



ATIS-0500043

ATIS Standard on -

Supplemental Test Areas for E9-1-1 Indoor Location Testing



As a leading technology and solutions development organization, the Alliance for Telecommunications Industry Solutions (ATIS) brings together the top global ICT companies to advance the industry's most pressing business priorities. ATIS' nearly 200 member companies are currently working to address the All-IP transition, 5G, network functions virtualization, big data analytics, cloud services, device solutions, emergency services, M2M, cyber security, network evolution, quality of service, billing support, operations, and much more. These priorities follow a fast-track development lifecycle — from design and innovation through standards, specifications, requirements, business use cases, software toolkits, open source solutions, and interoperability testing.

ATIS is accredited by the American National Standards Institute (ANSI). The organization is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a founding Partner of the oneM2M global initiative, a member of the International Telecommunication Union (ITU), as well as a member of the Inter-American Telecommunication Commission (CITEL). For more information, visit www.atis.org.

Notice of Disclaimer & Limitation of Liability

The information provided in this document is directed solely to professionals who have the appropriate degree of experience to understand and interpret its contents in accordance with generally accepted engineering or other professional standards and applicable regulations. No recommendation as to products or vendors is made or should be implied.

NO REPRESENTATION OR WARRANTY IS MADE THAT THE INFORMATION IS TECHNICALLY ACCURATE OR SUFFICIENT OR CONFORMS TO ANY STATUTE, GOVERNMENTAL RULE OR REGULATION, AND FURTHER, NO REPRESENTATION OR WARRANTY IS MADE OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. ATIS SHALL NOT BE LIABLE, BEYOND THE AMOUNT OF ANY SUM RECEIVED IN PAYMENT BY ATIS FOR THIS DOCUMENT, AND IN NO EVENT SHALL ATIS BE LIABLE FOR LOST PROFITS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES. ATIS EXPRESSLY ADVISES THAT ANY AND ALL USE OF OR RELIANCE UPON THE INFORMATION PROVIDED IN THIS DOCUMENT IS AT THE RISK OF THE USER.

NOTE - The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to whether use of an invention covered by patent rights will be required, and if any such use is required no position is taken regarding the validity of this claim or any patent rights in connection therewith. Please refer to [<http://www.atis.org/legal/patentinfo.asp>] to determine if any statement has been filed by a patent holder indicating a willingness to grant a license either without compensation or on reasonable and non-discriminatory terms and conditions to applicants desiring to obtain a license.

Published by

Alliance for Telecommunications Industry Solutions

1200 G Street, NW, Suite 500

Washington, DC 20005

Copyright © 2020 by Alliance for Telecommunications Industry Solutions

All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher. For information contact ATIS at 202.628.6380. ATIS is online at < <http://www.atis.org> >.

ATIS-0500043

ATIS Standard on

Supplemental Test Areas for E9-1-1 Indoor Location Testing

Alliance for Telecommunications Industry Solutions

Approved July 7, 2020

Abstract

This document defines additional test areas for integrated E9-1-1 X/Y-axis and Z-axis indoor location technology testing to supplement the test regions of Atlanta, Chicago, and San Francisco.

Foreword

The Alliance for Telecommunications Industry Solutions (ATIS) serves the public through improved understanding between carriers, customers, and manufacturers. The Emergency Services Interconnection Forum (ESIF) provides a forum to facilitate the identification and resolution of technical and/or operational issues related to the interconnection of wireline, wireless, cable, satellites, Internet, and emergency services networks.

The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages. The word *may* denotes an optional capability that could augment the standard. The standard is fully functional without the incorporation of this optional capability.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, Emergency Services Interconnection Forum (ESIF), 1200 G Street NW, Suite 500, Washington, DC 20005.

At the time of consensus on this document, ESIF, which was responsible for its development, had the following leadership:

J. Green, ESIF Chair and ESM Co-Chair (T-Mobile USA)

R. Muscat, ESIF 1st Vice-Chair (Bexar Metro 911)

D. Morkunas, ESIF 2nd Vice-Chair (Intrado)

K. Springer, ESIF ESM Co-Chair (AT&T)

The Emergency Services & Methodologies (ESM) Subcommittee was responsible for the development of this document.

Table of Contents

1 SCOPE, PURPOSE, & APPLICATION 1

1.1 SCOPE..... 1

1.2 PURPOSE..... 1

1.3 APPLICATION..... 1

2 REFERENCES 2

2.1 NORMATIVE REFERENCES..... 2

2.2 INFORMATIVE REFERENCES 2

3 DEFINITIONS, ACRONYMS, & ABBREVIATIONS 2

3.1 DEFINITIONS..... 2

3.2 ACRONYMS & ABBREVIATIONS 2

4 SUPPLEMENTAL TEST REGION INTRODUCTION..... 3

4.1 FACTORS DRIVING THE NEED FOR SUPPLEMENTAL TEST AREAS..... 3

4.2 ASSESSMENT CRITERIA 3

5 TEST AREAS TO SUPPLEMENT ATLANTA..... 4

6 TEST AREAS TO SUPPLEMENT CHICAGO..... 9

7 TEST AREAS TO SUPPLEMENT SAN FRANCISCO..... 14

8 SUMMARY 19

Table of Figures

FIGURE 5.1 SIDE-BY-SIDE COMPARISON OF DENSE URBAN DOWNTOWN ATLANTA AND HOUSTON..... 5

FIGURE 5.2 SIDE-BY-SIDE COMPARISON OF URBAN ATLANTA AND URBAN HOUSTON GALLERIA AREA 6

FIGURE 5.3 DENSE URBAN POLYGON SURROUNDING DOWNTOWN PHILADELPHIA 7

FIGURE 5.4 TEST POLYGON WITHIN URBAN PHILADELPHIA 7

FIGURE 5.5 DENSE URBAN POLYGON OF THE DENVER REGION 8

FIGURE 6.1 SIDE-BY-SIDE COMPARISON OF DENSE URBAN CHICAGO AND A SELECT PORTION OF MANHATTAN 10

FIGURE 6.2 URBAN CHICAGO SIDE-BY-SIDE WITH URBAN HUDSON COUNTY, NJ (NEW YORK REGION) 11

FIGURE 6.3 DENSE URBAN PORTION AND CORRESPONDING POLYGON IN DOWNTOWN MINNEAPOLIS..... 12

FIGURE 6.4 URBAN MINNEAPOLIS POLYGON..... 13

FIGURE 7.1 SIDE-BY-SIDE COMPARISON OF DENSE URBAN SAN FRANCISCO AND SEATTLE 15

FIGURE 7.2 SIDE-BY-SIDE COMPARISON OF URBAN SAN FRANCISCO AND SEATTLE..... 16

FIGURE 7.3 SIDE-BY-SIDE COMPARISON OF URBAN SAN JOSE (SAN FRANCISCO REGION) AND URBAN SEATTLE 17

FIGURE 7.4 URBAN AND DENSE URBAN SEATTLE POLYGONS..... 18

Table of Tables

TABLE 5.1 SUPPLEMENTING ATLANTA – EQUIVALENCE CHARACTERISTICS FOR HOUSTON AND PHILADELPHIA 8

TABLE 6.1 SUPPLEMENTING CHICAGO – EQUIVALENCE CHARACTERISTICS FOR NEW YORK AREA AND MINNEAPOLIS 13

TABLE 7.1 SUPPLEMENTING SAN FRANCISCO – EQUIVALENCE CHARACTERISTICS FOR SEATTLE 19

ATIS Standard on –

Supplemental Test Areas for E9-1-1 Indoor Location Testing

1 Scope, Purpose, & Application

1.1 Scope

This document defines additional E9-1-1 location technology test areas which may be used to supplement the current Atlanta, Chicago, and San Francisco test regions. These supplementary test areas are intended to provide additional choices of test buildings in dense urban and urban environments with similar characteristics to the current test regions. This document does not expand the scope of testing, but rather provides additional flexibility in the choice of equivalent buildings and settings. Importantly, this document does not intend to impact or expand the definitions in the FCC's Fourth Report & Order related to the Test Cities or the corresponding six Monitoring Regions defined in ATIS-0500031v.002 [Ref 1]. Furthermore, it does not impact or expand the Carrier's FCC accuracy compliance and reporting obligations, including the gathering of complementary outdoor accuracy test results in additional Test Bed areas.

