NextGen system wide information management (SWIM) capabilities such as the SWIM terminal data distribution system (STDSS) (Usmani 2012).
Collectively, these requirements and guidelines define how spatial data relevant to NextGen can be structured and exchanged. With the exception of AC 150/5300-18, U.S. airports are not required to meet the requirements of these documents. Airports may, however, use these documents to understand data provided by vendors, the FAA, or other sources that do follow these requirements. Airports may also consider some of the industry-wide best practices and expert consensus embodied in these documents when developing their own internal spatial databases.

RTCA has developed many of its documents in coordination with the European Organization for Civil Aviation Equipment (EUROCAE). RTCA DO-272 is also published as EUROCAE ED-99. Similarly, RTCA DO-276 is equivalent to ED-98 and RTCA DO-291 is equivalent to ED-119.

NAV Lean

Two common themes can be found in the previous sections’ discussion of the use and storage of spatial data: (1) the abundance of spatial data that could—but is not yet—being utilized in support of NextGen programs; and (2) the duplication of efforts to acquire and store data that resides in FAA databases and data that is being developed by airports, by other public sector agencies, and through third-party sources. Although it is not practical for all untapped or duplicate data sets to be brought to the same level of quality or currency, a lot of spatial data is being used for which a more current data set exists elsewhere; moreover, confusion is frequently caused by these duplicate data sets. To address these issues, in 2010 the FAA developed an implementation plan called NAV Lean to improve and streamline the processes used for developing and implementing all instrument flight procedures (IFPs), including PBN, and supporting EAs and NextGen operational improvements to surface operations and MRO.

The FAA’s goal for NAV Lean has been to establish a single, authoritative source for each data element in an accessible data repository available to FAA staff that has need of it. NAV Lean objectives included addressing problems in FAA’s procedure development, such as a lack of an expedited process for approving minor procedure revisions, inconsistent interpretation of environmental policies and guidance, and data discrepancies across diverse databases. The FAA identified 21 recommendations, which were grouped under nine issues. The recommendations touch on all major aspects of the IFP process, including policy, tools, data, and training. The FAA estimates that the full implementation of the 21 recommendations will reduce the time currently required to implement a new IFP by more than 40%. Full implementation of the NAV Lean program recommendations is intended to establish best implementation practices and operational standards and to produce safe and efficient procedures.

NextGen Programs and Spatial Data

Flight Procedures/PBN

Flight procedures are a fundamental contributor to the safety and capacity of our NAS. Analogous to driving directions used by automobile drivers, these directions are even more critical for pilots, who do not have roads, guardrails, signs, marking lines, and traffic signals to follow while in the air. For airports, flight procedures provide operational capacity and ensure safe operations. There is likely no other information product that more directly supports the underlying objectives of an airport (i.e., the take-off and landing of aircraft) than a flight procedure.

Currently, more than 33,000 active flight procedures are in use in the United States (FAA 2015a) and more than 5,000 flight procedures are in production (FAA 2015b). About half of these procedures are RNAV and Required Navigation Performance (RNP) procedures used for NextGen PBN.
PBN establishes an aircraft’s ability to navigate based on the capabilities of its onboard systems in conjunction with ground- or space-based NAVAIDs. One of the more mature NextGen initiatives, PBN has already been implemented at most of the nation’s largest airports, and many other airports also benefit. Benefits that PBN has delivered to airports include the following:

- **Fuel savings and emissions reductions.** Across 8 large metropolitan areas, or metroplexes, implementation of PBN has resulted in $65.6M in fuel savings and 293K fewer metric tons of CO\textsubscript{2} per year since 2011 (FAA 2015c).

- **Increased flight operations.** Memphis International Airport (MEM) realized a 17\% increase in flight operations per hour by FedEx due to PBN-enabled wake recategorization (FAA 2013b).

- **Increased departures per hour.** Dallas/Fort Worth International Airport (DFW) has seen a 15–20\% increase in departures per hour and a 40\% decrease in pilot-controller communications while American Airlines has saved $10–12M worth of fuel per year as a result of PBN implementation (FAA 2014i).

