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This paper postulates that those responsible for the layout out of cities will take an approach that is recognizable across time and culture. The conditions that may result in a grid layout are: 1) An unconstrained site that is large enough to accommodate the expected population; 2) A social structure that can direct the layout using accurate surveying equipment and skills; 3) The perceived need to provide an urban environment quickly.

The research consisted of measuring lots, blocks, streets, and sidewalks in five cities in the ancient Mediterranean Basin, three from the 19th century in the U.S. and three New Urbanist-influenced communities from the late 20th century, also in the U.S. The measurements were obtained from GIS systems using the "measure" tool, official records, excavation reports and personal field data. The measurements are displayed in their original form and in meters.

The paper deconstructs the grid into its components, including the lot, the block, the street, and the sidewalk. These are analyzed individually and yield ratios that transcend time and culture. For instance, lots range in dimension from 1:1 (width to length) to 1:4, with a mean of 1:2. Blocks, likewise, range from nearly square to 1:4 with the mean, median and mode being 1:2. Streets are designed for traffic expected at the time of city layout. Several streets in a city may be intentionally wider to convey a sense of importance. These axial streets may cross at right angles near the center of town and may be oriented to the cardinal points or important destinations.

INTENTIONAL URBANISM

by

Roger Bardsley

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Approved by

Dr. Selima Sultana
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DEDICATION

I dedicate this dissertation to my wife Elaine Brune for her support throughout this long process.

APPROVAL PAGE

This dissertation written by Roger Bardsley has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I: INTRODUCTION

In this dissertation, I examine cities from the ancient Mediterranean Basin, from the 19th Century U.S. and the late 20th Century U.S. to see if there are underlying organizational principles that guided the layout of the streets, sidewalks, and lots. The answers to this inquiry will help to write "rules" that were apparently followed when laying out cities, but rarely ever written down. I am treating the patterns created as artifacts that illustrate the ideas of those responsible for the layouts.

I focus on cities that were laid out in a grid pattern with streets intersecting at right angles to form blocks. The grid is an ancient city form that has been in use for at least 4,500 years, appearing in the Indus Valley at Harrapa and Mohenjo-Daro, fully formed, about 2,500 BCE (Lawler 2013), and continuing to the present in societies around the world (Fonyodi 2008). I pick up the history of the grid in ancient Greece and Rome and continue through the 19th Century to the 20th Century America.

My intent is not to do an exhaustive review of all grid pattern cities, and in fact, that might be an impossible task given the thousands of examples that exist. Instead, I pick two time periods and cultures in the ancient Mediterranean Basin and two time periods in the U.S. to measure characteristic shapes formed by the grid and compare them to look for similarities and differences. I intend to show that when organized groups of people need to build cities, they will approach the situation in similar ways.

In 1999 The Charter of the New Urbanism (CNU) was published by the Congress for the New Urbanism by a group of people who believed that modern city design is heavily skewed towards vehicular movement and does not meet the needs of the humans that occupy cities. One of the Chapters of the CNU has a preamble that indicates this group was thinking intensively about how cities are developed.

> The Charter's smallest scale is the Block, the Street, and the Building. At this scale, we need to accommodate automobiles as well as pedestrians. New Urbanism does not naively call for the elimination of the car. Rather, it challenges us to create environments that support walking, biking, transit, and the car. This section outlines urban design strategies that reinforce human scale while incorporating contemporary realities. (p 121)

The people who established CNU and other "new urbanist" organizations were reacting to two phenomena: First, the development of new urban and suburban communities that were laid out to accommodate vehicular movement and ignored human comfort outside the automobile; Second, the damage that motor vehicles have done to cities that were built before the advent of the automobile. I mention this because the New Urbanists often recommend a return to development patterns from the past that include grid pattern streets, short blocks, sidewalks and other "human scale" forms that would have been familiar to city dwellers over the centuries.

Through this analysis, I intend to show certain patterns that appear and reappear over several thousand years and indicate how people have attempted to create safe, livable communities.

I start below with definitions of the components that, where possible, will be analyzed.

Block Length and Block Width – Grid pattern cities are laid out to create "blocks" bounded on four sides by streets. The longer sides of the blocks are the "block length" while the shorter sides are the "block width". In the aerial view below from Greensboro, NC the short sides of the block have almost no homes facing them, while the long sides have rows of homes with consistent front setbacks and lots that meet in the middle of the block.

This block was laid out in 1926 after the automobile was well-established (Guilford County Register of Deeds, Sunset Hills, Plat Book 9, page 89). It nevertheless has a recognizable form and is part of a neighborhood where walking is a common means of transportation (Figure 1).

An important characteristic of the grid form block is that it features connectivity with its neighbors. In the example below, a property on this block of Ridgeway Dr. can be reached from Madison Ave. either from the east or west, from Rolling Road either from the east or west, and from Ridgeway Dr. either from the north or south. This characteristic was important to movement of people and goods before the automobile and retains value today for travel by foot and by bicycle.

Figure 1. Typical Block in a Grid Layout Neighborhood. Source: Guilford County GIS

Most of the private spaces (lots) face the long side of the block and stretch back into the interior. This maximizes the number of lots that can be created on a given length of street. The block width sides may also contain lots, but not as many as the long sides. This may create a street hierarchy in which the long side streets are busier than the short side streets. This concept can be seen in Pompeii, Italy in AD 79 Lawrence (2007) states that in Pompeii the important frontages on most insulae (blocks) were on major streets, while side streets had fewer entrances into the insulae. The relatively few insulae at the intersection of major streets could use more of their frontages while most of the other insulae had frontages on side streets that were not heavily used (p 122). Hartnett (2017) states Roman streets had a two-tiered scheme of streets. The alleyways along the long side of the city blocks were narrow and private while the roads along the short side of the blocks were wider, more public, and often accommodated cart/wagon traffic (p 32).

Before we continue it is important to introduce the notion of “public” versus “private” space that is predominant in Western societies. The street and sidewalks, if present, constitute public space that is available for everyone in the community to use. Behind the sidewalk is what we refer to as the right-of-way line, the demarcation between public and private space. In cities, this line may coincide with the front façades of the buildings, or there may be a substantial front setback, usually called a “front yard” in the U.S. The front yard may be fenced to emphasize the public/private dividing line, or simply be landscaped to set off the structure on the lot.

The public versus private space was important in Roman times. As Kaiser (2011) notes, “Roman urbanites had much more freedom to choose where to conduct certain activities than do their modern Western counterparts. As long as they kept the streets in front of their buildings clean and in good repair, they were mostly free to employ those buildings and street space in front of them as they wanted” (p 45). Citizens were, however, required to clean and not block the streets in front of their properties. In many cities today, vendors will use the public space to sell their products but are expected to not impede traffic nor erect permanent stalls.

Streets and Sidewalks – The terms “street” and “sidewalk” are commonly used and understood in the U.S. today and are often regulated by engineering standards laid out by state and local governments. Kaiser (2011 states, regarding Roman cities “Sidewalks flanked some streets, usually consisting of a row of curbstones approximately 30 cm high, that created a border into which earth was rammed for the walking surface” (p 50). The need for sidewalks, particularly on busy streets, was created by cart and wagon traffic and by herds of livestock being driven to market.

As I will show in the next chapter, Roman and Greek streets were generally narrower than streets in 19th century North America, creating more tension among users than where streets are wide. Lawrence (2007) analyzed the blockage of streets in Pompeii to through traffic, and concluded that as time went on, more traffic was concentrated on fewer through streets, and more blockages were created on side streets. The through-streets are connected to ports and major roadways in the region. As a corollary, he mapped streets with ruts into four categories, deep, shallow, faint, and no ruts to confirm which streets were being regularly used for through traffic (p 56). Hartnett (2017) states “Nothing kept someone from walking in the roadbed, but the presence of wheeled vehicles and animals (not to mention the glop that our sources describe there) likely squeezed most pedestrians onto narrow sidewalks. Even on main streets, four people squeezed shoulder-to-shoulder spanned nearly the whole width of one footpath, which was approximately 2 meters.” (p 73)

My sample 19th century cities were platted with wide streets and sidewalks even though photos from the late 19th century in those cities, i.e., Hansen (2013) show people walking in the streets, too. Our notion of strict separation of vehicles and pedestrians emerged after the development of the automobile and its much higher speeds (Dover and Masingdale 2014).

Today, street designs generally conform to the American Association of State Highway and Transportation Officials (AASHTO) Manual (2018).