1.2 Purpose

The purpose of this document is to expand the areas within which test buildings may be chosen and thereby expand the pool of available buildings which may be used for E9-1-1 location technology testing. Expanding the pool of available test buildings will give testers much needed flexibility – which translates into more efficient and more rapid test execution – while enabling optimal selection of buildings to meet the unique needs of each test campaign.

1.3 Application

This document expands upon the indoor location test bed regions defined in ATIS-0500031.v002, Clause 6 [Ref 1]. Supplemental test areas defined in this document may be used in future test campaigns undertaken by the 9-1-1 Indoor Location Technologies Test Bed, or independently by wireless carriers or location technology vendors. This applies, for example, to campaigns measuring the X/Y-axis and Z-axis performance, as defined in ATIS-0500040 [Ref 100].

2 References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

2.1 Normative References

[Ref 1] ATIS-0500031.v002, Test Bed and Monitoring Regions Definition and Methodology.¹

2.2 Informative References

[Ref 100] ATIS-0500040, Unified X/Y and Z Indoor Test Methodology.¹

3 Definitions, Acronyms, & Abbreviations

For a list of common communications terms and definitions, please visit the *ATIS Telecom Glossary*, which is located at < <https://glossary.atis.org/> >.

3.1 Definitions

X/Y-axis: Refers to a horizontal position, or testing intended to measure horizontal accuracy performance.

Z-axis: Refers to a vertical position or height, or testing intended to measure vertical accuracy performance.

3.2 Acronyms & Abbreviations

ATIS	Alliance for Telecommunications Industry Solutions
E9-1-1	Enhanced 9-1-1
ESIF	Emergency Services Interconnection Forum (a group within ATIS)
ESM	Emergency Services & Methodologies (an ESIF subcommittee)

¹ This document is available from the Alliance for Telecommunications Industry Solutions (ATIS) <https://www.atis.org/> >.

4 Supplemental Test Region Introduction

Test regions for use in indoor E9-1-1 location technology testing were originally defined in ATIS-0500031.v002, Clause 6 [Ref 1] for their morphological characteristics and regional representation. For each morphology within a test region, a polygon was created to define an area to test within that morphology of the region. Test buildings are then selected within these polygons for each test campaign. For the reasons summarized in Clause 4.1, additional test areas are needed to supplement each of the three current test regions. This document defines these new, supplemental test areas by providing Polygons for each, which are displayed visually in the clauses below. Additionally, 'kmz' map files providing exact polygon boundaries for all supplemental test areas are distributed with this document.

Note that only dense urban and urban morphologies are addressed here, since test building acquisition and retention in these conditions represents the greatest challenge. It is possible to extend this to suburban and rural morphologies in future revisions of this document as the need arises.

Clause 4.2 explains the assessment criteria used to identify and assess the supplemental test areas.

4.1 Factors Driving the Need for Supplemental Test Areas

The test regions recommended in ATIS-0500031.v002 [Ref 1] and adopted by the 9-1-1 Location Technologies Test Bed were chosen for their morphological characteristics and regional representation. These regions have been in use in the Test Bed since 2015. Their repeated utilization over the last four and half years in a dozen test campaigns, with by necessity the same test polygons and the set of available buildings within them, has resulted in what can be referred to as "building fatigue." This is the situation where once cooperative building managers, owners, or tenants become much less receptive to participating in the testing effort, regardless of offering access fees to encourage building and tenant participation. This has often translated into needing a very long time, as much as six months, with considerable associated costs to the body performing the testing just to acquire the required test buildings. Even more troublesome is the situation where some chosen buildings must be dropped after selection due to changing management or tenant views. This results in untenable delays in the middle of planned test campaigns, as the suitable replacements are often every limited.

These factors have resulted in a strong need to explore additional test areas to supplement the current regions: San Francisco, Atlanta and Chicago. The supplementary test areas would provide additional choices of test buildings in similar environments and with similar characteristics to the polygons in the original test regions. This need is particularly urgent for the dense urban and urban morphologies, whose selections of cooperating buildings are typically narrower and are generally more difficult to access.

It should be kept in mind that the objective is not to expand the scope of testing, but rather to provide additional flexibility in the choice of equivalent buildings and settings. Additional flexibility would make testing more feasible within the Test Bed and would enable more optimal selection of buildings to meet the unique needs of each test campaign, thus reducing building acquisition times and significantly improving test efficiency.

4.2 Assessment Criteria

Several factors should guide the selection of supplementary test areas. Additionally, since a test area can have varied attributes over a moderately large geographic expanse, these criteria should be applied specifically to the chosen candidate test polygons, which are designed to meet the assessment criteria at hand. The following is a list of salient factors to examine in the assessment:

- Building Density.
- Size of the available, suitable polygon.
- Approximate number of suitable structures in the polygon.
- Distribution of building characteristics (heights, construction, age).
- Geographic characteristics (terrain, open space, water bodies).
- Weather characteristics.

For each factor in the above list, a side-by-side comparison of the original and supplementary test area candidate is performed, and a level of equivalence is assessed as either 'Good', 'Fair', or 'Poor'. Additionally, the following standalone assessment criterion, which is more institutional in nature, takes on a binary value – either 'Yes' or 'No':

- Being in one of the six monitoring regions defined in ATIS-0500031.v002, Clause 5 [Ref 1].

5 Test Areas to Supplement Atlanta

Atlanta is a newer, growing, sprawling Southern US City. The morphology currently posing the most critical building acquisition challenge in Atlanta is the dense urban morphology, because of its rather limited extent and available building selections. An examination of cities like Atlanta, morphologically and regionally, revealed that a good match for its dense urban and urban morphologies is available in Houston, TX. Figure 5.1 illustrates side-by-side the downtown Atlanta dense urban polygon and a dense urban polygon in downtown Houston. The resemblance is easy to observe in the figure and will be reflected in the equivalence shown in Table 5.1 below.

Notably, downtown Houston provides a good selection of tall commercial buildings, which is one of the hardest categories to secure for testing, especially for test points or test paths in tenant spaces.

As for the urban Atlanta polygon, an area of similar building characteristics and density exists in the Houston Galleria (or Uptown) area. Figure 5.2 depicts a sizeable portion of the urban Atlanta test polygon side-by-side with an urban Houston-Galleria polygon. The similarity is clear.

An issue that may be of concern to some stakeholders is that Houston, like Seattle, is not part of the six monitoring regions used by the wireless carriers for their periodic accuracy compliance reporting. It should be emphasized that these guidelines do not alter the monitoring regions – all that is sought is to add test buildings in different cities that are of similar characteristics to Atlanta, Chicago and San Francisco, for the sole purpose of making testing more feasible.

Nevertheless, to address this concern, another option to supplement Atlanta that is among the six monitoring regions is Philadelphia. Although Philadelphia is an older northern city, i.e., from a different geographic region of the US with its own characteristics, it could be considered to have some similarity to Atlanta, at least as far as downtown and certain portions of its urban landscape.

Figure 5.3 shows a view of the Dense Urban Polygon surrounding downtown Philadelphia. This is a sizeable polygon and there are certainly enough commercial and residential building types in this polygon to serve as equivalents to buildings in downtown Atlanta.

For the urban morphology, the area surrounding Downtown Philadelphia is older and more tightly packed than urban Atlanta. An urban area within Philadelphia that resembles more closely urban Atlanta is across (east of) the river. A test polygon there is shown in Figure 5.4. It is a fraction of a considerably larger urban area defined in the Philadelphia monitoring region. (Note the geographic orientation of the test polygon is somewhat rotated to clarify its presentation in the image.) These figures show an adequate degree of equivalence, although in parts not as good as the Atlanta/Houston equivalence. It should be noted that the dense urban polygon is the same as that of the Philadelphia monitoring region, whereas the urban test polygon, as mentioned above, is only a relatively small subset of the large urban classification in that monitoring region.

