

Lone Star Geospatial

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San Marcos Municipal Airport  
Airspace Planning Project

Prepared by: Lone Star Geospatial

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# Introduction

## Summary:

As the city of San Marcos and neighboring areas continue to see steady growth, it becomes increasingly important that the city be able to regulate the air space surrounding San Marcos Municipal Airport accurately and safely. Since the last hazard zoning regulations enacted in 1984, the airport has been able to handle the growing use of its facilities sufficiently. The accurately hand drawn map that illustrates those 1984 hazard zones and runways, while outstanding in its time, has become outdated. The difficulty of distributing and correctly interpreting that map will become more and more apparent as technological culture continues to grow in the age of computer aided mapping. Current and future growth will also render those older hazard zoning regulations ineffective or obsolete.

Both local pilots as well as pilots from all regions of Texas, the United States, and even Mexico use San Marcos Municipal Airport’s facilities. The nearby cities of San Antonio and Austin often require airports such as San Marcos to help ease the burden of increased traffic. Those pilots require safe approaches and protected zones when using the air space surrounding the San Marcos airport. Without regulations, there is no way for the city to enforce restrictions on the height of buildings, and other structures, which could affect the approach slopes and safety of air traffic. Therefore, in cooperation with the Texas Department of Transportation (TxDOT), Lone Star Geospatial will conduct a planning study that will implement GIS tools, data, and maps in order to assist the city of San Marcos in updating and enacting new airport hazard zoning regulations to protect and preserve the air space surrounding San Marcos Municipal Airport.

## Purpose:

The purpose of this planning study is to provide the city of San Marcos with the tools and information they need to enact hazard zoning regulations that will protect and preserve the air space surrounding the San Marcos Municipal Airport. We have determined that these tools will need to be accessible to a wide array of people and that all data will need to be delivered to the client (TxDOT) so that future work and changes can be done, should they choose. With this in mind, we will be splitting this study in to two main goals. The result of these two main goals will be tools and information that will assist the city of San Marcos in creating and adopting new zoning regulations.