In the late 1960s in Delft, Netherlands the Dutch developed a concept called “Woonerf”, which according to Collarte (2012) means “residential yard.” Since that time, the concept has spread worldwide including on Wall Street in Asheville, NC (Figure 2). The curb is eliminated, and pedestrians, cars, and bicycles share the same space. Various measures are used to slow traffic to 8–10 miles per hour and everyone has access to the space with pedestrians taking priority over vehicles. Landscaping and seating encourage people to use the street for socializing. I mention this because it is a modern re-creation of street life in ancient Rome, as described by Hartnett (2017), and visible in photos and paintings of street life in 19th century Europe and the U.S. Although there were distinct street and sidewalk areas, people used the entire space for various activities.

Figure 2. Example of Woonerf in Asheville, NC. Source Google Earth

<u>Building Setbacks</u> – In the U.S. today building setbacks, which are the areas between the building and the right-of-way line, are controlled by zoning and subdivision regulations. For example, in Greensboro, NC the setback requirement in the Central Business District is 0 feet while in the R-3 district it is 25 feet on local streets or 35 feet from thoroughfares (Greensboro Land Development Ordinance 2010. 2019).

Roman cities generally did not have setbacks. Hartnett (2017) states that buildings in Pompeii and other Roman cities were built wall-to-wall with no spaces between them, and were set close to the street, creating “a solid physical boundary (that) penned in the space of the street. On average, at Pompeii, streets measured between 5 and 6 meters (building) face-to-face, which is only slightly less than the width of streets in Rome itself.” (p 30).

Nineteenth Century U.S. cities likewise did not have required setbacks, so buildings were often built starting at the back of the sidewalk. As residential development moved to the suburbs, setbacks appeared as part of the city planning movement of the late 19th Century that sought to improve health by lessening congestion and creating more green space (Lawrence 2007). This effort is often referred to as the "Garden City Movement" promoted by Ebenezer Howard who wrote "Garden Cities of To-morrow" in 1902.

Since building setbacks, particularly in residential areas, are almost universal in the 21st Century U.S., it is difficult to realize just how much they affect land use and appearances. Today large amounts of land in residential areas are devoted to front yards that have little function or value and are artifacts from a city planning effort developed to counter the crowded and dirty conditions in cities of the past.

Axial Thoroughfares – "Main Street", "High Street", "Main Drag", "Boulevard" and similar terms conjure images of a street that runs through a city and often connects to a highway that leads to important destinations. In the ancient world these roads often led to city gates or to the port and were expected to be busy and to carry significant amounts of freight. The adjective "axial" means that main roads serving the four cardinal directions would cross, sometimes near the center of town. Scholars who study Roman city layout coined the terms "cardo" and "decamanus" for the main north-south and east-west roads, respectively, in a city. Kaiser (2011) states that these terms were used by archaeologists and probably were not used by Roman citizens. Likewise, the axial thoroughfares often did not have a cardinal orientation simply because they connected destinations that were not aligned with compass points.

Public Spaces – The city is a destination, a market, an administrative center, an entertainment center, and in the ancient world, a religious center. These activities sometimes involved dedicated spaces. In a later chapter, I will note what types of spaces were/are and how they relate to the street network.

Measurements – My original and stated intention in measuring dimensions was to convert everything to metric figures. I quickly discovered, however, that the intent of the planners and surveyors can best be determined by using their original units of measure. The numbers are often in even increments and multiples, such as 50, 100, 200, and so forth. Since my starting point is the ancient Mediterranean, I decided to look at standard units in Greece, Rome, and Crete.

Graham (1960) wrote an article titled "The Minoan Unit of Length and Minoan Palace Planning" in which he described field work at four palace sites dating to 1700–1500 B.C.E. He concluded the following:

1) That there is good evidence for the use of a foot with a value between 303 and 304 mm. as a standard of length in the palaces at Phaistos, Mallia, Knossos, and Gournia. [Graham arrived at this conclusion by a process called "reverse engineering"]
2) That the foot as a linear measure was probably used in Mycenaean Greece and passed on to the Classical Greeks, amongst whom it possibly survived locally with approximately its Minoan value.
3) By following foot-unit dimensions in round numbers we can see the last palace at Phaistos, and more dimly at Mallia and Knossos, something of the way in which the Minoan architects set about designing the palaces at these sites.

I would like to note several points here: The standard English foot is 304.8 mm (Judson 1976), essentially identical to the Minoan foot; the Minoans wrote in the Linear A script, which has not been translated; the island of Crete was invaded by Mycenaean Greeks about BC 1200 and the Minoan culture was destroyed/assimilated. The Mycenaean culture was dominant in Greece, with connections to other Bronze Age societies, from about BC 600–1100 BCE. It collapsed about BC 1100 at the beginning of the Greek “Dark Ages” that lasted until BC 800. It seems unlikely to me that the Minoan foot could have been intentionally preserved through that length of time.

The “Greek foot”, the measurement used in Classical Greece, has been researched and discussed by various authors. Stieglitz (2006) reexamined an architect’s rule and architect’s square that were found in a BC 400 shipwreck off the coast of Israel in 1985. The rule could be read in two different foot measurements, one of 333 mm and one of 328 mm. The square had one blade that corresponded to the Archaic foot of 277.5 mm. The author also mentions the Greek “common foot” of 308 mm, although as we see in some city examples below, the “common foot” was typically 297 mm. Morrison (1991) calculated that the Erechtheion on the Acropolis in Athens (BC 421) was built using the 333 mm foot, while the naval storehouse in Piraeus was built using the 328 mm foot.

One of the best discussions of the “Roman foot” was written by John Greaves in 1647. It is titled “A Discourse of the Romane Foot, and Denarius: From whence, as from two principles; the measures and weights used by the ancients, may be deduced.” The author recounts his trip to Italy in 1639 in which he made measurements of the Cossutius foot and the Roman foot in the Capitol, and brass rods found in the “ruins” in Rome. He also measured building dimensions in various places, including the Pantheon. He found that the Cossutius foot was the predominant measure. “For most of the white marble stone on the pavement [of the Pantheon], contained exactly three of those Romane feet on Cossutius’ monument, and the lesser stone in Porphyry contained one and half.” (p 23)

The modern equivalent of the Cossutius Roman foot is 296 mm (men's size 13 U.S.). Greaves made an interesting observation in his treatise "When Vitruvius observes, that the Latines denominated most of their measures, as their digit, palm, foot, and cubit, from the parts and members of a man: who shall be that perfect and square man, from whom we may take a pattern of these measures? Or if there be any such, how shall we know him? Or how shall we be certain the Ancients ever made choice of any such?" (p 9) I believe that he is alluding to the great variety in the size of the human foot. There are certainly examples of prominent men, such as Cossutius and Titus Statilius, wanting to be the perfect man and preserving the measurement by means of a statue. I think it is likely, however, that Cossutius had his statue made with a foot that corresponded to the "common foot" of Rome.

When we discuss Pompeii, Poehler (2021) states that most of the city seems to have been laid out by Oscan-speaking peoples using the Oscan foot of 275 mm. He then says, "When we find metrological signatures (including at least one 'ruler') the 0.296 measure is found." (Personal communication 3/26/21). The 296 mm foot is the Roman foot, and would be expected to be encountered in the Pompeii of AD 79.

The apparent universality of the foot as a unit of measure for buildings and city layout is striking. Over 4,000 years, two continents and many societies it has varied little. The difference between the Oscan foot and the larger Greek foot is 21%, but most common foot measures vary only slightly from 300 mm.

This is also an excellent example of the artifactual nature of cities. That is, the city blocks in Pompeii were laid out in Oscan feet and would not have corresponded to the Roman foot in use in Pompeii in the early Empire when the city was "frozen" in time. To change the layout would have required massive redevelopment. Such redevelopment generally only occurs when there is widespread destruction that creates an opportunity for change.

The metric system, introduced in the early 19th century, was a successful attempt to introduce precision in a world that increasingly required precision for machinery and trade (Goldsmith 2010). It has replaced, for the most part, "English" measurements in all but common usage. English measurements, as we see, are ancient ways of dividing the world into units that feel right to the users.

This dissertation intends to show that organized groups of people (societies), at least in what we often term a "Western" tradition, will lay out cities using roughly similar concepts of streets, sidewalks, blocks, public spaces, and private spaces. These cities, in turn, become artifacts that preserve the mental image that their founders had during their creation.

A factor that may contribute to city form similarities over time is the use of the "foot" as a tool in city layout. When I say "foot" I include multiples such as the yard or mile. Goldsmith (2010) gives a brief history of standardized measurement, the study of which is called Metrology. He begins with the Egyptian cubit (Egyptians also used the foot) and brings the history forward to today when physical weights and measures have been converted to physical constants that are not affected by gravity, temperature, or other factors.

