GAST-D Siting Requirements

Federal Aviation Administration

Local Area Augmentation Systems

Presented to: GBAS / LAAS Chinese Visitation

By: Joseph Gillespie

Date: October 18th - 22nd, 2010

Presentation Outline

- **Presentation Introduction**
- **GAST-D Siting Constraints:**
  - Derived from the proposed GAST-D Annex 10 Amendments
- **View of Selected Airports:**
  - Map such siting requirements by utilizing Google Earth
- **Presentation Summary / Review**
- **Presentation References**

Presentation Introduction

- **Current GBAS / LAAS Installations:**
  - Developed as early implementations and did not include the benefit of formally approved installation procedures / documentation associated with a commissioned system
  - The Federal Aviation Administration has created a formal GBAS siting order based on current development and approval experience
- **Current developments have shifted focus from CAT I to CAT II / III implementation:**
  - The ICAO CSG has developed a new standards concept, termed GAST-D, to support CAT II / III precision approach and auto-land operations.
  - Standards supporting CAT I have now been renamed as GAST-C

GAST-D Siting Constraints

- **Key Factor 1:**
  - The LAAS system components need to be installed in a secure area, generally the AOA of any given airport [1]

- **Key Factor 2:**
  - The 4 LAAS receive antennas as a group, arranged on a given area of land, will have a mathematical virtual center point that is referred to as the centroid. This centroid must be within 5 kilometers (approximately 2.7 NM) of each runway approach threshold crossing to be supported (measured at ground level) [2]
  - Service providers must 1) evaluate the area around the RRAs and 2) the possible affects it might have on the system's differential corrections, this is referred to as the Local Object Consideration Area

GAST-D Siting Constraints

- **Key Factor 3:**
  - The VDB Antenna maximum field strength exclusion region must not exceed 200 meters in radius to prevent overdriving LAAS avionics [2,3]
  - Measures should be taken to site the VDB Antenna 200 meters from any operational aircraft venues (runways, taxiways, and ramps)
  - The VDB antenna is to be installed so that no users can employ the LAAS signal for navigation in an area where this signal exceeds the maximum permitted signal level [2]
  - The actual upper bound on the maximum field strength distance is based on the VDB hardware and nominal LAAS VDB power range, both of which are design specific (system is flexible!)