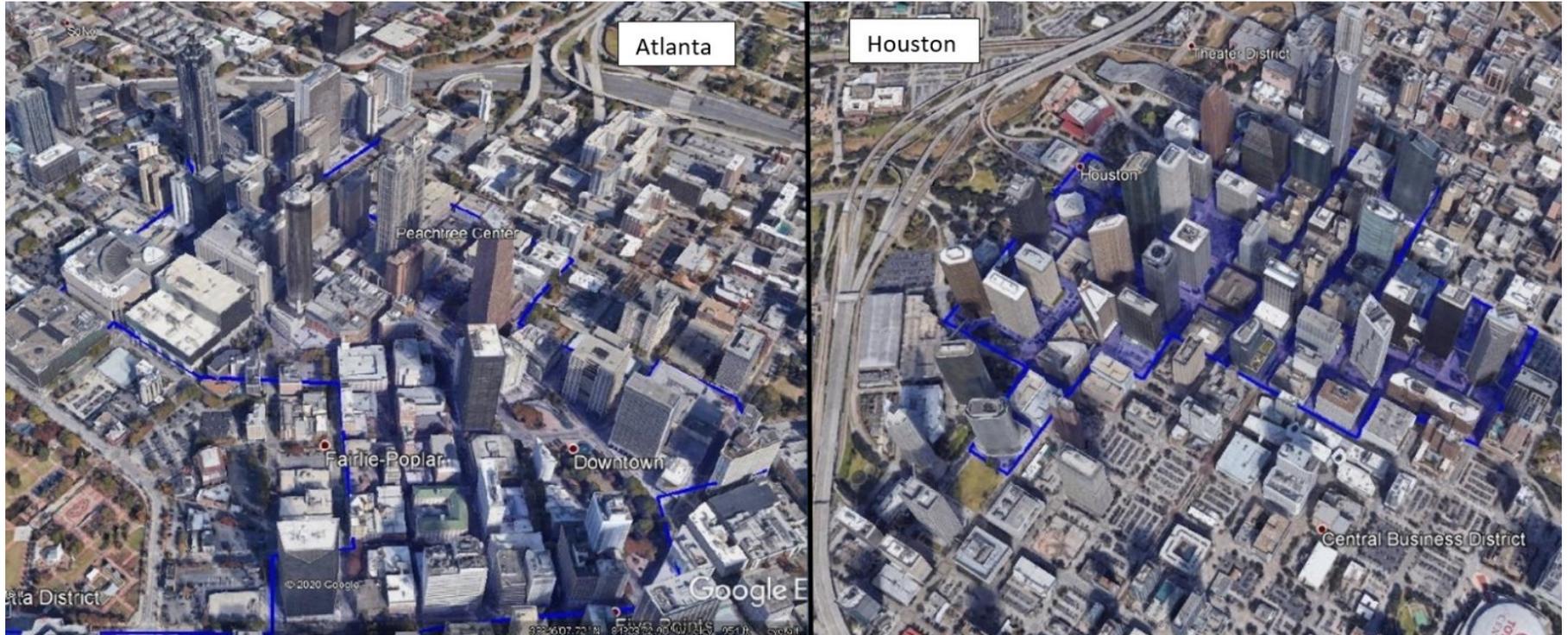


Figure 5.1 Side-by-side Comparison of Dense Urban Downtown Atlanta and Houston

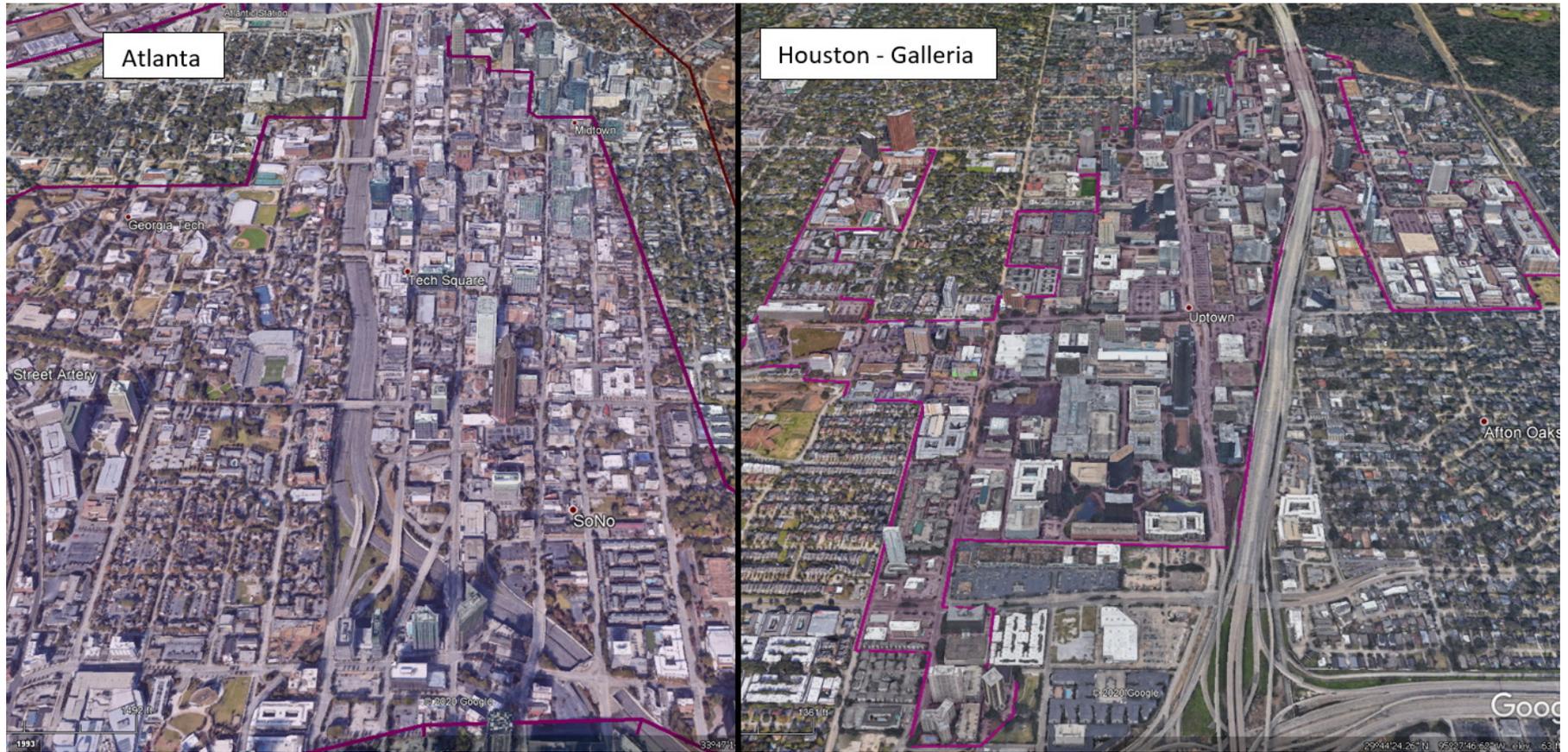


Figure 5.2 Side-by-side Comparison of Urban Atlanta and Urban Houston Galleria Area