Throughout much of history, measurements were critical for surveying, construction, and trade. During the 18th Century, measurements became very important in manufacturing where standardization and interchangeability drove factory production. Today we assume that what we buy, and use has been made to appropriate tolerances using standardized measures. Goldsmith (2010) portrays our situation today as the product of a human desire to quantify the variables in life, and I see that as another facet of the human desire to shape the built environment.

In the following chapters I review the layout of Greek and Roman cities in the ancient Mediterranean Basin, in the 19th Century U.S. and New Urbanist communities in the late 20th Century. In these I collect and analyze data on streets and blocks and, where possible, on sidewalks and axial thoroughfares. These data suggest that when a society needs to provide for a group of people on a timely basis, and has a clear site available, some form of grid pattern will be used.

CHAPTER II: CITIES OF THE ANCIENT MEDITERRANEAN BASIN

The cities and towns of the ancient Mediterranean shown below are those that were well enough preserved for us to be sure that the measurements of their layouts are accurate. This is important because it is difficult to say with certainty that these are a representative sample of the Greek and Roman towns laid out between about 700 BCE and 200 CE (Gates, 2011).

Ancient cities were preserved in several ways: First, and rarely, they were buried by natural forces such as volcanic ash (Pompeii, Herculaneum and Akrotiri) or desert sand. Second, they may have been abandoned because of geographic changes, such as Priene, or sadly, because they were overrun by enemies and their populations sold into slavery. Sometimes when that happened, no one reoccupied the town site, or it was moved.

Most of the rest of the ancient cities were occupied continuously with building and rebuilding going on throughout. When this happens, cities grow upwards, producing distinct strata, one on top of the other. For instance, in Bath, England, the Roman layer is three meters below the current surface and today's street pattern may or may not resemble the Roman street pattern (personal observation 2011). In Nafplio, a seaport in the Peloponnese area of Greece, some of the ancient streets, paved in Roman basalt blocks, are one meter below and directly under the modern streets (personal observation 2015). In Naples, Italy, the Roman street pattern is visible in aerial photos, but the Roman streets themselves are a meter or more below grade. We will therefore confine the analysis to towns and cities where either preservation or excavation permits an analysis of the original street and block pattern.

Many Greek and Roman cities displayed the characteristics discussed above, such as right-angle streets, axial thoroughfares, and, oftentimes, uniform blocks, or insulae. The word insulae is the plural form of insula, which often refers to the apartment blocks in Rome or other large cities. The other usage is that of a city block, bounded on all sides by streets, and facing those streets with building walls. The residential spaces faced inward, and there was no setback from the street. Small shops and workshops faced the street, as can be seen today in Pompeii.

Stanislawski (1946) and Fonyodi (2008) wrote articles describing the development and spread of the grid in the ancient world. Both described the benefits of the pattern, such as ease of land subdivision and the potential for expansion, while Stanislawski mentioned that straight streets were less defensible when a city was under attack.

I have selected seven ancient cities, four "Greek" and three "Roman" for an analysis of the street and lot patterns. I italicize "Greek" and "Roman" because the terms refer to culture rather than location. In most instances, the cities were intentionally developed in a short period of time (10–20 years), but several, including Pompeii, were developed over a much longer period. In all instances, I chose cities in which the original layout can be discerned with some certainty.

Piraeus

Piraeus was founded about BC 500 as the port for Athens, five miles away. About BC 483, the Athenian fleet was transferred to Piraeus, and 200 triremes were built in its shipyards. The Athenian fleet helped defeat the Persians in the battle of Salamis in BC 480. From then on, Piraeus was used as the navy's base. The Long Walls connecting Piraeus to Athens helped turn Piraeus into a great military and commercial harbor. Meanwhile, Piraeus itself was rebuilt, based on the grid plan of the architect Hipppodamus.

> His fame rests on his construction, not of single buildings, but of whole cities. His first great work was the town of Piraeus, which Themistocles had made a tolerably secure port

> for Athens, but which was first formed into a regularly-planned town by Hippodamus, under the auspices of Pericles. . . The change which Hippodamus introduced was the substitution of broad straight streets, crossing each other at right angles, for the crooked narrow streets, with angular crossings, which had before prevailed throughout the greater part, if not the whole, of Greece (Smith, 1859 p. 489)

Piraeus flourished, becoming a highly secure port with booming commercial and military activity (Cartwright, 2013). In the second year of the Peloponnesian War (BC 431–404), Piraeus suffered a major setback when the inhabitants were infected with a plague that killed an estimated 25% of the population. In BC 404, the Spartan fleet blockaded Piraeus, and subsequently, Athens surrendered to the Spartans. The Spartans tore down the city walls and the Long Walls. The Athenian fleet surrendered, some of the triremes were burned, and the boat sheds were pulled down. As a result, the unfortified city lost its dominant position in the region.

Conon rebuilt the walls in BC 393, and Philon built the famous Skeuoteke (Smith, 1859), the ruins of which were discovered at Zea Harbor. The reconstruction of Piraeus went on during the period of Alexander the Great, but this revival of the town was quashed by the Roman Lucius Cornelius Sulla, who captured and totally destroyed Piraeus in BC 86. The city never really recovered until the twentieth century. This long period of inactivity contributed to some of the ancient city being available for excavation.

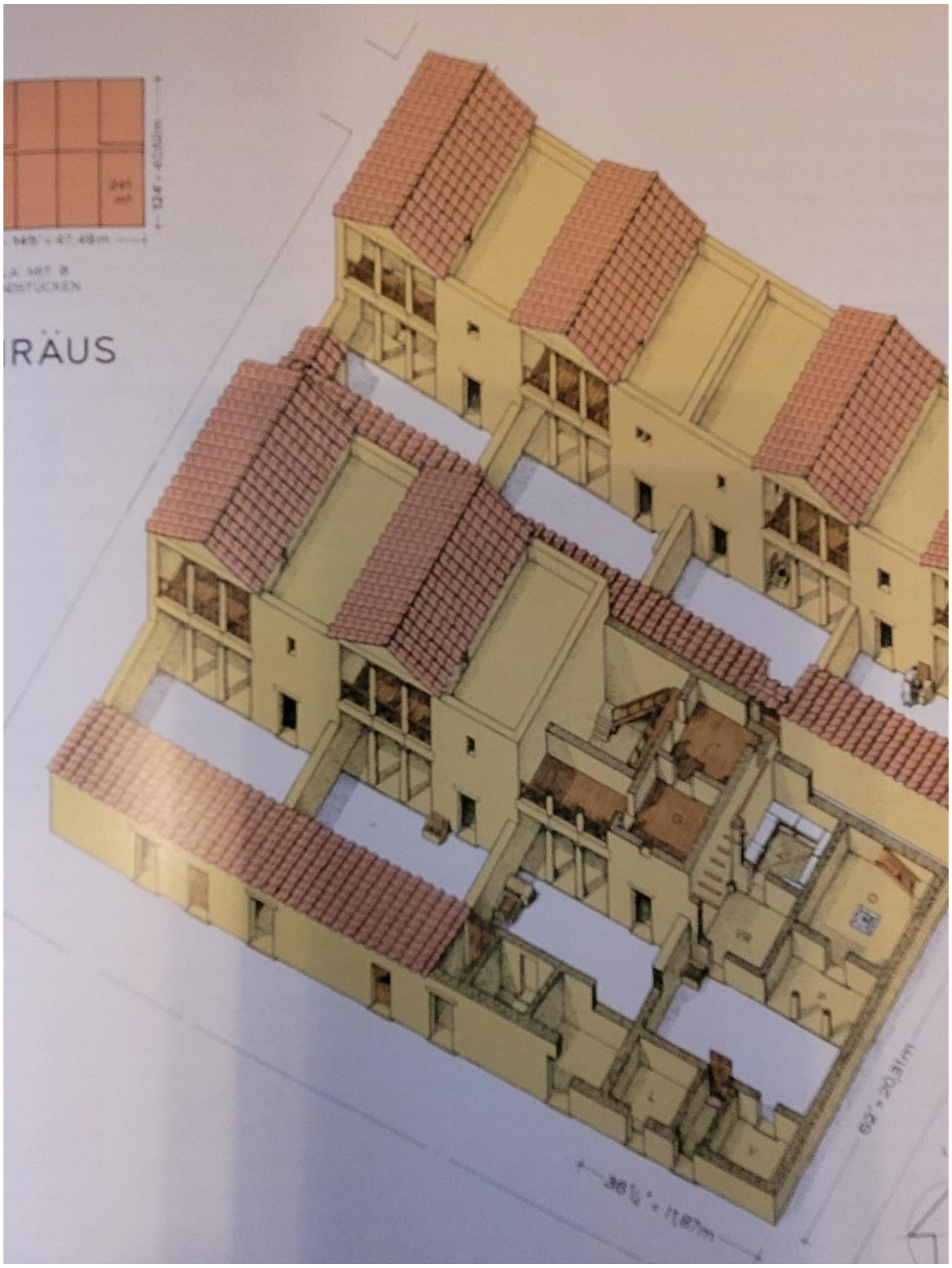
This discussion is intended to establish the provenance of the measurements shown by Hoepfner and Schwander on the following map (Figure 3). The map focuses on one block in Piraeus that may have been typical of the original layout. We see that the block consists of two rows of houses. The block is 145 (Attic) feet long by 124 feet wide, a ratio of 1:1.l7. The houses all face the long sides of the block and are identical in size. The streets are 15 feet wide and short alleys penetrate the block in two locations from the side streets. Each house is 36 feet wide by 62 feet long.