- **More options during poor weather conditions.** PBN has facilitated access for aircraft to more than 2,500 runway ends in poor weather conditions with minimums as low as 200 ft. (FAA 2012c). The increased access has provided a significant boost to many general aviation (GA) airports. For example, Beverly Regional Airport (BVY) in Beverly, Massachusetts, has attracted new corporate operators and boosted fuel sales at their fixed-base operator (FBO).

These benefits of PBN would not be possible without spatial data. Like all flight procedures, PBN flight procedures are developed using coordinates for runway ends, obstacles, NAVAIDs, as well as elevation data for terrain, existing traffic flow patterns, and airspace restrictions. The spatial data commonly mentioned by FAA, airline, and consultant flight procedure designers interviewed for this project includes:

- Runway end locations;
- Runway profile-point elevations;
- Obstacle locations, types, heights, and lighting characteristics;
- NAVAID locations and types;
- Airfield marking lines, areas, and colors;
- Terrain elevations;
- Air traffic flows, waypoints, and historical flight tracks;
- Airspace restrictions in the vicinity of the airport; and
- Areas covered by certificates of waiver or authorization (COAs) for unmanned aerial systems (UAS).

In addition to the primary data sets listed above, spatial data related to the environmental impact of flight procedures is often used, particularly if a categorical exclusion (CatEx) is not granted and an Environmental Assessment (EA) is therefore required under the National Environmental Policy Act of 1969 (NEPA). The spatial data typically needed for such assessments is sometimes used regardless of whether an EA is required, and includes the following:

- Noise contours showing day-night average sound (or noise) levels (DNLs), are typically prepared as a part of a Federal Aviation Regulation (FAR) Part 150 study or specifically for an EA;
- Noise-sensitive areas where residents, businesses, or other occupants may be particularly impacted by aircraft noise;
Population density data showing locations where high proportions of residents or businesses may be affected by aircraft noise;

Land use zones that help identify sensitive areas or areas for compatible development;

Noise abatement procedures established by an airport to reduce noise impact on sensitive areas;

Habitats that may attract wildlife that are not conducive to safe aircraft operations; and

Water bodies and wetland areas that may attract wildlife or that are protected from certain types of development.

These spatial data sets, which are used for flight procedure development, currently come from a variety of sources. Airports supply some of this data—namely runway, NAVAID, and obstacle data deemed safety-critical by FAA AC 150/5300-18—via the FAA’s AGIS. The AGIS data is provided to procedure designers via universal data delivery format (UDDF) files that are exported from AGIS to the FAA’s third-party surveying system (TPSS). The data also is loaded into the FAA’s Aviation system standards information system (AVNIS) database on the 56-day aeronautical information regulation and control (AIRAC) schedule established by the International Civil Aviation Organization’s (ICAO) Annex 15 Aeronautical Information Services (AIS) document. Flight procedure design software, such as instrument approach procedures automation (IAPA), terminal area route generation and traffic simulation (TARGETS), and the instrument procedure development system (IPDS) directly read file-based updates or are linked to online updates of the AVNIS data. Other sources of spatial data used by pilots and flight procedure developers include the following:

National airspace system resources (NASR) data from the National Flight Data Center (NFDC) which is updated based on the 56-day AIRAC cycle;

Internet Obstruction Evaluation/Airport Airspace Analysis (iOE/AAA) program data on obstacles;

Digital Obstacle File (DOF) data, which provides information on all known human-made obstacles relevant to aviation users and which also is updated on the 56-day AIRAC cycle;

Shuttle radar topography mission (SRTM) 3 arc-second elevation data;

United States Geological Survey (USGS) scanned topographical maps that show major terrain and human-made features (but which may not be current);

Airport navigation aid database application (AIRNAV 2.0) data, which is expected to become the authoritative source for airport navigational data; and

Operational analysis and reporting system (OARS) data, which is expected to become the authoritative source for obstacle data and soon will be merged into AIRNAV 2.0.