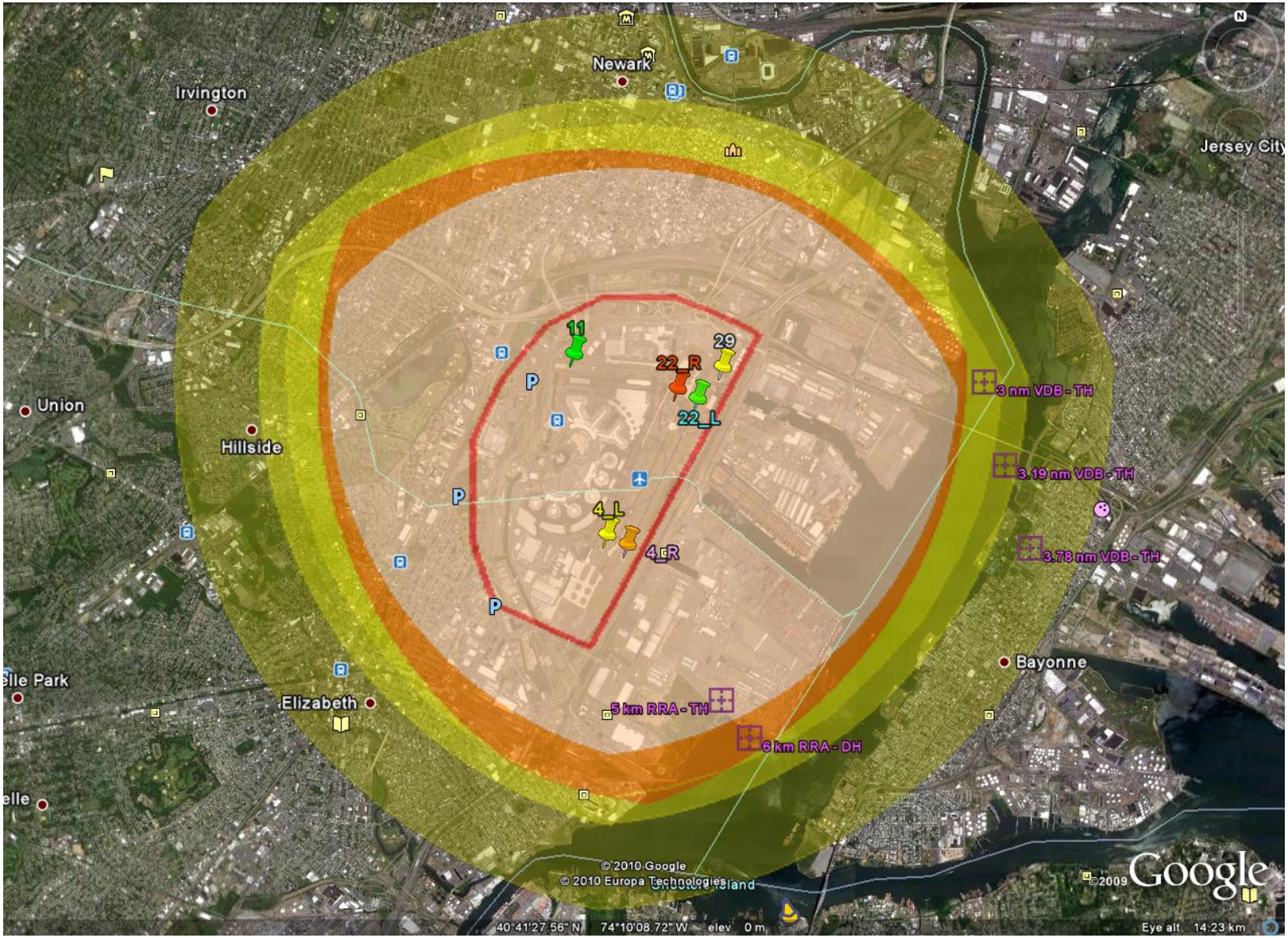
GAST-D Siting Constraints

- **Key Factor 4:**
  - Using a 50 foot ground antenna height, the minimum field strength vs. distance results for 8 ft and 12 ft vertical coverage are satisfied out to a distance of 5.9 km (3.19 NM) and 7 km (3.78 NM) respectively
  - A VDB transmitter should be located no further than this distance from any part of the runway surface where lateral rollout guidance is key
  - For locations near runway approaches, a 50:1 Obstacle Free Zone applies and antenna heights above 25 feet are not recommended
  - As a result, this distance can shrink to as little as 3.33 km (1.8 nm) and 4.25 km (2.3 nm) for 8 and 12 ft vertical coverage respectively when accounting for Earth curvature