Figure 3. House and Block Layout in Piraeus, “Haus und Stadt” 1994

Hoepfner and Schwander display these measurements in Greek feet and in meters. This allowed me to determine that they were using an ancient Greek foot (the Doric foot) of 328 mm, which is approximately 7% larger than an English foot. It also lets us see that the surveyors who staked out the town had regular dimensions in mind.

Hoepfner and Schwander (1994) point out that the houses had plain front facades that were one-story in height, and the back portions of the houses were two-story, with an enclosed courtyard. The second illustration (Figure 4) shows an oblique top view of the block, showing its uniformity. …"all excavation findings point us to a uniform planning not only for the street grid, but also for the house plans. (p 39)"

Figure 4. Reconstructed View of House Layout, "Haus und Stadt" 1994



Philon's Skeuothek (boat shed) was discovered in 1988–89. Piraeus was intentionally built as the naval base for Athens, and the boat shed housed hundreds of triremes. The shed was known from an inscription found about 1880 that describes the dimensions of the building, allowing a scale model to be built. When portions of the building were discovered through excavation for a parking deck, they matched the inscription exactly and allowed a conclusive determination that the architects had used the Doric foot (p 44). The shed was 400 feet long, and its other measurements were regular and proportional to the overall length. The authors speculated that the whole town was laid out with enough buildings to house the necessary workers and sailors and was then surrounded by a wall (Hoepfner and Schwander p 43).

Piraeus is an example of intentional development when there is a need to quickly provide housing and the city planner has an open area in which to do the layout (Figure 3).

Olynthos

Olynthos is located in a fertile plain at the head of the Gulf of Torone, near the neck of the peninsula of Pallene in northern Greece. In BC 423 Olynthos became the head of the Chalcidian League that contained 32 cities. At its height, the population may have been as large as 10,000 people (Hoepfner and Schwander, 1994 p.72).

The site, located on two flat-topped hills, had Neolithic as well as Archaic remains on the South Hill. In BC 432 the city received a large influx of settlers from nearby towns, and this led to a rapid planned development of the North Hill. The city prospered until it was besieged and destroyed by Philip of Macedon in BC 348. Philip sold the inhabitants into slavery, but a few residents returned and occupied parts of the site until BC 318. After that it was completely abandoned. Although the buildings and walls were razed, the foundations remained and the site, with minimal stratigraphy, was easily excavated in four campaigns between 1928 and 1938 (Robinson, 1932).

David Robinson (1932), one of the leaders of the expeditions published four articles from Johns Hopkins University, that present their findings. Robinson, in cooperation with the Greek government, employed a large crew of laborers that cleared streets and over 100 houses, revealing a representative portion of both the South and North Hills. Numerous artifacts and burials were uncovered that permitted a clear look at the town during its heyday. Scholars were intrigued by the classical Greek house forms that had been perfectly preserved.

Figures 5 and 6 are from the second campaign and show the layout of the streets and some of the houses on North Hill. Figure 6 is from Hoepfner and Schwander and shows a reconstructed layout of the entire North Hill. Note the main north/south street that leads from a gate in the city wall at the north end to the Agora in what is roughly the center of town. Hoepfner and Schwander (1994) discuss the additional gridded area outside the walls that were added to accommodate population growth.

Figure 5. The Residential Districts and the Cemeteries at Olynthos, Robinson 1932

THE RESIDENTIAL DISTRICTS AND THE CEMETERIES AT OLYNTHOS[1]

PLATES V–VIII

CITY PLAN. The entire North Hill, which so far as excavated has proved to be mostly residential, was laid off in accordance with the Hippodamian system,[2] in a

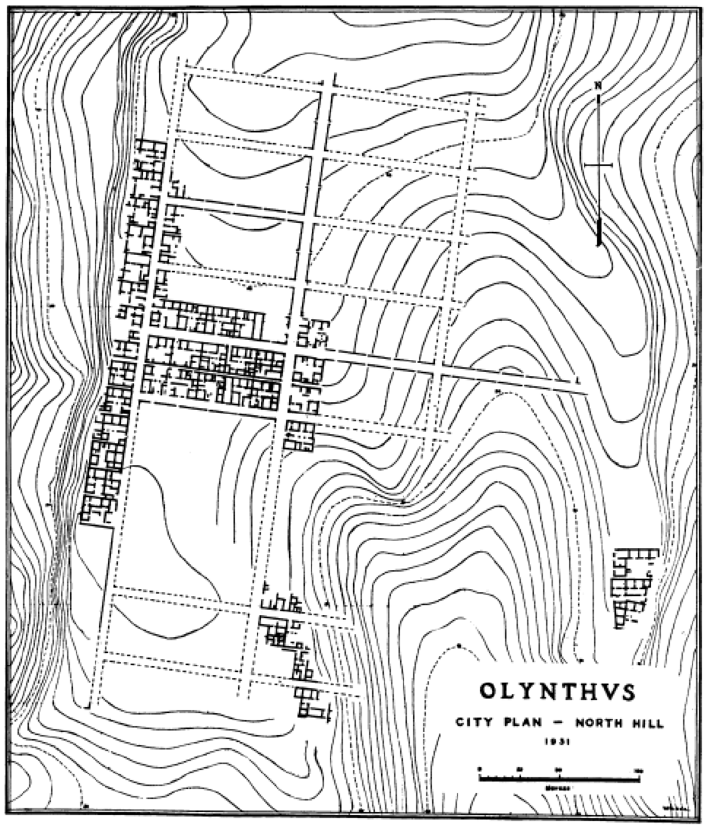


FIG. 1.—PART OF CITY PLAN. NORTH HILL. *By Donald N. Wilber*

network of straight streets running at right angles to one another at uniform intervals. The almost level surface of the hill lent itself admirably to such a system.

[1] Part II of a preliminary report on the second campaign at Olynthos. For Part I, *cf. A.J.A.* XXXVI (1932), pp.16–24, pls. I–IV. [2] *Cf. Excavations at Olynthus*, II, p. 39.

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AMERICAN SCHOOL OF CLASSICAL STUDIES AT ATHENS

Figure 6. Olynthos, North Hill showing grid layout within and outside the city walls, “Haus und Stadt”, 1994