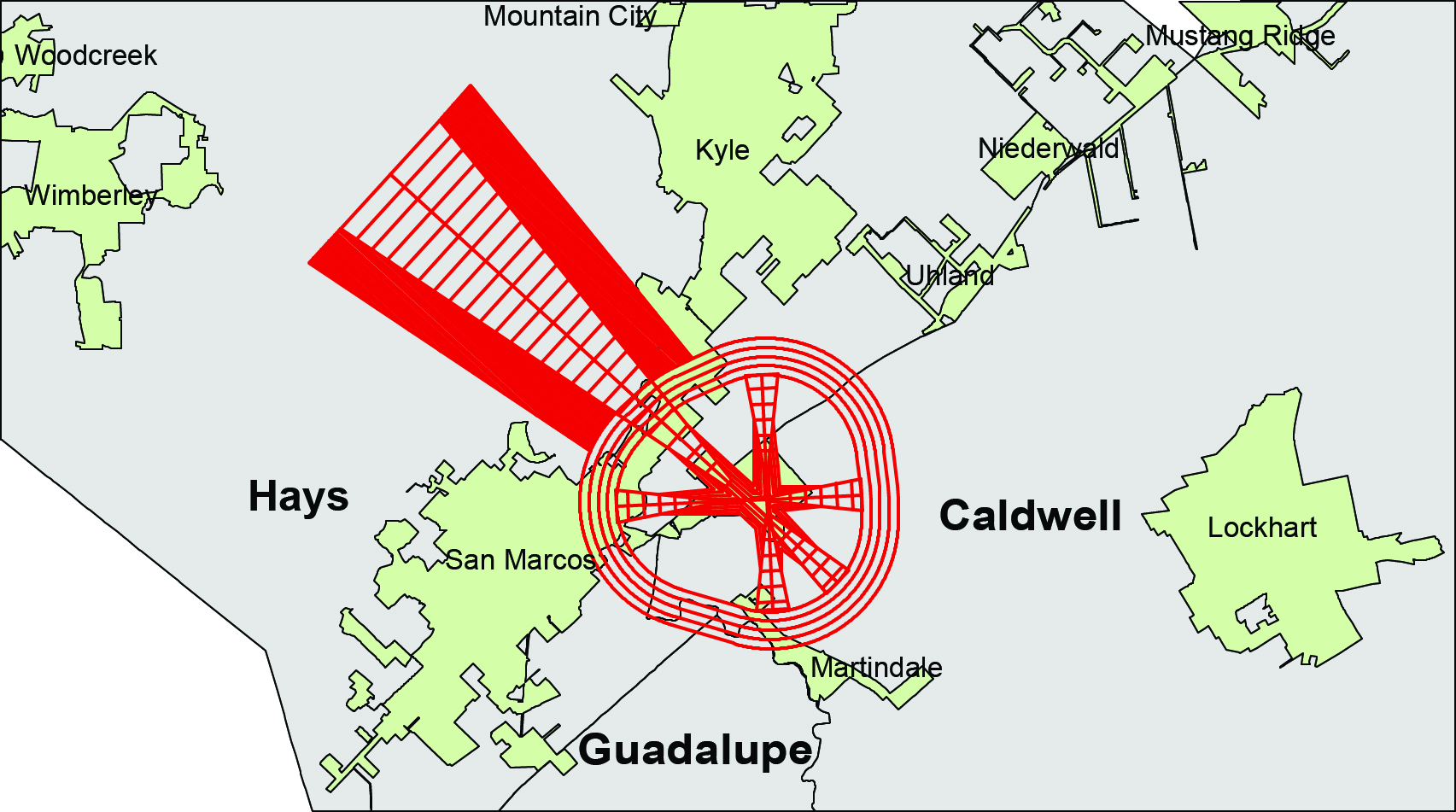
Our initial goal will be to create accurate three-dimensional imaginary surfaces that will establish and define strict zones in the air space surrounding the San Marcos Municipal Airport. In order to understand and create accurate imaginary surfaces we have conducted thorough research including real world examples of imaginary surfaces as well as government regulations. The regulations we are referencing are Title 14 Code of Federal Regulations Part 77 – Safe, Efficient Use, and Preservation of the Navigable Airspace, Airport Cooperative Research Program (ACRP) Report 38 – Understanding Airspace, Objects, and their effects on Airports, and Texas local government code Title 7 Subtitle C Chapter 241 – Municipal and County Zoning Authority around Airports. Once created the imaginary surfaces will allow us to create a new overlays and a new airport hazard zoning map that can be distributed in standard digital or print format.

Our second goal will be to develop an automated screening tool for use by the Texas Department of Transportation, city of San Marcos, or any other authorities that require accurate information regarding the air space around the airport. Utilizing the imaginary surfaces we create in a GIS, and the obstacle data received from a National Flight Data Survey and GIS survey, we will create an interactive mapping tool. Due to the requirements on the distribution and availability of the tool, and our research of examples of similar tools, we have determined that the best solution is a web based application. This web based interactive mapping tool will allow users to determine the allowable heights of objects within the airport hazard zones, as well as any obstructions that currently penetrate those zones, based on location.

## Scope:

The geographic extent of this study centers on the San Marcos Municipal Airport and the surrounding ground and air space associated with the currently operational runways: 8/26, 13/31, and 17/35. The airport reference point is 29° 53′ 34″ N and 97° 51′ 47″ W and the associated air space covers areas in Hays County, Caldwell County, and a small portion of Guadalupe County. New hazard zone regulations will or could possibly affect the cities of San Marcos, Kyle, Martindale, Wimberley, and Lockhart and are therefore part of the extent of this planning study.

The map below shows the San Marcos Municipal Airport hazard zones in low detail in red (the lack of detail is for simplifying visualization and does not reflect the final amount of detail our final products will have). This map illustrates how these zones cross into three different counties (Hays, Caldwell, and Guadalupe) and overlap a couple of cities (San Marcos and Martindale). It also illustrates how regulations that may extend beyond the hazard zones might affect other nearby cities.