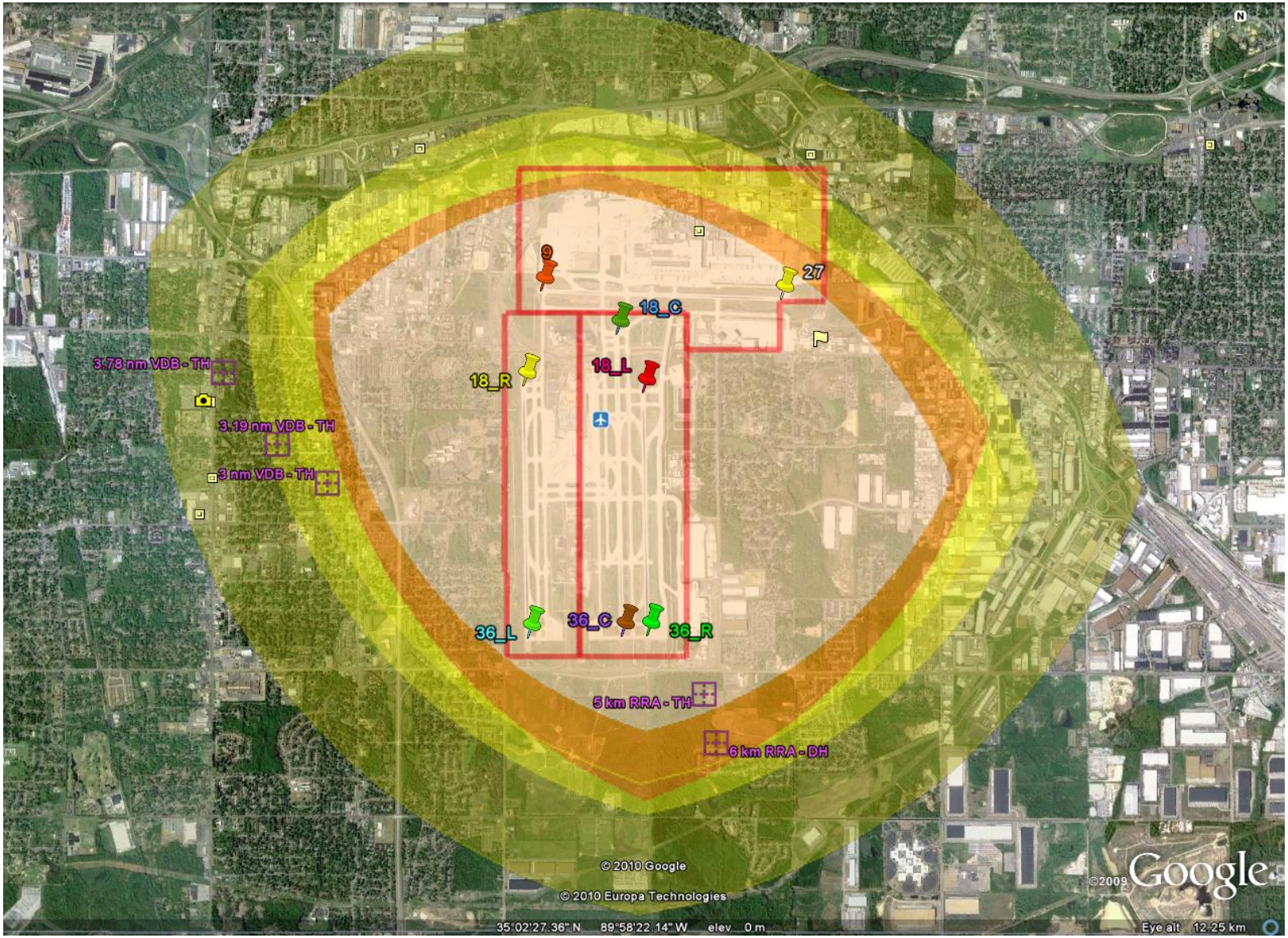
View of Selected Airports

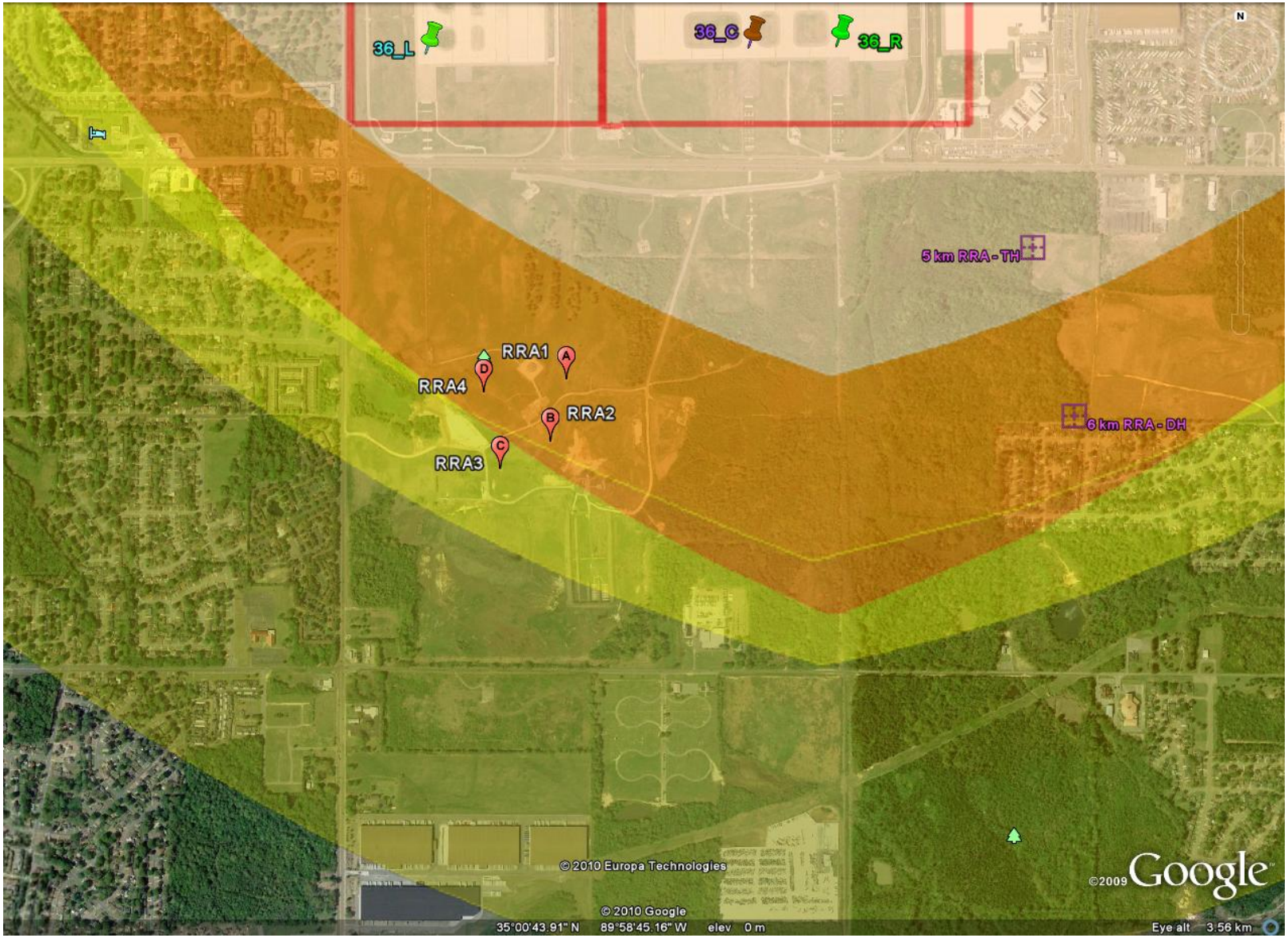
- **A high level assessment was completed for several GAST-D candidate airports within the U.S. The following airports were examined:**
  - Newark International Airport (EWR)
  - Memphis International Airport (MEM)
  - Houston George Bush Intercontinental Airport (IAH)