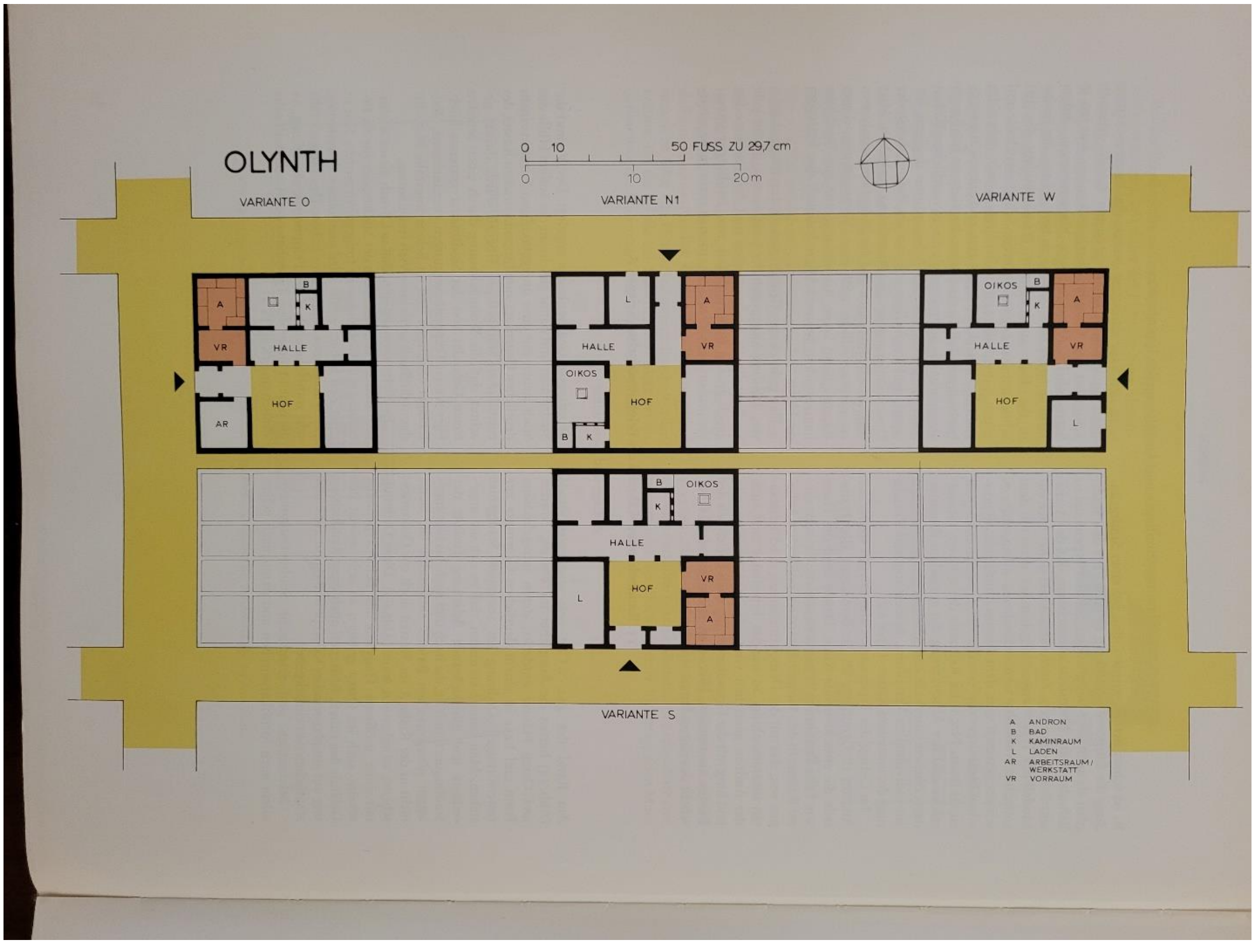
Other scholars , including Hoepfner and Schwander, have studied the material in depth. On the North Hill the houses are arranged 10 to a block, with each block “300 Greek feet by 120 feet” Robinson (1932). That is a ratio of 1:2.5. I turned to Hoepner and Schwander to determine which Greek foot Robinson referred to. They showed measurements from the town in meters and feet and indicated that the Greek foot in Olynthos was 297 mm. I believe that measurement would be a “common foot” and closely related to the Minoan foot of 304 mm and to the later Roman foot of 296 mm.

Regardless, the typical house size in Olynthos (58’ x 57 ½’) makes great sense when presented in common Greek feet, as do the blocks (300’ x 120’) and the streets, either 30’ for the main north-south route or 17’ for most of the remaining roads. Both Robinson and Hoepfner/Schwander believed that the streets and housing blocks were surveyed at the same time. The 57 ½’ side allowed for a drainage channel between the housing blocks. Within each house there was considerable variation in room layout.

Robinson (1932) excavated many of the roads in Olynthos and mentioned some of their dimensions in meters. He and his team appeared interested in demonstrating a Hippodamian plan and determining which roads led to the town gates, markets, or public spaces. Hoepfner and Schwander spent more time on the size and function of the roads, stating that the main north/south road was 30’ in width, and may have been used for ceremonial purposes in addition to commerce. Most of the remaining roads were 17’ in width and were built as such to accommodate wagon traffic (p.77). They included a diagram of two wagons passing each other that accounts for the wheels, hubs, sidewalk blocks and curb blocks that residents used to mark and protect their home entrances from the street.

The following map (Figure 7) is a blow-up of several blocks in Olynthos from Hoepfner and Schwander (p. 90). It also shows the room layout in several of the homes. Notice that each home is allocated a 58’ by 57 ½’ walled space.

Figure 7. Illustration of Typical Block and Houses in Olynthos, "Haus und Stadt" 1994



Hoepfner and Schwander state that in Greek colonies the blocks are generally 100 feet or 120 feet long (p. 76). Greek "mother" cities in Greece established daughter colonies from the 8^{th} to the 5^{th} centuries BC, throughout the Mediterranean, that retained affiliations with each other. There were so many colonies in Sicily and southern Italy that the area was called Magna Graecia by the Romans (Cartwright, 2013).

Olynthos was not a colony, but apparently the same surveying customs were used that were commonly employed in colonies. The town received many new inhabitants in a short period of time. The town leadership responded by surveying and developing the vacant North Hill site quickly, producing a uniform grid of streets and home sites. The Greek colonies were likewise developed (generally) on vacant land and built accordingly to a plan that allowed the colonists to be housed in a timely manner.

Priene

Priene is in southwestern Turkey close to the Aegean Sea. The town may have originally been located closer to the Meander River mouth in the 8th and 7th centuries BC, but what is certain is that about BC 350 the town was moved to its present location. The reason for this is shown on a speculative map by Eric Gaba (2009 Figure 8) below. The Meander River carried a great deal of silt over a period of several thousand years and deposited it as a delta in Miletus bay. Today the bay is almost gone and this geologic process had a profound effect on towns that had lined the bay. Miletus, shown on the map on the opposite side of the bay, survived as a port. Priene, on the other hand, was cut off from the Aegean and eventually abandoned.

Figure 8. Evolution of the Silting In Miletus Bay, Gabba (2009)

Priene was dramatically laid out in a grid plan that rises from the plain to the top of a nearby hill. The topography required the streets running parallel to the hill to be terraced while the streets that ascend the hill are in some cases built as stairs.

The town was divided into about 80 blocks, or insulae, each averaging 160 by 120 feet (Greek common foot of 297 mm). About 50 insulae are devoted to private houses; a few insulae had four houses apiece, but most were subdivided into smaller dwellings. The private houses typically consisted of a rectangular courtyard enclosed by living quarters and storerooms and opening to the south onto the street by way of a small vestibule.

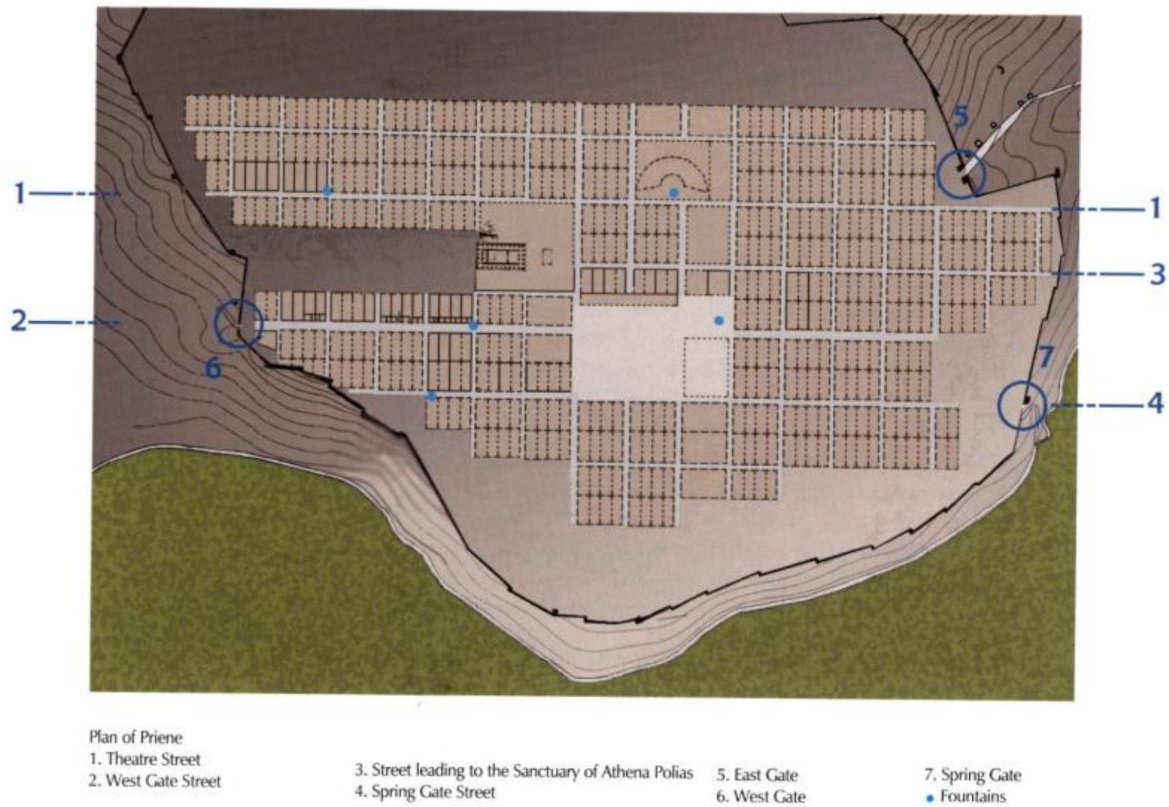
The following diagrams from Hoepfner and Schwander illustrate the development pattern. The streets vary in width depending on their position in the city and the traffic they were intended to bear. The main street is 19 Greek feet wide, while others are 12 feet or 16 feet in width. Presumably, the streets with steps carried only foot and pack animal traffic while the flatter streets could accommodate wagons.