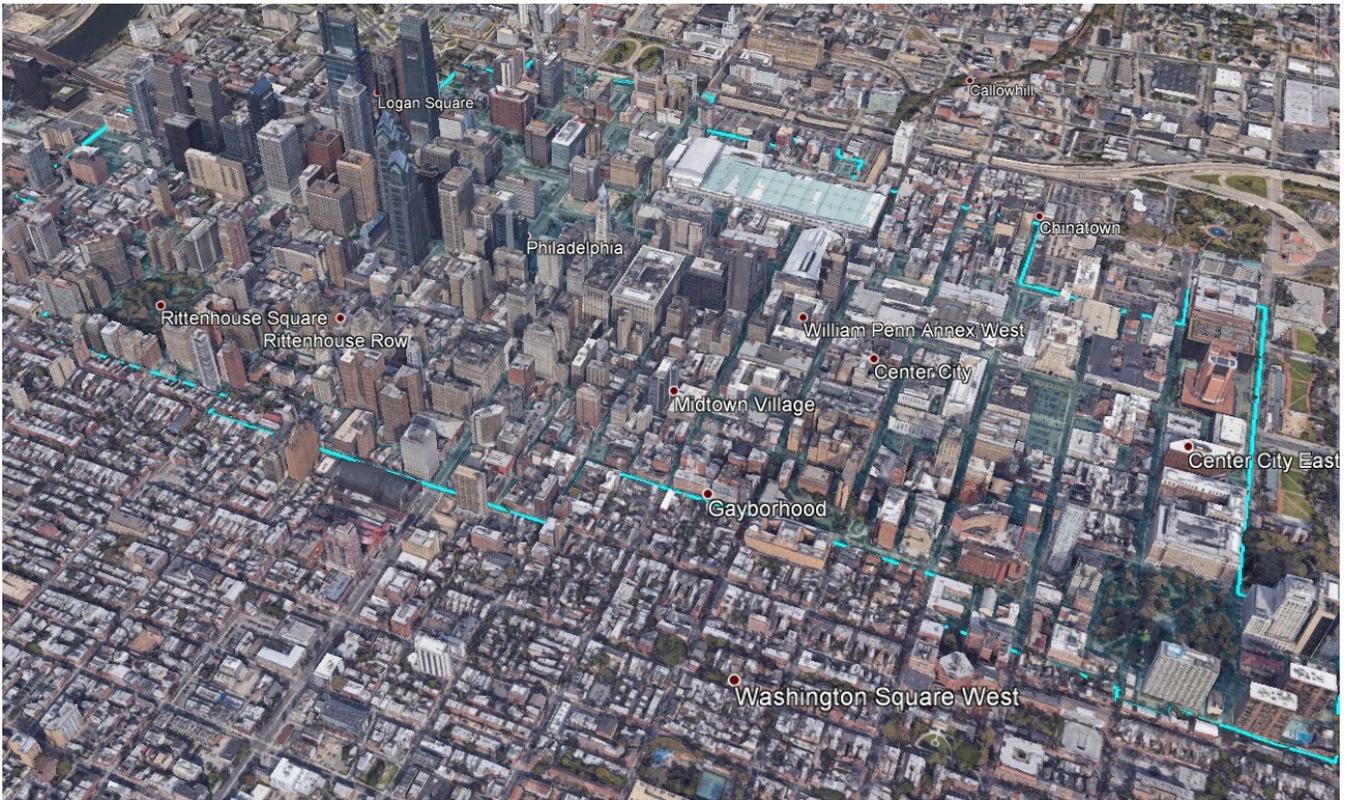


Figure 5.3 Dense Urban Polygon Surrounding Downtown Philadelphia

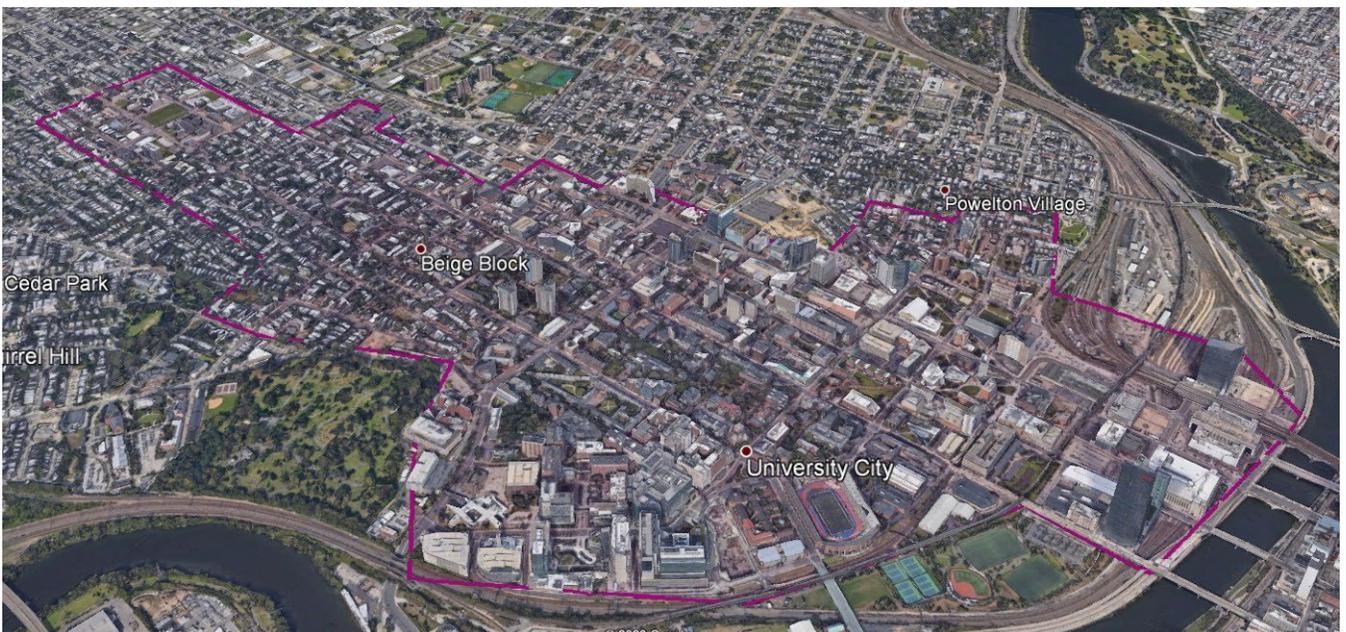


Figure 5.4 Test Polygon within Urban Philadelphia

In preparing these guidelines, Denver was also examined to assess its usability. The dense urban polygon of the Denver monitoring region is shown in Figure 5.5. It can be seen that Downtown Denver is less dense than Atlanta with very few urban canyon scenarios. Based on this, Denver is not considered to be a viable option to supplement Atlanta or any of the test regions.