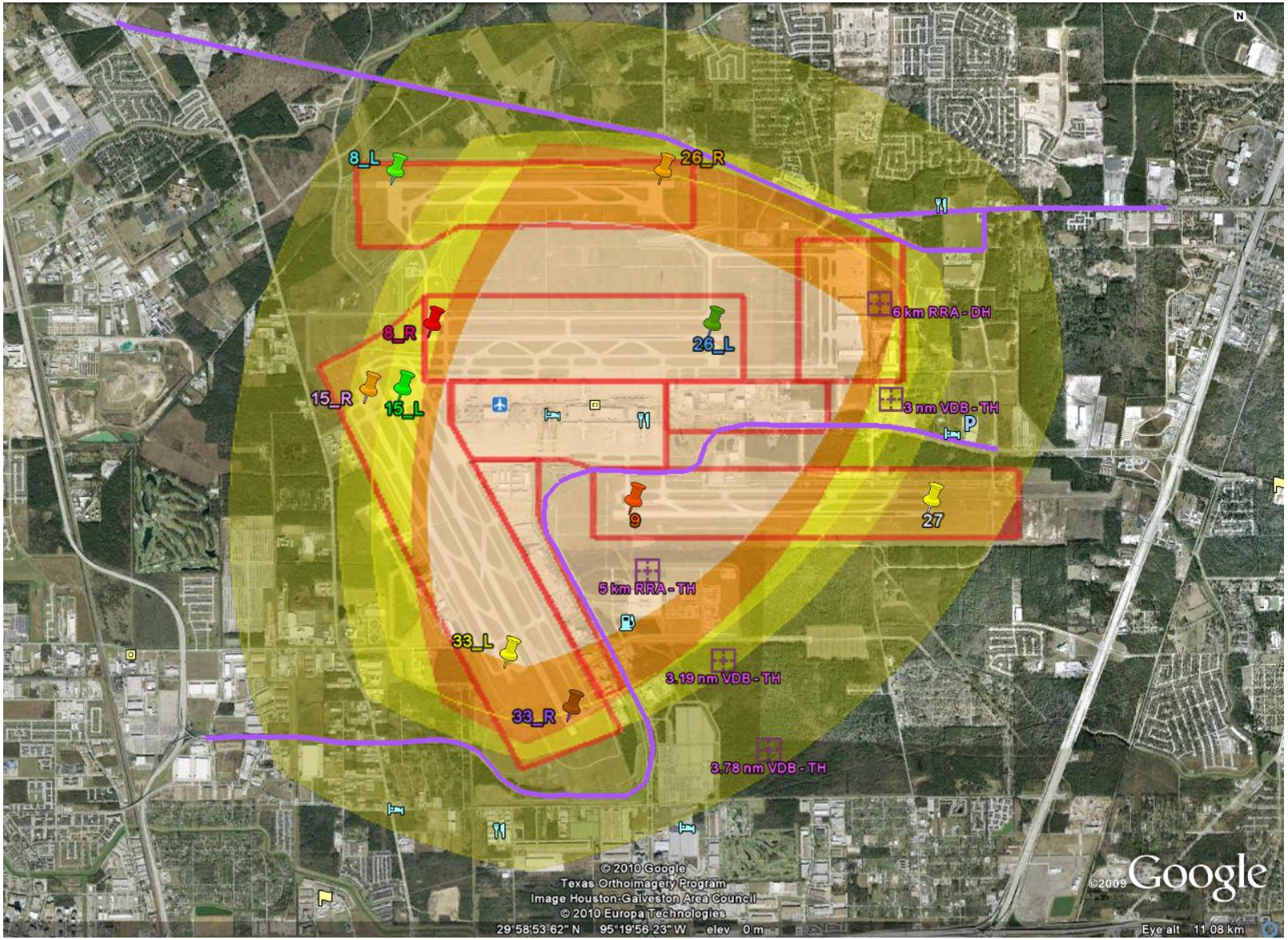
- **We can simulate and map potential GBAS / LAAS installations by the utilization of Google Earth:**
  - Provides considerably accurate overhead views of selected airports