The first diagram (Figure 9) is a perspective reconstruction of Priene (p. 194) that shows the streets running uphill to the temple and agora. The entire site is surrounded by a city wall with towers. The theater is intact and usable today.

Figure 9. Perspective Reconstruction of Priene, "Haus und Stadt" 1994

The next map (Figure 10) is a reconstruction of Priene by Kleopatra Ferla (2005) that shows the same layout from an overhead perspective.

Figure 10. Plan of Priene, Ferla (2005)



Her comments on the layout were:

The houses of Priene were 30 attic feet wide and 80 attic feet deep. They were organized in blocks of 8 houses of equal surface area (in two rows of four houses), slight adjustments being made depending on their position in the block (i.e., in the middle or corner of the block).

STREETS: The city's road system is clearly oriented towards the south. On either side of the basic east-to-west road axis there are five additional streets: three to the north and two to the south. As they intersect 15 narrower streets, so building plots are formed.

> In Priene, the width of each street was related to its function and followed an elaborate scaling system. Thus, commercial streets were wider than streets of residential areas. The main street leading to the West Gate from the north side of the Agora was the widest (24 attic feet). Three streets, 20 feet wide each, crossed the main street at right angles and defined the rectangle of the Agora (p 52).

The second illustration (Figure 9) shows details of a typical insula (p. 210). Note the 160’ by 120’ block, with eight houses per block. Each home has a courtyard and is shown as having two floors. The second floor is speculative but attested by evidence for landings for stairs or ladders.

Figure 11. Typical Insula (Block) in Priene, "Haus und Stadt" 1994

The residents of what became Priene relocated from their previous settlement to the new location apparently in one organized move. The new site was vacant and could be laid out according to a plan. The grid pattern is typical of Greek colonies and is notable because it was overlaid on a steep hill.

Rhodes

The island of Rhodes, 16 km off the south-western corner of the Anatolian mainland, sat on two ancient sea routes: between Egypt and Cyrenaica to the south and the Ionian

> trading towns along the Anatolian coast to its north; and between mainland Greece to the west and Cyprus and the Levant to the east. (Jordan, 2002 p. 2)

Rhodes was known for the "Colossus of Rhodes", one of the seven wonders of the ancient world. It was built starting after BC 304 when the city successfully resisted a siege by Demetrius, son of Antigonous, one of the Macedonian generals who served under Alexander the Great. The city sold the weapons left by Demetrius after he withdrew from Rhodes and used the proceeds to fund a gigantic statue of Apollo. The statue had an iron frame and was clad in bronze. It was toppled by an earthquake about 50 years later.

The town of Rhodes on the north end of the island was founded in BC 409 on vacant land when the island's largest existing towns, Lalyssos, Kamiros and Lindos, pooled their resources. It was laid out in a grid and a mole was built out to sea to provide two harbors, one for the commercial trade between Greece and the East and the other for shipbuilding and repairs. (Jordan, 2002)

Rhodes has suffered many earthquakes during its history and has been occupied by various rulers, such as the Knights Hospitallers, the Ottoman Turks, the Italians, and the Germans (briefly during WWII). This means that very little of the BC 409 plan is visible today.

The following figure (Figure 12) is a speculative view of the new city shortly after its development. The second (Figure 13) shows several original streets and their layout superimposed over the current street pattern. Hoepfner and Schwander state that the typical residential street was 8–9 meters wide, and that the city was laid out using the Doric foot of 327 mm (p. 57). On the drawing below, these are the north/south streets P 31– P33. The main roads, running east/west are larger, typically 12 meters or 37 Doric feet (p. 57). Reconstruction of the original city layout has been difficult and is based on piecing together spot excavations done prior to modern redevelopment of various sites.

The authors state that finding the original insulae walls, which also mark the edges of the streets, has been difficult because of redevelopment and the use of rubble to build new walls. On the detailed drawing (Figure 13) below the insulae scale at 138 x 77 feet, a ratio of 1:1.8. The authors state that it is not clear if each insula contained three or four dwellings.