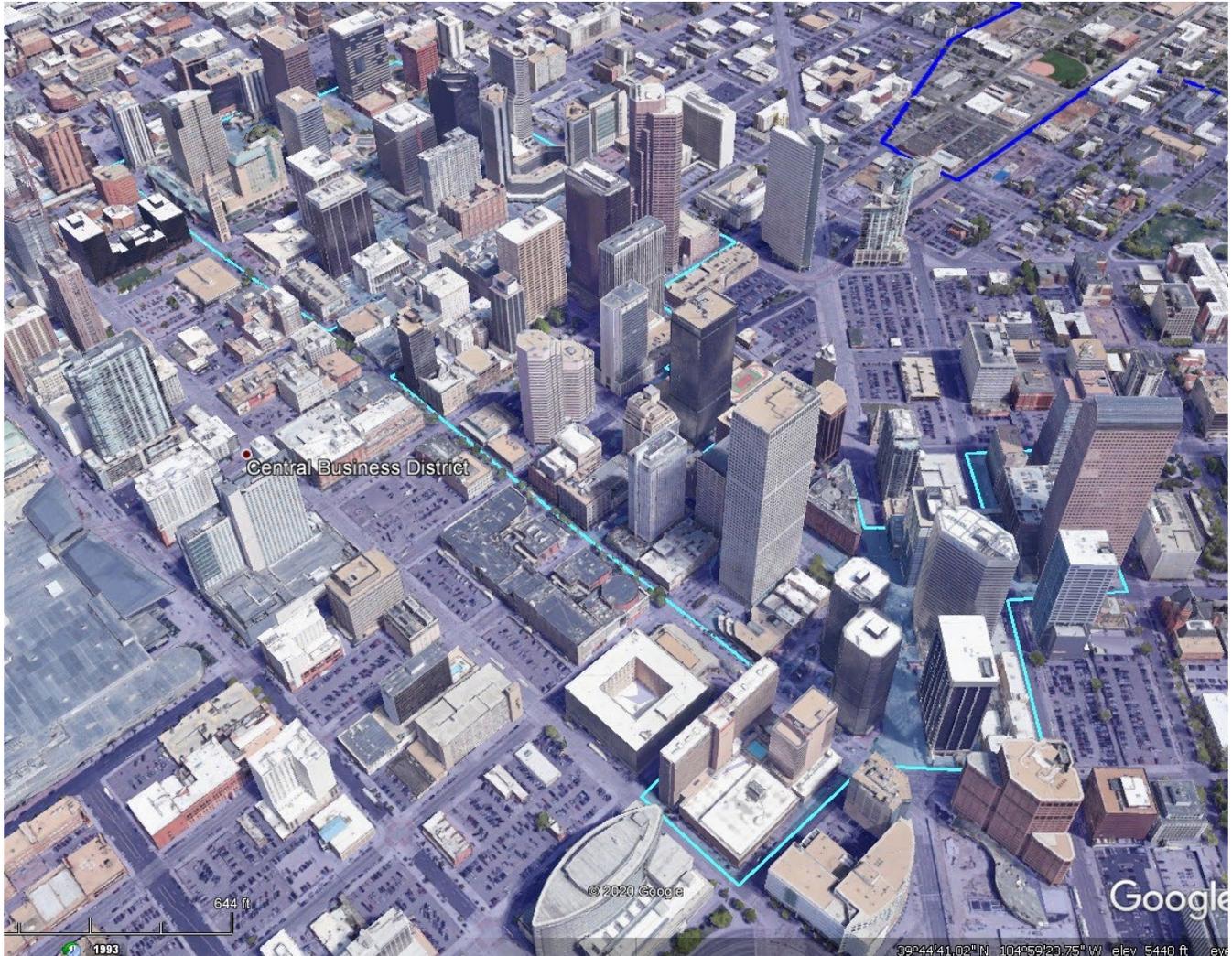


Figure 5.5 Dense Urban Polygon of the Denver Region

The equivalence characteristics for the viable options to supplement Atlanta are shown in Table 5.1

Table 5.1 Supplementing Atlanta – Equivalence Characteristics for Houston and Philadelphia

Characteristic	Level of Equivalence for Houston	Level of Equivalence for Philadelphia
Building Density	Good	Fair to Good
Size of the available, suitable polygon	Good	Good
Approximate number of suitable structures in the polygon	Good	Good
Distribution of building characteristics (heights, construction, age)	Good	Fair to Good
Geographic characteristics (terrain, open space, water bodies)	Good	Good

ATIS-0500043

Characteristic	Level of Equivalence for Houston	Level of Equivalence for Philadelphia
Weather characteristics	Good	Fair
Monitoring region	No	Yes
	<i>Best for matching Atlanta's characteristics</i>	<i>Best if staying in the 6 monitoring regions is the primary concern</i>

Both Houston and Philadelphia may be used to supplement the Atlanta test region. Each choice has advantages and disadvantages, and the decision as to which to choose comes down to the following:

- Houston is best for matching morphology and building characteristics overall.
- Philadelphia is best if staying within the six monitoring regions is the primary concern.

Both options achieve the goal of giving additional flexibility to the Test Bed or other testing parties, adding building options, and relieving ‘building fatigue.’

6 Test Areas to Supplement Chicago

Chicago was originally included in the Test Bed to address the need to test z-axis technologies that used barometric pressure in their measurements. Existing Z-axis solutions use barometric pressure to varying degrees, and it is clear that barometric pressure measurements will remain an important part of hybridized Z-axis solutions for the conceivable future. The Chicago region has now been included as an integral part of the combined X/Y/Z test methodology guidelines detailed in ATIS-500040 [Ref 100] because Z technologies, regardless of their extent of reliance on barometers, can be impacted by various factors highlighted in Chicago. These include unique density of urbanization, distribution of building heights, and proximity of multiple taller buildings, in addition to weather effects.

The dense urban environment in Chicago is quite unique and not easily replicated elsewhere, it certainly does not exist in any other midwestern city. The closest setting to dense urban Chicago, from the perspective of building density and variety, is actually New York City. This is illustrated in the side-by-side comparison shown in Figure 6.1, where the dense urban Chicago polygon is displayed along with a polygon that encompasses portions of Midtown Manhattan and the Upper West Side. These portions of Manhattan have an expansive mix of commercial and residential buildings of widely varying heights and distribution to offer many opportunities to target for testing. The resulting comparative assessment for the dense urban polygon of Chicago and the New York polygon is given in Table 6.1 below.

New York is of course one of the monitoring regions, which is an inherent advantage. However, New York City is not without its challenges in testing, including likely those associated with higher transportation costs and private space access fees, as well as possible added building access logistics to contend with. Nevertheless, the plethora of buildings, both commercial and residential, make it a rich target to consider specifically for dense urban testing.

For the urban morphology, various options are available in the New York monitoring region, which includes several counties in New Jersey. A survey of the various urban counties surrounding Manhattan indicated that Hudson County, NJ contains various areas that would be a good supplement to urban Chicago. It has a similar mix of taller and shorter residential and commercial buildings, in an area surrounded by water and greenery on the periphery. Some of the other counties in the New York Region, such as other boroughs of New York City, were not selected because many of their residential buildings are bulkier (thicker, with more collocated units) and denser than in urban Chicago.

The urban test polygon in Hudson County, NJ, is shown in Figure 6.2 along with a portion of the urban Chicago polygon to offer a visual comparison. The equivalence factors of the urban Chicago polygon and the urban Hudson County, NJ polygon are summarized in Table 6.1. Note that the Hudson County polygon could be easily expanded, if needed in the future, using the remainder of the urban classification in Hudson County, which was provided as part of the New York monitoring region definition in ATIS-0500031.v002 [Ref 1].