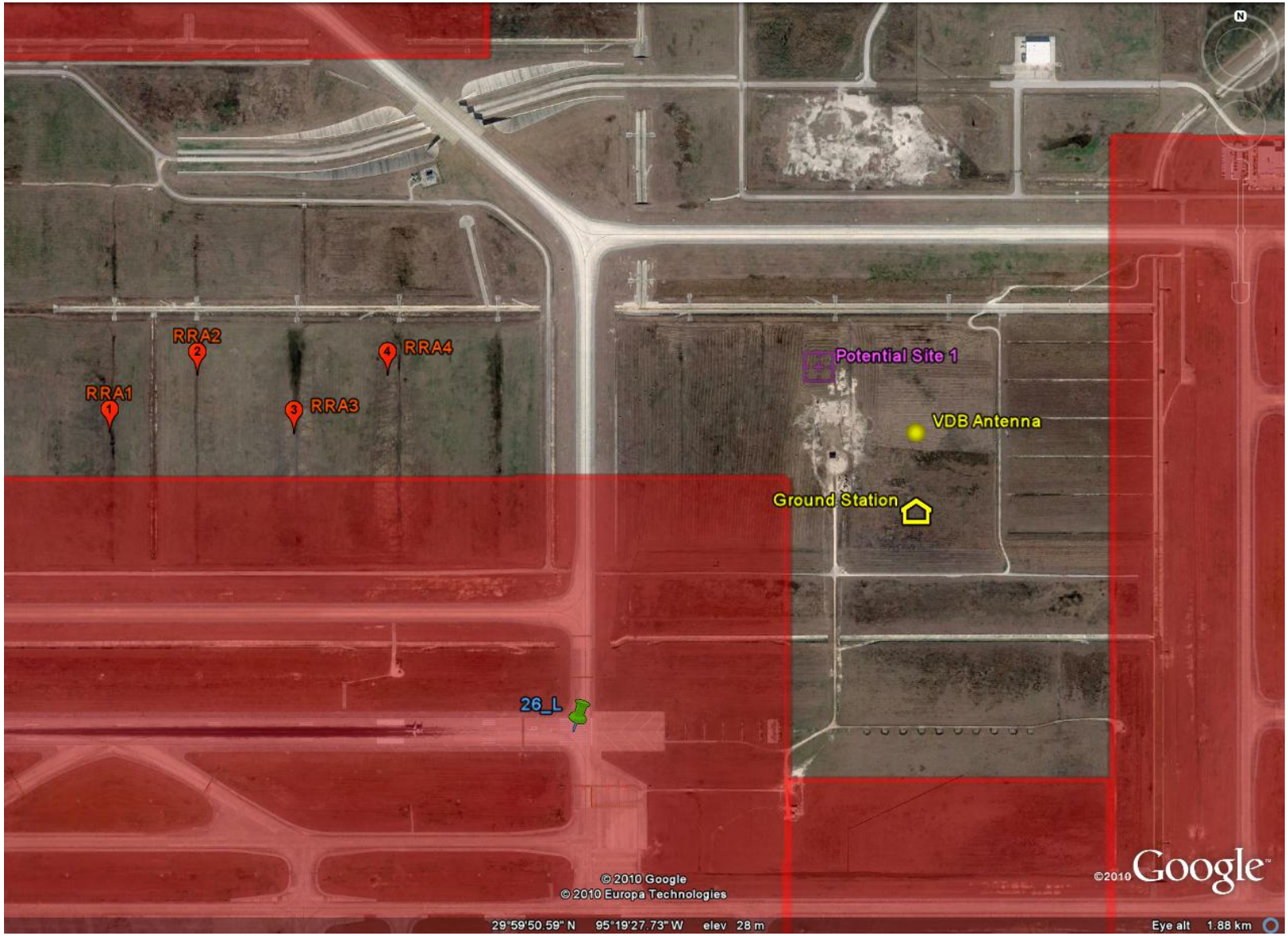

Newark
Irvington
Jersey City
Union
Hillside
Elizabeth
Bayonne
11
29
22_R
22_L
4_L
4_R
3 nm VDB - TH
3.19 nm VDB - TH
3.78 nm VDB - TH
5 km RRA - TH
6 km RRA - DH
© 2010 Google
© 2010 Europa Technologies
©2009 Google
40°41'27.56" N 74°10'08.72" W elev 0 m
Eye alt 14.23 km