Noise, land use, and demographic information used to support EAs or the FAA environmental pre-screening process, which guides users through the environmental requirements of their procedure design, is sought on an as-needed basis from airports or sometimes from local agencies. Some of the procedure designers who were interviewed for this study do not use this data and rely on FAA environmental specialists to conduct these assessments. Other procedure designers seek this data only when it is needed because a CatEx cannot be obtained.

Although spatial data is essential to flight procedure design, the spatial data developed by airports is not being utilized to its full potential, which limits its benefit to NextGen. Despite the theoretical availability of AGIS data to flight procedure designers, few of those interviewed knew if or how this data was getting to them. Some designers explicitly stated that it was not. Some indicated that they may request it directly from the airport if they learn that an AGIS survey has been completed. These responses suggest that while AGIS data can be an enabler of NextGen, and specifically an enabler of
PBN flight procedure development, the potential uses of AGIS data for procedure design have not yet been fully realized.

One objective of FAA’s NAV Lean initiative is to streamline this process and establish a more consistently applied, systematic approach of conveying spatial data to procedure designers. Under NAV Lean, authoritative sources for airport, NAVAID, and obstacle data are being established. It is unclear how much of the data required by procedure designers is currently available. Furthermore, procedure designers can only use the GIS data that airports, consultants, and other stakeholders collect but do not upload to AGIS if they are aware the data exists. Typically, designers are made aware of this data when the airport is a proponent of the new procedure; but that seldom occurs, as the FAA is the proponent for the vast majority of flight procedures.

Similarly, airports have not yet realized the full potential benefits of spatial data collected for use in NextGen initiatives. Airports have benefited indirectly when new procedures developed, but the spatial data developed and submitted to AGIS in support of these procedures is perceived as being of limited direct use to the airport. This data can be used by airports to identify and mitigate obstacles, for land use compatibility planning, to obtain navigation easements, and for other activities that protect current and future air service capacity. Although the number is growing, relatively few airports have used this data for these purposes. (For more details, see the section on cost-benefit information in Chapter 3.)

Furthermore, few airports are aware of or use the available external sources of data because the information they provide has not traditionally been needed to support airport requirements. As the challenge of obstruction mitigation and land use-compatible planning grows, however, some airports have begun to implement ongoing obstruction analysis and mitigation programs. Some state departments of transportation (DOTs), such as the South Carolina DOT, have established statewide legislation requiring such activities and providing resources to help. Similarly, planning organizations like the Puget Sound Regional Council in Washington State are working in collaboration with the FAA to develop regional programs and capabilities to help smaller GA airports.

This growth in the use of spatial data by airports has been fueled by increasing demand for comprehensive and accurate obstruction data by the FAA, which in turn has been largely driven by the increase in new procedure design associated with NextGen. In the near future, the issuance of COAs for UAS will further propel this demand. Land development near many airports in the United States has also increased the encroachment issues faced by airports. For these reasons, the need for airports to proactively seek and use AGIS safety-critical data and other airspace related data sets is likely to grow.

Improved Surface Operations

A few NextGen programs provide a variety of capabilities that support communications with, data exchange between, and the coordination of aircraft and surface vehicles operating on the airfield. Air traffic controllers, vehicle operators, and airport personnel use this information to improve the safety and efficiency of surface operations such as the taxiing of aircraft and the movement of ground service vehicles. The following capabilities related to surface operations have been implemented at several core and non-core airports:

• Advanced electronic flight strips (AEFS);
• Airport surface detection equipment, Model X (ASDE-X);
• Airport surface surveillance capability (ASSC);
• External surface data release; and
• Situational awareness and alerting of ground vehicles (FAA n.d.f).
In addition to these airport-specific implementations of NextGen capabilities, cockpit display of traffic information (CDTI) with traffic information service-broadcast (TIS-B), ADS-B for surface, moving map with own-ship position, traffic flow management system (TFMS), and time-based flow management (TBFM) new data sharing via SWIM subscription capabilities have been implemented across the NAS. The surface visualization tool also has been implemented at several ATC facilities.