Figure 12. Layout of Ancient Rhodes, "Haus und Stadt", 1994

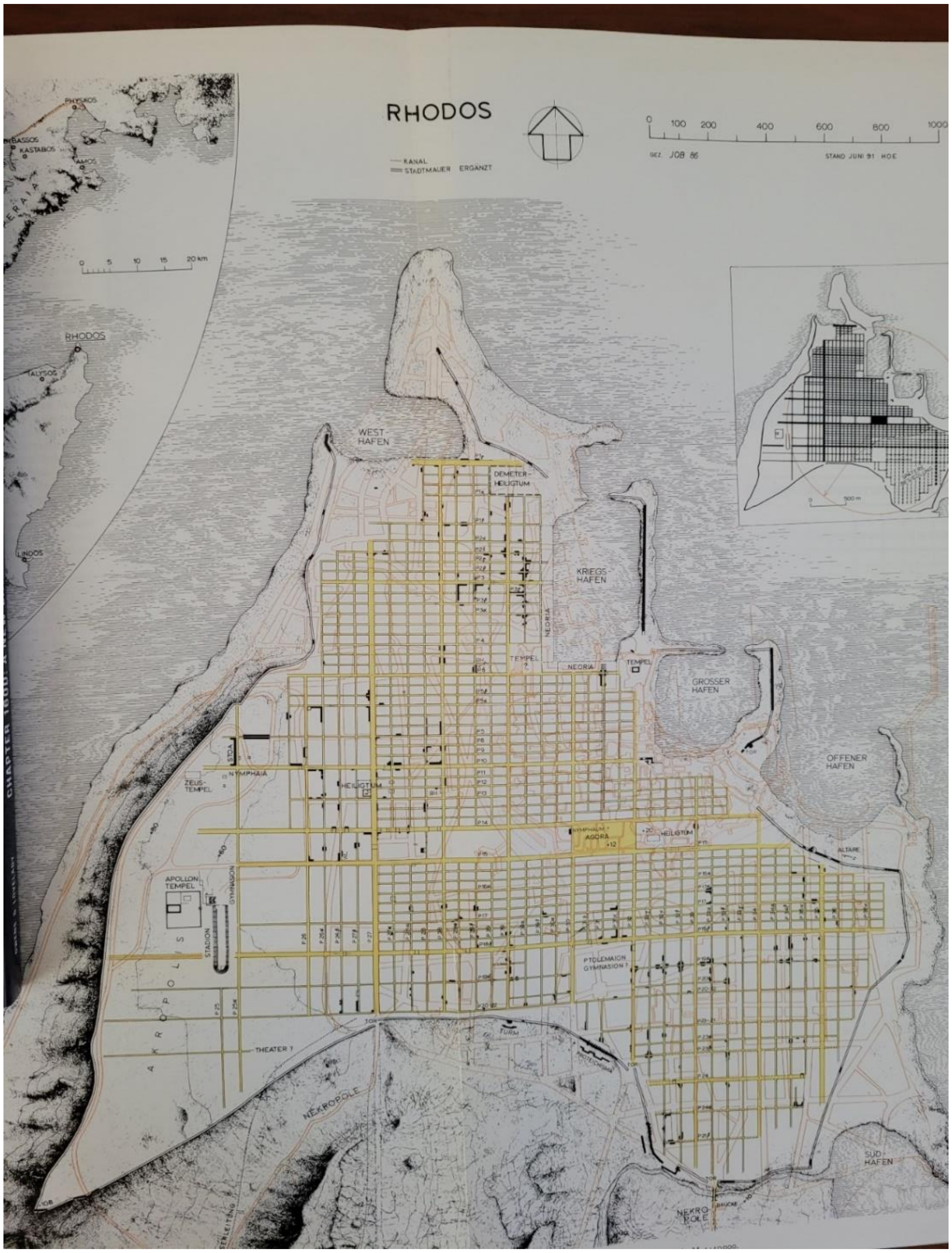
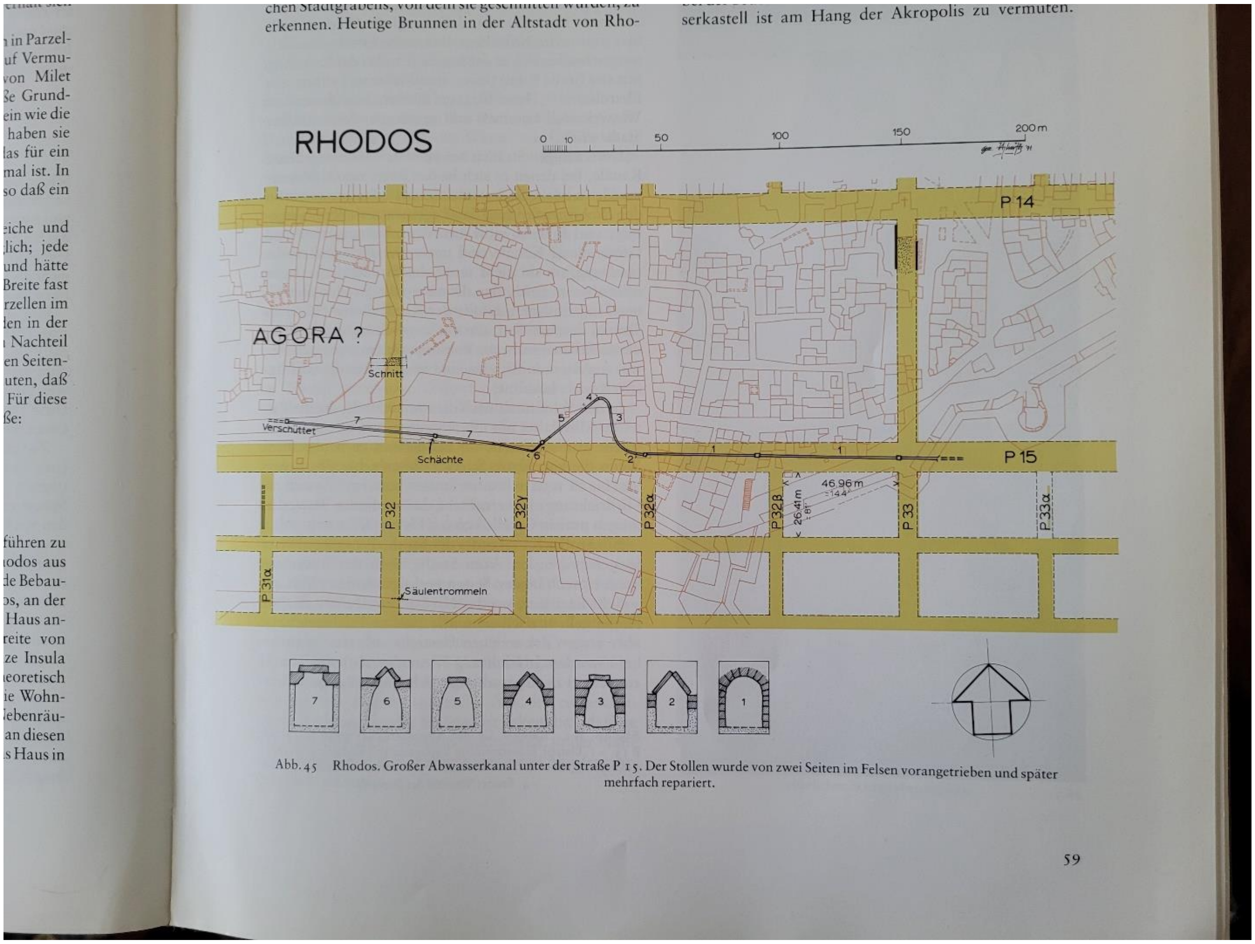


Figure 13. Detail of Rhodes showing major and minor streets, “Haus und Stadt” 1994



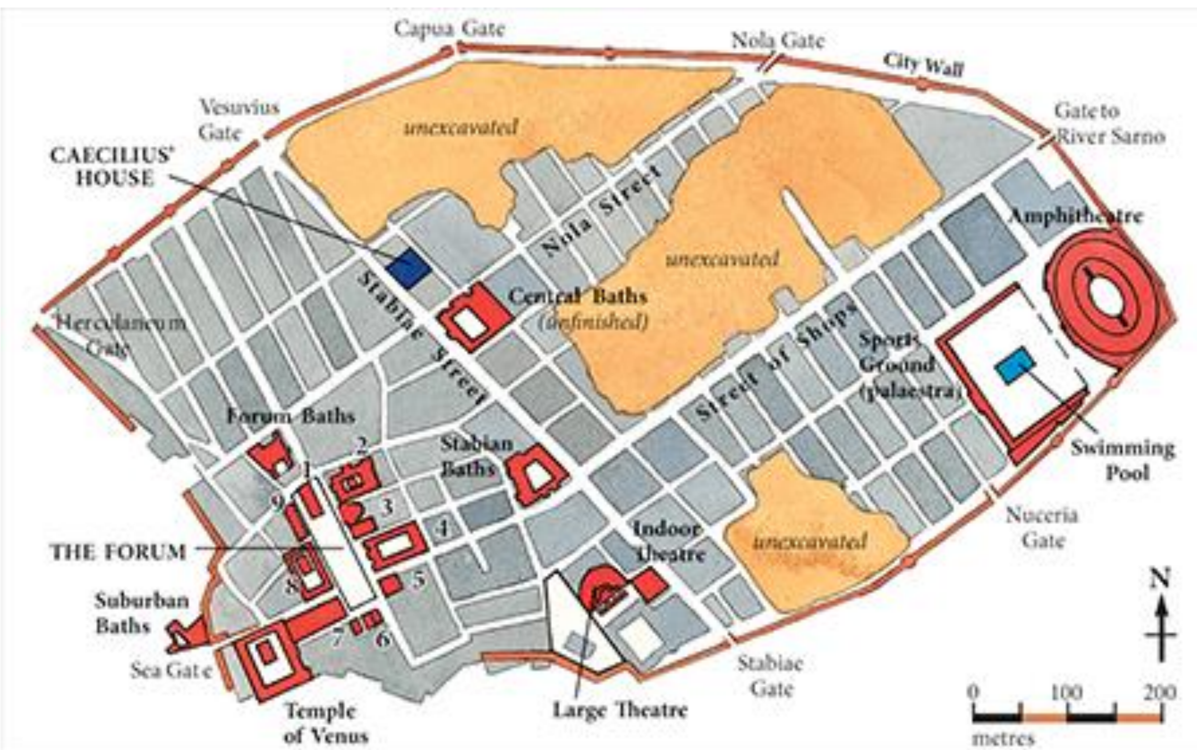
In the drawing above, note the channel that, in part, runs down the street labeled P 15. Rhodes had well-developed water and sewer systems that made fresh water available to all the residents, either through direct connections or nearby fountains. The underground channels are still in existence and have been extensively studied.

Rhodes was created through cooperative action by the inhabitants of the island to build a new community that would support a new harbor that they, presumably, believed would allow them to dominate trade routes in the eastern Mediterranean. The street layout was a grid, with streets that were sized by function and oriented to the cardinal points. My view is that the cardinal (north-south) orientation may be a function of the city being sited on a promontory that projects to the north. In any event, the result was an excellent example of the grid plan.

Pompeii

Our first Roman city is Pompeii, chosen because it is one of the best-preserved, and certainly the most intensively studied ancient cities. As most people know, Pompeii was covered by ash from the eruption of Mount Vesuvius in AD 79, early in the Roman Empire period. This event left Pompeii frozen in time and available for excavation and study from the 18th century on (Figure 14).