## Literature Review and Research:

In preparation for this planning study, we made sure to research different types of information related to airport regulation. This research included two prior projects conducted by other student companies on the New Braunfels and San Marcos airports. It also included Federal Aviation Administration (FAA) documentation, an Airport Cooperative Research Program (ACRP) report, and a State of Texas statute. Lastly, we studied the uses of interactive web mapping tools from the city of Houston and New Braunfels (via Geo Solutions, Inc.) that focused on airport hazard zoning and air space planning.

The first project we referenced focused on the New Braunfels airport and conducted by Geo Solutions, Inc. From their project, we studied their methods of creating imaginary surfaces for airport zones, and we noted the software and techniques they used to develop and distribute their results. We also researched the web based map tool that they created as an example of an interactive tool for identifying airport hazard zones. We were able to glean many pros and cons of their design. The second project that we researched covered the San Marcos Municipal Airport and conducted by Geo-Air Consulting. From this project we were able to observe how the methods they used to record obstructions, map imaginary surfaces, and discover penetrations. However, because that project also focused on planning for runway extensions we chose to use their data and results for reference purposes.

During our research, we also consulted Federal Aviation Administration regulations to note the parameters required to establish imaginary surfaces with relation to airports and their runways. These regulations, Title 14 Code of Federal Regulations Part 77, provide exact details on the dimensions that each imaginary surface is allowed to have. In addition to federal regulations, we also consulted statutes from the Texas State Legislature regarding the general provisions of airport zoning. From this statute (Title 7, Subtitle C, Chapter 241) we were able to understand the importance that accurate hazard zoning has on the public and to the city (or regulating officials).

We also consulted a report done by the Airport Cooperative Research Program for this study. We studied the ACRP report 38 Understanding Airspace, Objects, and Their Effect on Airports, which provided excellent information on the best practices and recommendations for local and regional agencies concerning planning. Finally, we studied one more example of an interactive tool from the city of Houston for their airport system. It provided us with a great working example of an interactive screening tool used to identify maximum allowable building heights. While much of the functionality in that tool is beyond the scope of this project, we believe that many of its features will fit into our time line and goals well.

# Proposal

## Data:

* DEM or NED (USGS)
* 3D imaginary surfaces (produced in-house)
* World Street Map (ESRI – reference only)
* County Boundaries (TNRIS – reference only)
* Shapefiles for San Marcos Facilities (TxDOT)
* Obstruction Point Data (TxDOT)
* 14 CFR 77 (e-Code of Federal Regulations)

## Software:

* ArcScene and/or Google SketchUp after evaluating ease of use for final deliverables
* ArcGIS (for analysis and map creation)
* Manifold (for web development)

In order to generate an interactive mapping tool and identify obstacles within the regulated imaginary surfaces, we will need both vector and raster data. These will include a digital elevation model (DEM) or national elevation dataset (NED), shapefiles for the San Marcos Municipal Airport facilities and runways, obstruction point data, and street maps and county boundaries to be used for reference with the mapping tool. The DEM or NED will come from the United States Geological Survey (USGS) website in raster format. The shapefiles for the airport facilities and the obstruction point data will be provided by Texas Department of Transportation (TxDOT) in vector format. The street maps for reference will be obtained from ESRI datasets in vector format. Finally, the county boundaries for reference will come from Texas Natural Resources Information System (TNRIS). In addition to the raster and vector data, we will follow the rules and regulations laid out in the Code of Federal Regulations (14 CFR 77.19) and Chapter 241 of the Texas Local Government Code. We will use a combination of Google SketchUp and/or ArcScene to develop the 3D models for the interactive map tool, and ArcMap 10.1 for the analysis and 2D map development. In addition, we will use Manifold to develop and manage the web portion of the interactive map tool.