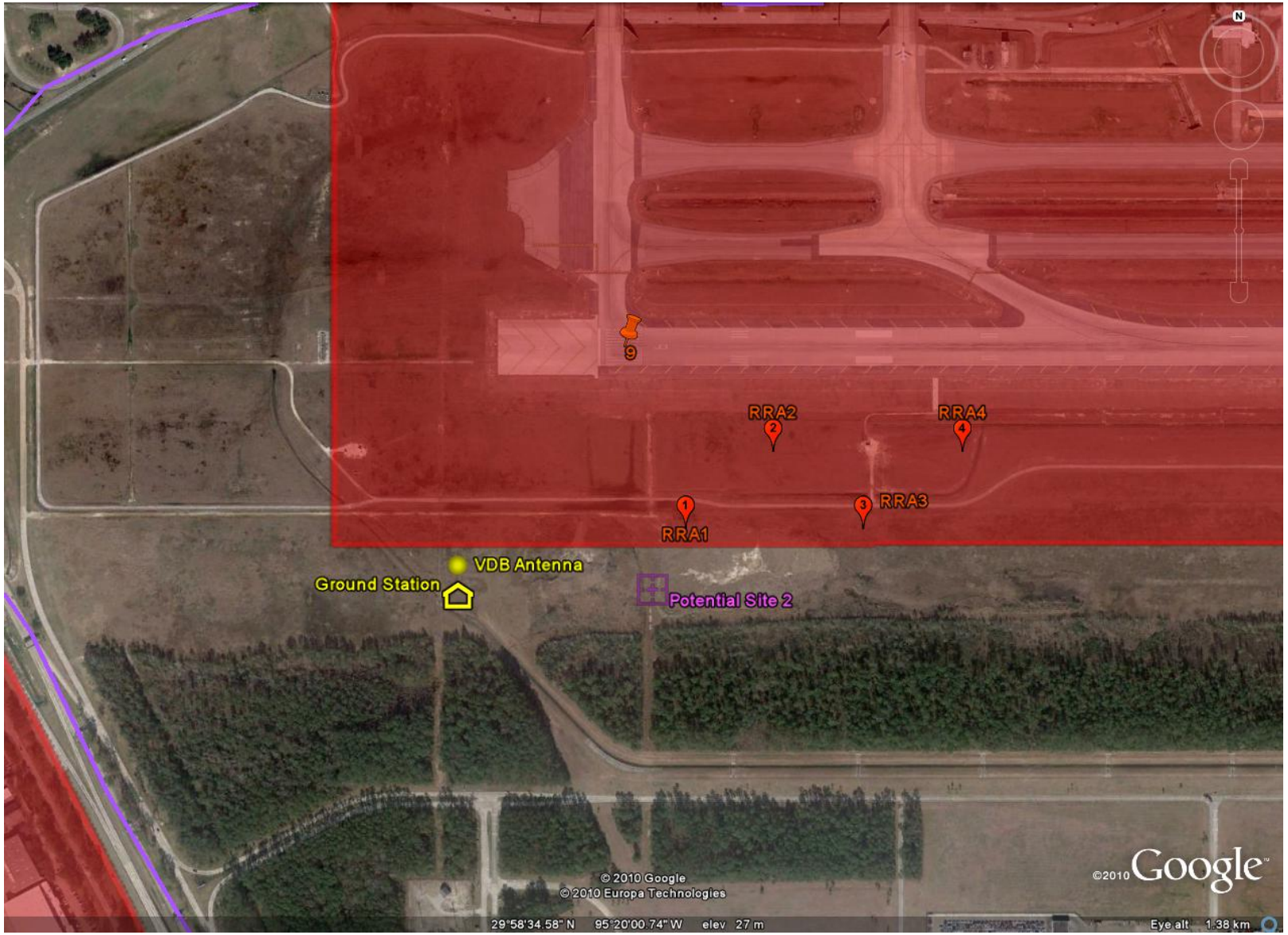

11
29
22_R
22_L
RRA4
RRA3
RRA2
RRA1
VDB Antenna
4_L
4_R
Image © 2010 Sanborn
© 2010 Google
© 2010 Europa Technologies
40°41'26.47" N 74°10'14.88" W elev 2 m
©2009 Google
Eye alt 3.51 km


9
27
18_C
18_R
18_L
3.78 nm VDB - TH
3.19 nm VDB - TH
3 nm VDB - TH
36_L
36_C
36_R
5 km RRA - TH
6 km RRA - DH
© 2010 Google
© 2010 Europa Technologies
35°02'27.36" N 89°58'22.14" W elev 0 m
©2009 Google
Eye alt 12.25 km


36_L
36_C
36_R
5 km RRA - TH
6 km RRA - DH
RRA1
RRA2
RRA3
RRA4
A
B
C
D
© 2010 Europa Technologies
© 2010 Google
©2009 Google
35°00'43.91" N 89°58'45.16" W elev 0 m
Eye alt 3.56 km


8_L
26_R
8_R
26_L
15_R
15_L
6 km RRA - DH
3 nm VDB - TH
9
27
5 km RRA - TH
33_L
3.19 nm VDB - TH
33_R
3.78 nm VDB - TH
© 2010 Google
Texas Orthoimagery Program
Image Houston-Galveston Area Council
© 2010 Europa Technologies
29°58'53.62" N 95°19'56.23" W elev 0 m
©2009 Google
Eye alt 11.08 km


RRA1
RRA2
RRA3
RRA4
Potential Site 1
VDB Antenna
Ground Station
26_L
© 2010 Google
© 2010 Europa Technologies
©2010 Google
29°59'50.59" N 95°19'27.73" W elev 28 m
Eye alt 1.88 km


9
RRA2
2
RRA4
4
RRA3
3
1
RRA1
VDB Antenna
Ground Station
Potential Site 2
© 2010 Google
© 2010 Europa Technologies
©2010 Google
29°58'34.58" N 95°20'00.74" W elev 27 m
Eye alt 1.38 km

Presentation Summary / Review

- **Presentation Introduction**
- **GAST-D Siting Constraints:**
  - Derived from the proposed GAST-D Annex 10 Amendments
- **View of Selected Airports:**
  - Map such siting requirements by utilizing Google Earth
- **We have now seen a brief overview of the U.S. Map Study for GAST-D siting requirements**

Presentation References

[1] Siting Order for Local Area Augmentation Systems, Category 1, *Department of Transportation*, Federal Aviation Administration, Jun. 30th, 2009.

[2] Gillespie, Joseph; Skidmore, Trent; Warburton, John; Burns, Jason; US Map Study for GAST-C and D, Navigation Systems Panel (NSP), Working Group of the Whole (WGW), *Department of Transportation* , Federal Aviation Administration, Montreal, Canada, May 17th – 28th, 2010.

[3] RTCA DO-245A, "Minimum Aviation System Performance Standards for Local Area Augmentation Systems (LAAS), RTCA, 2004.

[4] S. Narelich, "Working Paper 13: Contribution to Discussion and Validation of VDB Coverage for Auto-land," ICAO/NSP, Seattle, July 2009.

Comments?