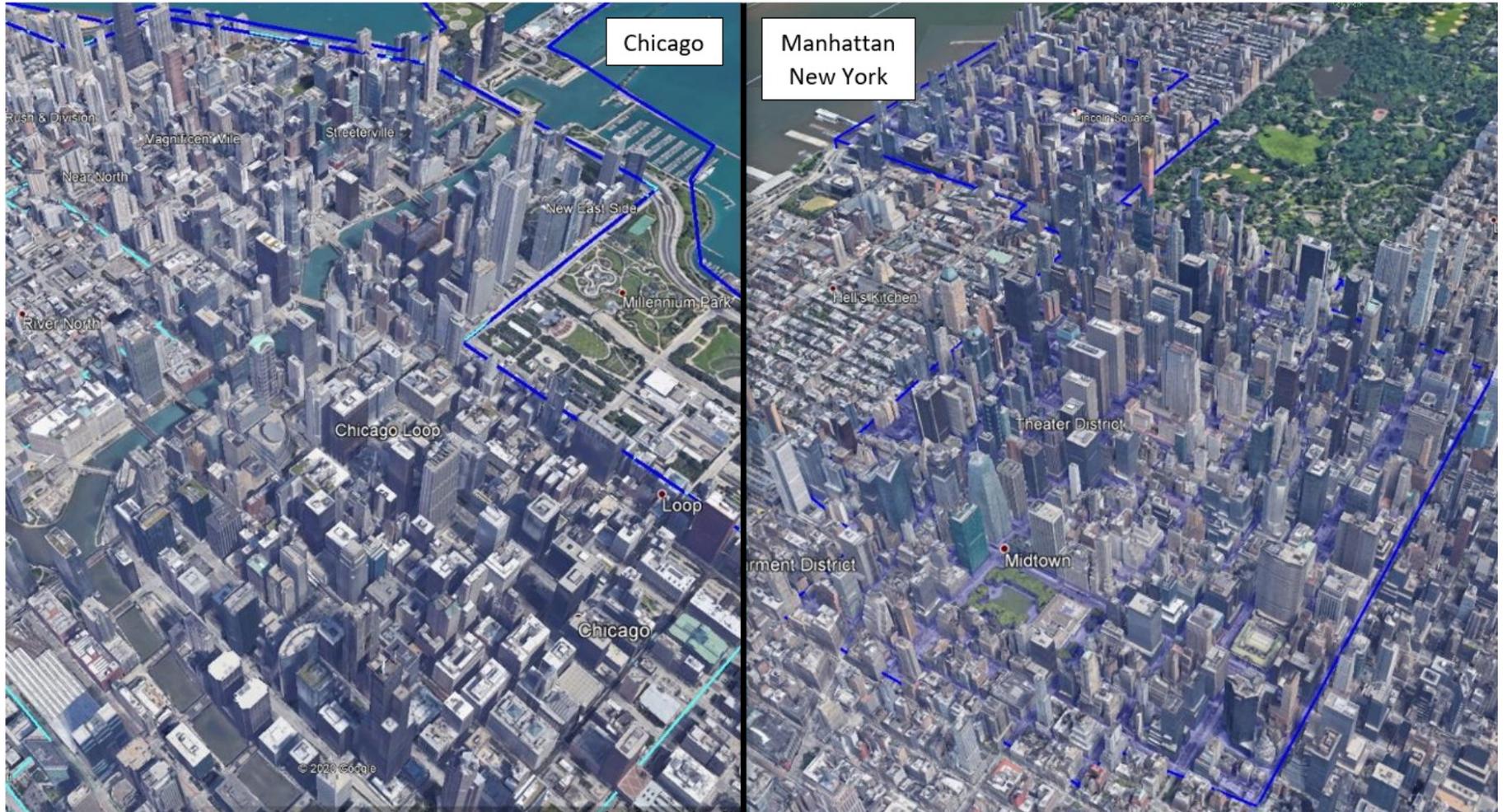


Figure 6.1 Side-by-side Comparison of Dense Urban Chicago and a Select Portion of Manhattan

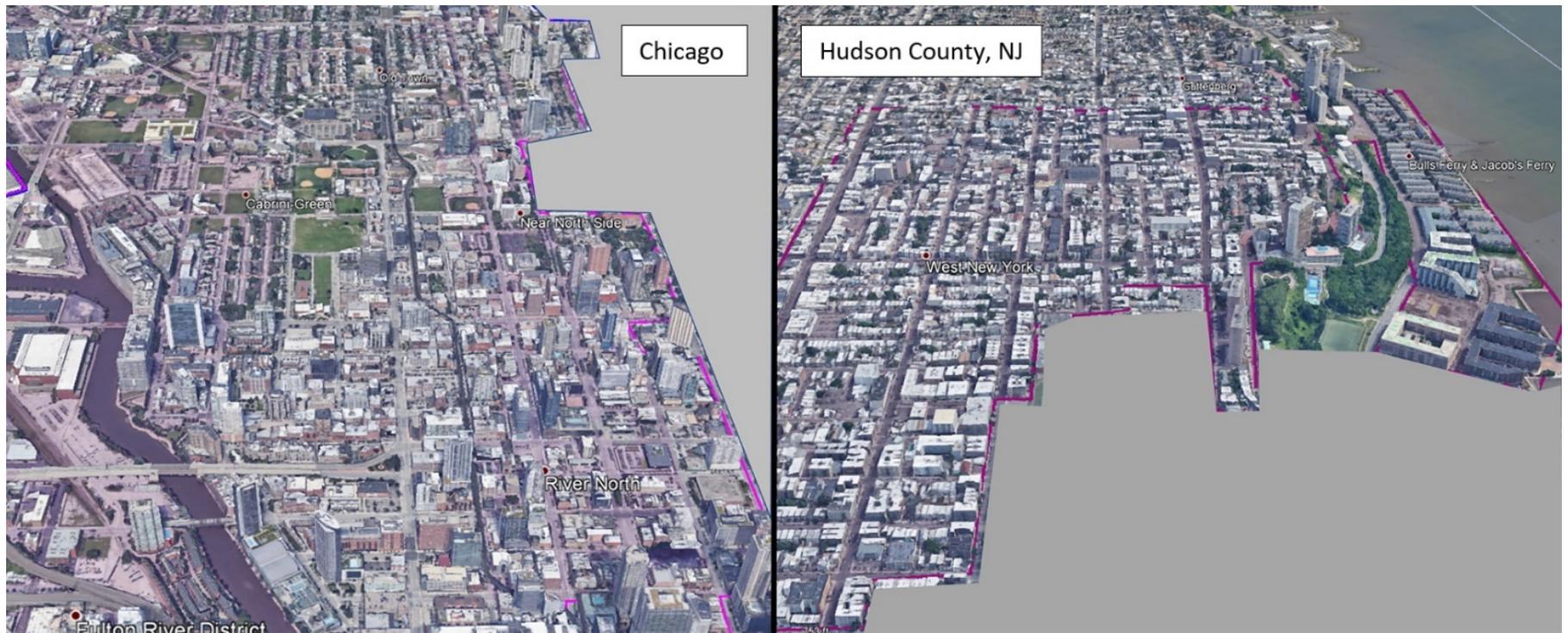


Figure 6.2 Urban Chicago Side-by-side with Urban Hudson County, NJ (New York Region)

One attribute of the Chicago area that is less present in the New York region is its extreme cold weather in winter – characteristic of the upper Midwestern region of the US. The weather does get cold and windy in the New York area in winter, but not quite as severely or as often as in Chicago. (Note that wind is less of a factor in this selection, since San Francisco is on average windier than Chicago.) In the event that testing is intended to be performed in the middle of winter and a primary testing objective is to subject the technologies and networks under test to a very cold exterior climate, an alternate to the New York area may be needed.

A survey of Midwestern cities indicated that Minneapolis is likely the only regional alternative that can offer an adequate combination of dense urban and urban buildings to meaningfully supplement Chicago. This is based on broad evaluations that follow the criteria described in this document (see Clause 4.2).

Figure 6.3 shows the relatively small downtown area of Minneapolis. It does have a number of taller buildings, creating a few urban canyons in between. It is possible therefore to envision performing cold weather testing in one or two such buildings, having certain desired characteristics, as part of a cold weather-oriented test campaign. The equivalence criteria are provided below in Table 6.1.

The urban area surrounding downtown Minneapolis could also serve to supplement urban Chicago during cold weather testing. An urban polygon is shown in Figure 6.4. (Geographic direction rotated for clarity of the displayed morphology). Obviously, this urban morphology is not quite as varied, extensive or challenging as urban Chicago. Nevertheless, a few of its buildings could serve to supplement urban Chicago buildings in a cold weather test campaign. The same equivalence criteria in Table 6.1 apply to the urban polygons as well.