## Analysis/Methodology:

The first objective is an interactive map tool to be used by the City of San Marcos. We will create 3D imaginary surfaces based on state and federal regulations and compare them with elevation models to determine the difference between them. This will give us a value for the highest allowable building heights within each imaginary surface zone. This will be a complicated process because the regulations define many different zone types surrounding each runway and around the airport facilities. As a final deliverable, our interactive map will contain a continuous layer of maximum building heights even for areas where multiple zones will overlap. This will allow the user to select any location on the map to find the accurate maximum building height for that individual location. Once these assets have been generated, we will begin analysis for our second objective which is to identify any obstacles currently penetrating the regulated imaginary surfaces. We will import the obstruction point data and assign it appropriate elevation values based on the ground elevation and the height of each obstruction. Then we will compare the obstruction elevation with the elevation at the same location on the imaginary surface to determine if the obstruction is penetrating the surface and by how much.

### Interactive Map content

We will create imaginary surface polygons based on Federal regulations and from the shapefiles of the San Marcos airport facilities. Then we will use these polygons later to determine the maximum allowable building heights within each imaginary surface zone.

In order to use the DEMs for analysis, we will first have to convert the elevations from meters to feet. Once converted, we will create a Triangulated Irregular Network (TIN) to assign height values to the imaginary surfaces polygons.

To calculate the maximum building height we will use the difference from the elevation values and the imaginary surface height values.

At this point we can import Texas county boundaries and world street maps and clip them to the scope of our study area to produce map data that can be used by TxDOT and the City of San Marcos.

### Obstructions Analysis:

Using the map content generated and compiled above, we can add the provided obstruction point data and calculate obstruction elevation (if it is only provided as height). We can calculate the difference in elevation along the imaginary surfaces to the elevation of the obstructions to see if they penetrate those surfaces. We will generate a map with our findings for reference.

## Implications:

Our team’s project will have two final results. First, will be a 2013 hazard zoning map for the San Marcos Municipal airport. The map will use current data, with which TxDOT will be able to create new air space boundaries and help better enforce hazard regulations. These hazard regulations are necessary to help minimize encroachment and allow for a better functioning airport, allowing for a possibility of greater economic traffic. The second result will be a web based automated screening tool, which will allow any user with access to the Internet to determine the allowable heights of objects within the airport hazard zones. In addition, it will also show any obstructions that currently penetrate those zones. With the aid of our maps and automated screening tool, we believe TxDOT and the San Marcos Municipal airport will be able to better serve the city of San Marcos.

## Budget:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Data Collection and Processing | | | Total Hours | 105 |  |
|  | 10 hours/week x 3 weeks x 3 consultants +  5 hours/week x 3 weeks x 1 consultant | | |  |  |
|  | Hourly Pay | | | $23.00 |  |
|  | Total | | |  | $2,415.00 |
| Data Analysis | | Total Hours | | 105 |  |
|  | 10 hours/week x 3 weeks x 3 consultants +  5 hours/week x 3 weeks x 1 consultant | | |  |  |
|  | Hourly Pay | | | $23.00 |  |
|  | Total | | |  | $2,415.00 |
| Web Development | | | Total Hours | 45 |  |
|  | 10 hours/week x 3 weeks x 1 consultants +  5 hours/week x 3 weeks x 1 consultant | | |  |  |
|  | Hourly Pay | | | $36.00 |  |
|  | Total | | |  | $1,620.00 |
| Map Development | | | Total Hours | 60 |  |
|  | 10 hours/week x 3 weeks x 2 consultants | | |  |  |
|  | Hourly Pay | | | $26.00 |  |
|  | Total | | |  | $1,560.00 |
| Data Interpretation | | | Total Hours | 35 |  |
|  | 10 hours/week x 1 weeks x 3 consultants +  5 hours/week x 1 weeks x 1 consultant | | |  |  |
|  | Hourly Pay | | | $45.00 |  |
|  | Total | | |  | $1,575.00 |
| System Management | | | Total Hours | 50 |  |
|  | 5 hours/week x 10 weeks *Project Manager* | | |  |  |
|  | Hourly Pay | | | $32.00 |  |
|  | Pay | | | $1,600.00 |  |
|  | Total | | |  | $1,600.00 |
| Equipment Costs (for 10 weeks) | | | |  |  |
|  | Supplies  $150/workstation x 4 workstations | | | $600.00 |  |
|  | Maintenance  $200/workstation x 4 workstations | | | $800.00 |  |
|  | Depreciation  $8,000 [total value of computers]  ÷ 36 (equip life in months)   x 2.5 (months equipment will be  in exclusive use for project) | | | $555.56 |  |
|  | Total Equipment Costs | | |  | $1,955.56 |
| Software Costs | | | |  |  |
|  | Purchase of Manifold | | | $800.00 |  |
|  | ArcGIS License  $1,500 x 4 consultants prorated for 2.5 months | | | $1,250.00 |  |
|  | Total Data & Software Costs | | |  | $2,050.00 |
| TOTAL COSTS | | | |  | $15,190.56 |