Many of these systems and tools provide pilots, controllers, dispatchers, and ground personnel with maps that display the locations of aircraft and properly equipped surface vehicles. Symbols depict the vehicles on the maps at their specific locations, and additional details are given such as vehicle or flight identification numbers and the time each vehicle was at that location. This information represents spatial data, attributes, and metadata that become far more useful when displayed in conjunction with other layers of information, such as runway, taxiway, and apron boundaries, turning the base map into a critical visual reference.

It appears that these base maps are assembled on a case-by-case basis, using the best sources that can be identified. These sources may include AMDBs that adhere to the requirements documented in RTCA DO-272, airport spatial data that is uploaded to the FAA’s AGIS, traditional ALP drawings, airport diagrams prepared by the FAA, and other sources.

Airports are more likely to benefit from NextGen surface operations capabilities if they collect and maintain spatial data that accurately depicts the current layout of their airfield. Some airports have provided such information to the FAA so that capabilities can be implemented. Others have provided data to vendors that they have selected to provide similar airfield map displays. Although some airports have begun to develop and share such data, there is significant room for growth as NextGen capabilities continue to be rolled out.

MRO

Another portfolio of NextGen capabilities that continues to benefit airports is improved MRO. Airports that have closely spaced parallel runways, runways with converging paths, and other multiple runway configurations have begun to benefit from a variety of NextGen capabilities that improve access to the airport and increase air service capacity while preserving high safety standards. These capabilities include:

- Converging runway display aid (CRDA);
- Dependent approaches to closely spaced parallel runways (CSPR), discussed in FAA Order JO 7110.308;
- Additional approach options for new independent runway separation standards;
- Satellite navigation (SATNAV) or instrument landing system (ILS) for parallel runway operations; and
- Wake turbulence mitigation (FAA n.d.g).

These capabilities are supported by adjustments the FAA has made to standards and specifications for arriving and departing aircraft, including amended dependent runway separation standards in FAA Order JO 7110.65, amended independent runway standards in FAA Order JO 7110.65, and amended simultaneous dependent approaches to closely spaced parallel runways in FAA Order JO 7110.308.

The studies that supported these adjustments to FAA operating specifications benefited from spatial data to some degree, but the ongoing benefit is gained through the use of spatial data to provide a base map to the map displays and input to new procedures upon which these capabilities rely. Improved MRO will continue to improve air service at numerous airports, resulting in higher revenues,
reduced operating costs, and higher customer satisfaction. Spatial data is one of many essential ingredients that help deliver these benefits to aircraft operators and airports.

NextGen Programs That Produce or Enhance Spatial Data

Although not abundant, some spatial data that benefits airports is produced explicitly by NextGen programs. In addition, NextGen programs produce data that enhances existing spatial data sets.

NextGen-related technologies such as ASDE-X can produce a rich data set that has the ability to enhance existing spatial data for an airport’s noise program or for situational awareness. One capability of ASDE-X is determining the position of an aircraft on the airfield or on final approach. When added to an airfield base map or overlaid on a map showing noise complaint locations, the ASDE-X data can greatly add to the value of these spatial data sets and provide the airport with greatly enhanced safety and public outreach benefits.

When designing and installing new NAVAIDs and facilities in support of NextGen capabilities, an airport may install new utilities and construct new infrastructure and support buildings. These new facilities will produce as-built records that contain information such as underground utility locations. Some design and installation data may have security protocols attached to it, but such data could be made available to certain departments of an airport if it is protected under the shield of the airport’s own security plans and requirements. For example, the airport’s public safety office may require certain data in case an issue occurs at or near the location. Sharing data that is not restricted or that is protected by the airport’s security protocols can help the airport maintain a complete utility network for modeling and quickly resolving any issues that may come up such as a utility break.