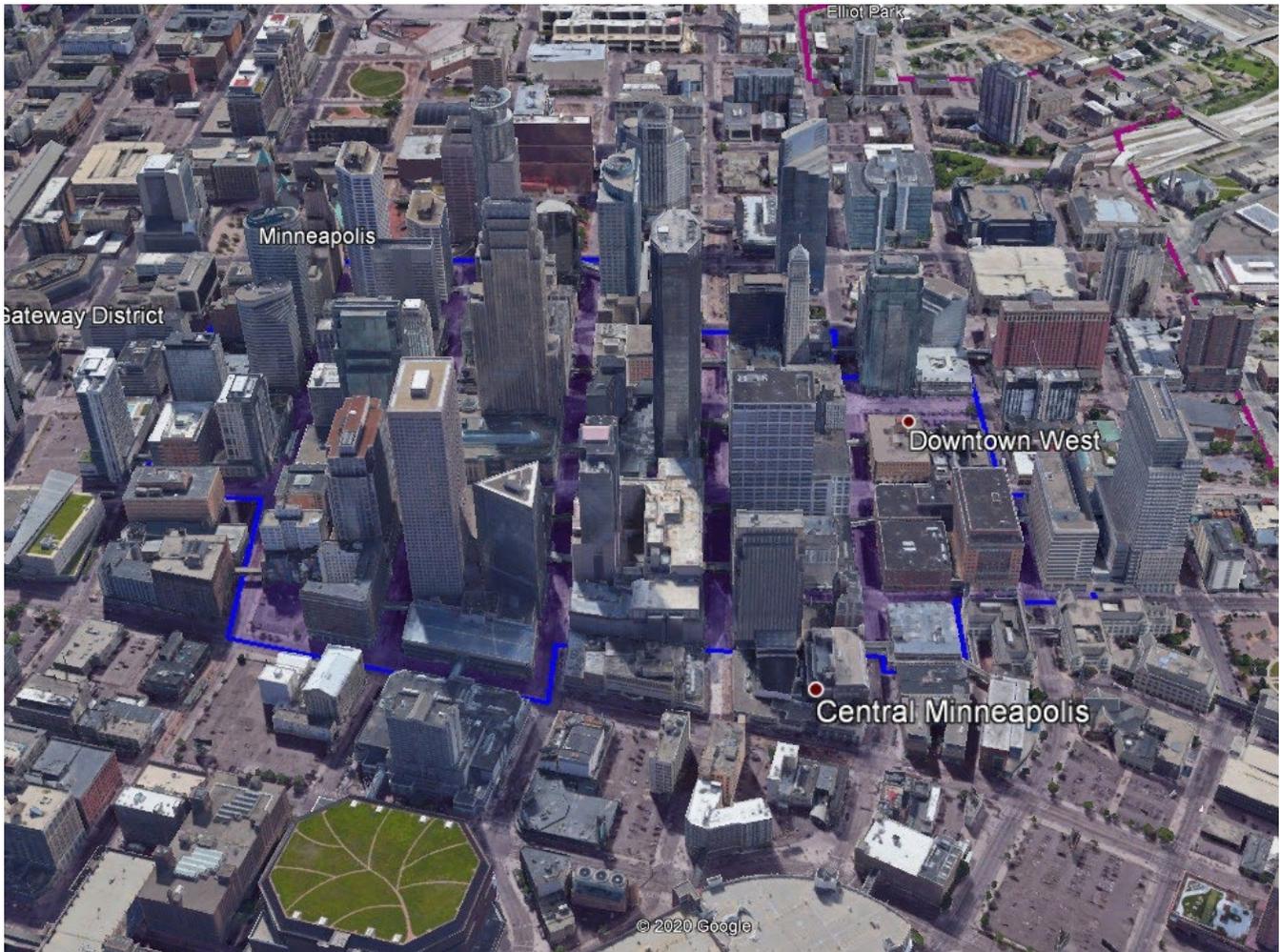


Figure 6.3 Dense Urban Portion and Corresponding Polygon in Downtown Minneapolis

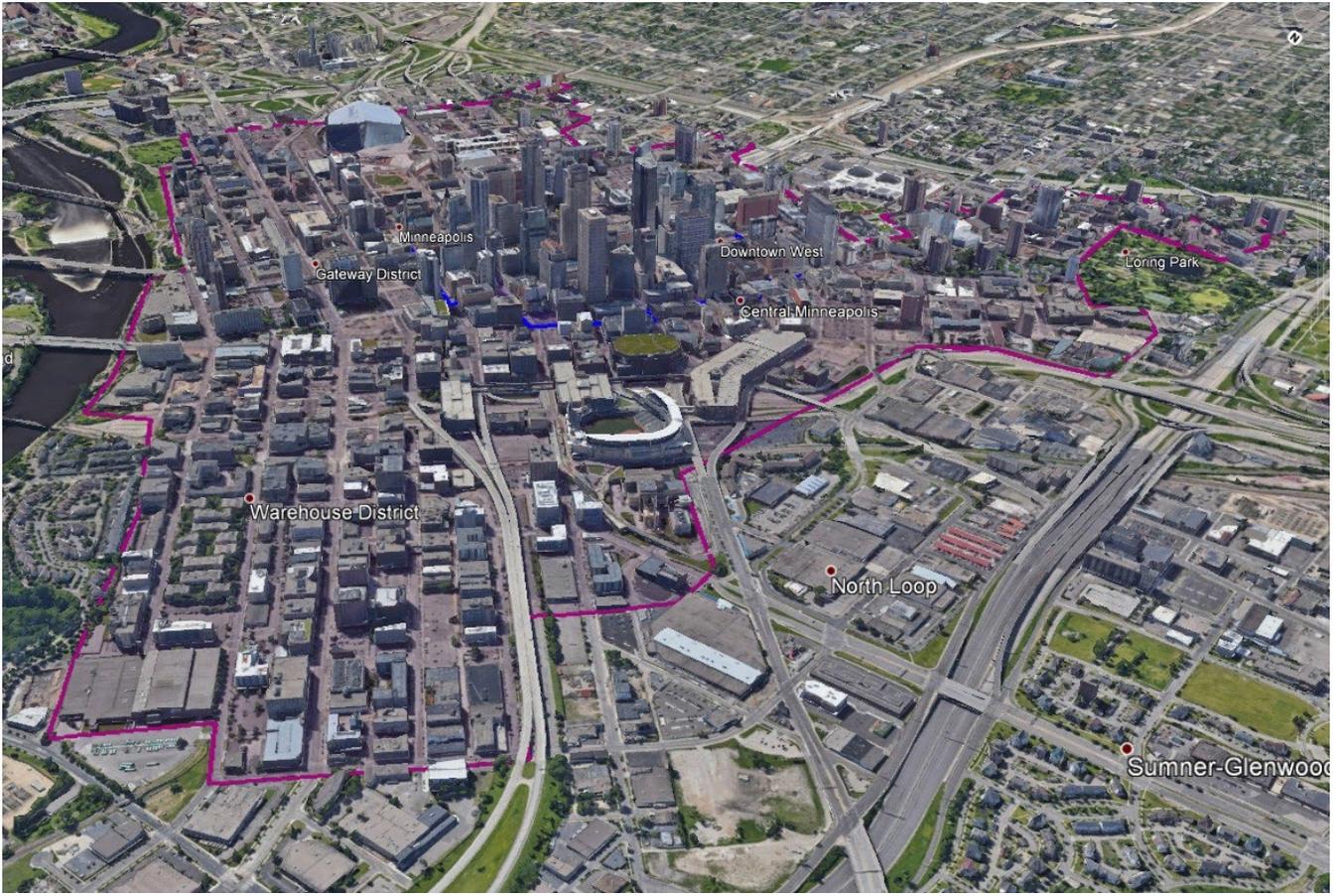


Figure 6.4 Urban Minneapolis Polygon

Both the New York area and Minneapolis may be used to supplement the Chicago test region. The equivalence characteristics are shown in Table 6.1, with their unique characteristics highlighted. The New York City region is by far the better option from the perspective of matching Chicago’s morphology, building and density characteristics, and it has the added advantage that it is one of the six monitoring regions. Minneapolis is best suited for testing in extreme winter weather conditions. Either option would achieve, in its own way, the goal of giving additional testing flexibility, adding building options, and relieving ‘building fatigue.’

Table 6.1 Supplementing Chicago – Equivalence Characteristics for New York Area and Minneapolis

Characteristic	Level of Equivalence for Manhattan	Level of Equivalence for Hudson Co., NJ	Level of Equivalence for Minneapolis
Building Density	Good	Good	Fair
Size of the available, suitable polygon	Good	Good	Fair
Approximate number of suitable structures in the polygon	Good	Good	Fair
Distribution of building characteristics (heights, construction, age)	Good	Fair to Good	Fair to Good
Geographic characteristics (terrain, open space, water bodies)	Good	Good	Fair
Weather characteristics	Fair to Good	Fair to Good	Good
Monitoring region	Yes	Yes	No
	<i>Best for matching Chicago's characteristics and if staying in the six monitoring regions is a concern</i>		<i>Best for testing in extreme cold weather</i>

7 Test Areas to Supplement San Francisco

The San Francisco region, with its test bed polygons defined in ATIS-0500031v.002 [Ref 1], was selected to be representative of the West Coast of the United States. The West Coast is unique in several aspects, including its construction methods, with newer lighter construction (frequently with wood and wood framing or steel with lighter walls to accommodate seismic activity), hilly terrain, and milder year-round climate with mostly evergreen vegetation. Because of these unique attributes and their possible impact on the performance of indoor wireless location systems, it is not appropriate to use regions from outside the West Coast to supplement San Francisco.