## Timetable:

### Phase1: Data Collection and Processing

The initial phase will be three weeks focused on data collection and processing. TxDOT has provided some of the data required for this project; however, to complete our goals other data will need to be gathered. Once gathered we will begin processing it to ensure that it is of consistent format and quality.

### Phase 2: Data Analysis

The second phase of this study will be three weeks involving the creation and analysis of all imaginary surfaces, base maps, and overlays with ArcGIS software.

### Phase 3: Web and Map Development

The third phase will be three weeks to allow for the development of the automated screening tool, hazard zoning map, and other deliverables. This phase will involve quality assurance testing of our products.

### Phase 4: Data Interpretation

The final phase allows one week to interpret the results in our deliverables. We will determine if strict and accurate hazard zoning regulations will be able to be enacted based on the information in our automated screening tool and maps. This will also be a period of quality assurance testing for our deliverables to ensure client satisfaction.

| October | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| S | M | T | W | H | F | S |
|  | ***30*** | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | ***28*** | 29 | 30 | 31 |  |  |

| november | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| S | M | T | W | H | F | S |
|  |  |  |  |  | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |

| december | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| S | M | T | W | H | F | S |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | ***9*** | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 |  |  |  |  |

September 30: Proposal Presentation  
October 28: Progress Presentation  
December 9: Final Product Delivered

## Final Deliverables:

Lone Star Geospatial will be able to provide at the end an interactive screening tool that provides a visual representation to aid the city in writing new zoning regulations. The tool will be able to display allowable height for future buildings or obstructions and identity of existing objects within each zone. An updated airport hazard zoning map with appropriate imaginary surfaces as defined in Title 14, Code of Federal Regulations, Part 77 will also be included. As well as, a detailed final report, a poster, and a CD containing the following:

* Metadata
* Report
* Poster
* PowerPoint Presentation
* Readme file with instruction on how to use CD

# Conclusion

Taking into consideration how fast San Marcos and surrounding areas are growing, it is of great importance to keep the zoning regulations updated and make sure they are being implemented to protect the air spaces for the San Marcos Municipal Airport. Keeping in mind how long it has been since the last hazard zoning regulation was enacted, Lone Star Geospatial will provide the tools to help the San Marcos Municipal Airport staff and any other officials plan and enact these regulations.

With the help of ArcScene or Google SketchUp, Lone Star Geospatial will create an interactive screening tool that will display to the general public and city officials the allowable height for future construction of objects near the airport and its protected airspaces. TxDOT staff will also receive an updated airport hazard zoning map and its metadata so changes can be adjusted as needed in the future. We will also be using past projects data, with similar objectives, to generate a new slope polygon to represent the current layout of the airport runways. We are also ready to prepare any other data needed to meet our client’s needs.

We anticipate this project to be done by December2013 and with our budget of $ 15,190.56. The budget includes the equipment, time and software needed to meet our client’s needs for this project.

Thank you for considering Lone Star Geospatial. We look forward in working with you.

# Participation

Casey Carpenter:

* Cover Page / Title Page / Table of Contents
* Introduction: Summary / Purpose / Scope

Jason Ford:

* Proposal: Data / Software / Analysis / Methodology
* Document layout and formatting

Greyson Jones:

* Proposal: Implications / Timetable

Patricia Michel:

* Proposal: Budget / Final Deliverables
* Conclusion/Consequences