A survey of the metropolitan areas along the West Coast revealed that Seattle provides the best potential for use as a supplement to the San Francisco area. The supplemental dense urban polygon around Downtown Seattle is shown in Figure 7.1 along with downtown San Francisco. Although Downtown San Francisco has deeper, narrower urban canyons, Downtown Seattle is the closest there is on the West Coast, and it does have urban canyons and some closely spaced tall buildings. More importantly, it is a good-sized dense urban area for the West Coast with an adequate supply of taller buildings of varying heights.

The supplemental urban polygon in Seattle is shown side-by-side with the urban test polygon in the City of San Francisco in Figure 7.2 and side-by-side with the urban test polygon around San Jose in Figure 7.3. Examination of these two figures reveals that buildings in urban San Francisco (Figure 7.2) are more tightly packed than Seattle. However, the density in urban Seattle is close to that of the urban test polygon of San Jose. Accordingly, urban Seattle may be used as a supplement to the San Francisco region, although with an emphasis on substituting for San Jose urban test buildings.



Figure 7.1 Side-by-side Comparison of Dense Urban San Francisco and Seattle



Figure 7.2 Side-by-side Comparison of Urban San Francisco and Seattle

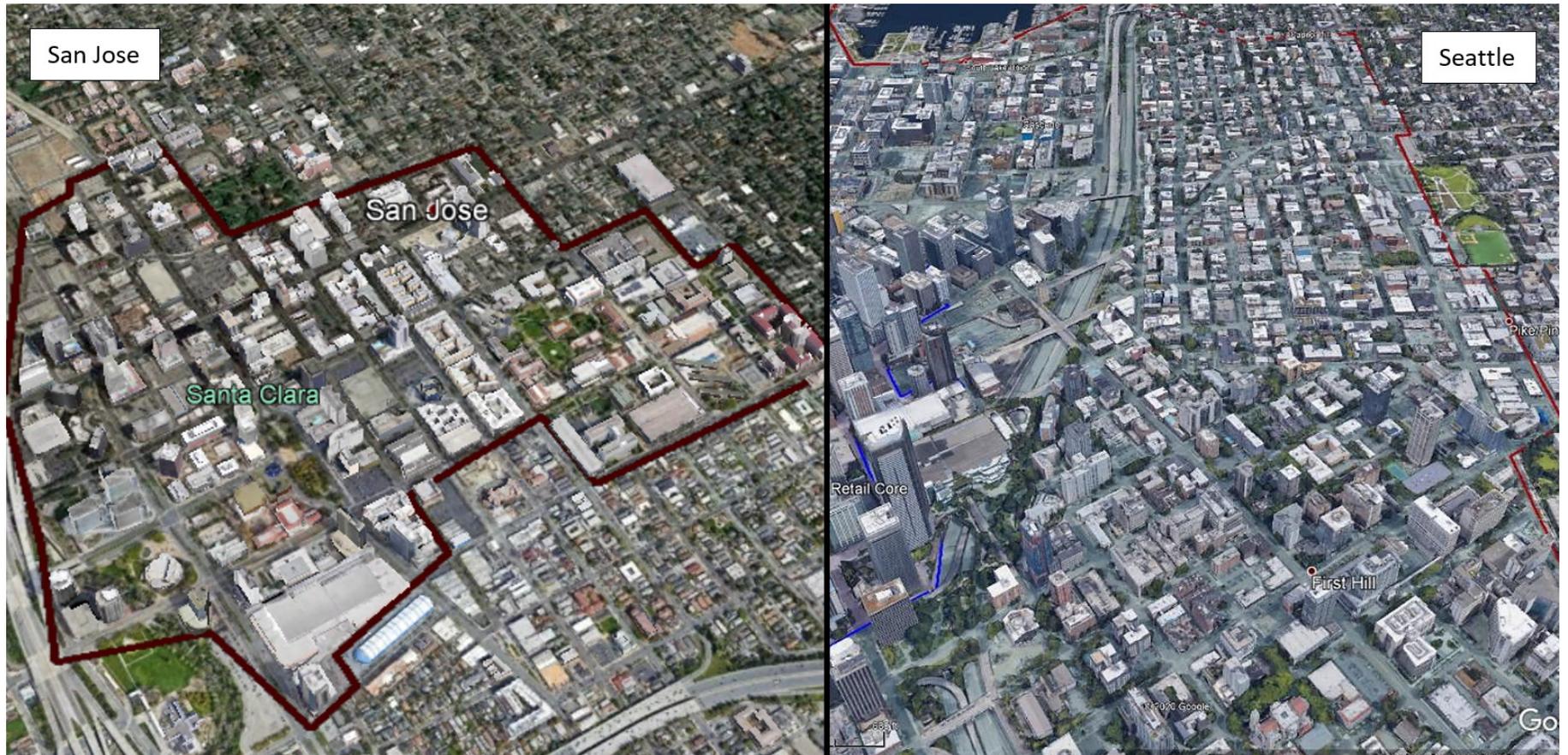


Figure 7.3 Side-by-side Comparison of Urban San Jose (San Francisco Region) and Urban Seattle

The Seattle urban and urban polygons are illustrated jointly in Figure 7.4.



Figure 7.4 Urban and Dense Urban Seattle Polygons

The Seattle region may be used to supplement the San Francisco region. The equivalence characteristics are summarized in Table 7.1. Dense urban and urban morphologies are broken out separately, as is the comparison to the San Francisco urban polygon versus the San Jose urban polygon, as they differ in their salient characteristics. The table further highlights that downtown Seattle is the only viable substitute for dense urban San Francisco, while urban Seattle is best suited as a substitute for urban San Jose buildings.

Table 7.1 Supplementing San Francisco – Equivalence Characteristics for Seattle

Characteristic	Level of Equivalence for Dense Urban Seattle	Level of Equivalence for Urban Seattle
Building Density	Fair to Good	Fair SF/Good SJ
Size of the available, suitable polygon	Good	Good
Approximate number of suitable structures in the polygon	Good	Good
Distribution of building characteristics (heights, construction, age)	Good	Fair SF/Good SJ
Geographic characteristics (terrain, open space, water bodies)	Good	Good
Weather characteristics	Good	Good
Monitoring region	No	No
	<i>Downtown Seattle is the only viable substitute for dense urban San Francisco</i>	<i>Urban Seattle is best suited as a substitute for Urban San Jose</i>

8 Summary

To respond to the critical need of supplementing the current test regions of San Francisco, Atlanta and Chicago, the definition of supplemental test areas for each of these three test bed regions are provided in this document. In each supplemental test area, specific dense urban or urban polygons have been defined. These provide added choices of test buildings with similar environments and characteristics as those found in either the San Francisco, Atlanta or Chicago test regions. This augmentation of ATIS-0500031v.002 [Ref 1] will provide much needed flexibility to the Test Bed and others who seek to perform testing, such as wireless carriers or technology providers, by making available a wider selection of building options and relieve the test ‘building fatigue’ currently occurring in the three test regions. It should remain clear that the objective is not to expand the scope of testing, but only to provide additional flexibility and building choice, so that testing can be more efficient, faster, and less expensive.

The supplemental test areas are summarized as follows:

- To supplement the Atlanta test region, Houston and/or Philadelphia are available choices. Houston is best for matching Atlanta’s characteristics overall, while Philadelphia is an acceptable choice if staying within the six monitoring regions is the primary concern.
- To supplement the Chicago test region, both the New York City region and/or Minneapolis are options. New York is by far the better option from the perspective of matching Chicago’s morphology, building and density characteristics, and it has the added advantage that it is one of the six monitoring regions. Minneapolis is best suited for testing in extreme winter weather conditions.
- To supplement the San Francisco test region, Seattle is the only viable choice. Downtown Seattle is a suitable supplement for dense urban San Francisco, while urban Seattle is a suitable substitute for urban San Jose.

The exact choice of supplemental test areas to use or their mix will be left to the testing body to determine in response to the requirements of each test campaign and the relevant technology capabilities under test.