Figure 14. Layout of Ancient Pompeii showing Excavated and Unexcavated Areas, Digital Maps of the Ancient World (2020)



Unlike, for instance, Priene or Olynthos, Pompeii was not built on a "greenfield" site. As Gates (2011) says:

> Pompeii is located on the Bay of Naples south of the city of Naples. The town lay well sited close to the sea at a crossroads point where an important route to the interior branched off from the coast road. The larger region of Campania and the Bay of Naples had already seen much development by the time Pompeii was first settled in the sixth century BC. Greeks had established themselves at the north end of the bay two centuries earlier, first at Pithekoussai on the island of Ischia, then at Kyme (later Cumae) on the mainland opposite. A late sixth-century BC Doric temple in the Triangular Forum records their influence in early Pompeii. Etruscans expanded into Campania in the sixth century BC, only to be expelled by the Greeks in BC 474. By the fifth century BC, Pompeii was the preserve of the Samnites, a local people related to the Latins. But the Romans were expanding, and in BC 290 they defeated the Samnites and took control of Campania. Pompeii remained ethnically Samnite, however. In the 80s BC, Pompeii joined other Campanian cities in the "Social War," an unsuccessful uprising against Roman domination. In the aftermath of his victory, the Roman general Sulla established a veterans' colony in Pompeii, with his veterans displacing local Samnite notables. The Romanization of the city was now complete. (p. 356-57)

I quote Gates above because he provides an excellent and concise history of Pompeii prior to its destruction.

By the time Pompeii was destroyed it had been settled for 500 years and by people representing several different cultures. The layout of the streets and arrangement of insulae were not the result of a master plan, such as Hippodamus reputedly did for Piraeus. Instead, it appears to be the result of many years of small developments. According to Gates:

> The early city lay in the south-west, a small area with irregular streets. The forum lies within this sector. By the fourth century BC the town expanded north of the forum, now following a grid plan. City blocks in the north area contain some of Pompeii's oldest surviving houses. A circuit wall ca. 1200m x 720m was erected sometime in the third century BC, enclosing fields and gardens. Around BC 200 a further expansion took place toward the east. During the second century BC, the last Samnite period, the town had two major north-south and east-west streets; much building took place, including the theater, baths and the portico that framed the forum. The arrival of Sulla's veterans stimulated a new building boom, with such structures as the amphitheater and the odeum erected in the first century BC. (p. 358)

Another benefit of looking at Pompeii is that we can examine the relationship between streets and sidewalks since the sidewalks are perfectly preserved. In cities that were destroyed by war, evidence for the width of sidewalks may be less clear. This is because the ruins may have been exposed for years, both to the elements and to people wanting to salvage building material.

Eric Poehler (2017) has produced a map that shows most of Pompeii's physical features in GIS-based layers in an interactive format. He states:

> The second map by the PBMP [Pompeii Bibliography and Mapping Project] is now online. Updated with new data and a richer environment, users can explore all 640,000 square meters of Pompeii's urban landscape from an overview of the entire site to individual objects, such as fountains, millstones, or stepping-stones. (Posted November 29, 2017, by Eric Poehler)

For my purposes, the street widths, sidewalk widths and insulae measurements can be obtained using the "measure" tool in the ArcGIS program (personal communication with Eric Poehler in 2020). This is the same tool I successfully used in the 19th Century U.S. cities discussed later. In those cities the measure tool results could be confirmed by Engineering Department records. In the case of Pompeii, the dimensions used to make the digital map have been entered with a high degree of accuracy by researchers over a period of years and I am using them as a primary data source.

My intention was to measure insulae, streets and sidewalks in two areas, one on the west side of the city west of the via Stabiana, and one on the east side, south of the Street of Shops (Abbondanza.) These correspond to the areas described by Gates as being developed in the 4th century BC and around BC 200, respectively.

The via Stabiana runs from the Vesuvius Gate on the north to the Stabia Gate on the south. The Abbondanza runs from the River Sarno Gate to the Forum. These were major thoroughfares in Pompeii, but do not have the cardo and decamanus orientation of some Roman colonial cities.

West side insulae (n=10): These insulae can be divided into a northern half and a southern half. The northern half did not have a road at the north-west end of the blocks. They ended at an open area that ran along the city wall. The southern half are fully enclosed (Figure 15).

Figure 15. West Side Insulae (Blocks) in Pompeii shown on Table 1, PBMP 2017

At first glance insulae 1–5 are longer than 6–10. At the northern end, the streets look "unfinished" as though they were interrupted by construction of the circuit wall. Since the wall post-dates the insulae in this area, however, the reason is not clear. My measurements using the "measure" tool are as follows (Table 1):

Table 1. Block Measurements for West Side Insulae

Northern Insulae, West Side

Block length	Oscan feet	Meters
1	515	141.9
2	520	143
3	510	140.5
4	504	138.8
5	505	139
Mean	510.8	140.64

Block Width	Oscan feet	Meters	Length/Width Ratio
1	131	36	1:3.94
2	121	33.5	1:4.27
3	123.3	33.9	1:4.14
4	117	32.3	1:4.35
5	120	33.1	1:4.20
Mean	122.46	33.76	1:4.17

The ratio range, 3.94 – 4.30, is 9%

Southern Insulae, West Side

Block Length	Oscan feet	Meters	
6	323	88.8	
7	335	92.2	
8	321	88.3	
9	328	90.3	
10	330	90.9	
Mean	327.4	90.1	
Block Width	**Oscan feet**	**Meters**	
6	128	35.1	1:2.53
7	118	32.5	1:2.84
8	116	32	1:2.76
9	119	32.8	1:2.75
10	121	33.4	1:2.72
Mean	120.4	33.16	1:2.72

The ratio range, 2.53–2.84, is 12%.

East side insulae (n=11)

The insulae on the east side of Pompeii are somewhat more regular than those on the west side and were developed later (Figure 16). Although Gates says that the east side area was developed during the last Samnite period, presumably using the Oscan foot, it accommodated Sulla's Roman army veterans. I have, therefore, shown the measurements in the Roman common foot as well as the Oscan foot (Table 2).

Figure 16. East Side Insulae (Blocks) in Pompeii shown on Table 2, PBMP 2017

Table 2. Block Lengths and Widths in East Side Insulae

Block Length	Oscan feet	Roman feet	Meters
1	323	300	88.8
2	318	295.6	87.5
3	318.5	295.9	87.6
4	322.5	299.7	88.7

5	321.8	299.0	88.5
6	323.6	300.7	89
7	322.5	299.7	88.7
8	318.5	295.9	87.6
9	300	278.7	82.5
10	299.3	278.0	82.3
11	297.5	276.4	81.8
12	302.9	281.4	83.3
Mean	314.01	291.75	86.36

Block Width	Oscan feet	Roman feet	Meters	Length/Width Ratio
1	124	115.2	34.1	1:2.60
2	125.5	116.6	34.5	1:2.54
3	117.5	109.1	32.3	1:2.71
4	117.8	109.5	32.4	1:2.74
5	125.5	116.6	34.5	1:2.57
6	125.5	116.6	34.5	1:2.58
7	115.3	107.1	31.7	1:2.80
8	117.5	109.1	32.3	1:2.71
9	122.2	113.5	33.6	1:2.46
10	121.1	112.5	33.2	1:2.48
11	123.3	114.5	33.9	1:2.41
12	124.0	115.2	34.1	1:2.44

Mean	121.52	112.96	33.43	1:2.58

The ratio range, 2.41–2.80 is 16.2%.

Insulae 1–8 are slightly longer than 9–12. I speculate that the longer blocks were laid out in Roman feet since all are very close to 300 feet in length. The shorter blocks measure very close to 300 Oscan feet. The block widths are less regular. The length/width ratios are variable, with the ratio ranging from 2.54 to 2.80 for blocks 1–8 (10%). The ratios for blocks 9–12 range from 2.41 to 2.71 (12%).

In short, while both areas in Pompeii exhibit a grid pattern, the measurements are not precise and exhibit more variation than, for instance, Priene or Olynthos. I believe that this results from Pompeii being developed over a long period of time with the involvement of many people who may have had differing ideas about city layout.

In the archaeological literature dating to the early 20th Century there are references to "organic" development versus "planned" development of cities. Archaeologists noted early on that some cities had a grid layout, and some did not. This fostered a planned versus unplanned dichotomy (Stanislawski 1947) that continues today (Fonyodi 2008). Fonyodi notes that the city is a "never-ended artifact" in which city development is influenced more by the past than the present. I believe Pompeii is an excellent example of the constraints of past development affecting the layout of newer areas. It appears that the newer areas, such as those laid out to accommodate army veterans, were intended to be grids, but in connecting to existing streets compromises were made.

Lots

Before proceeding to an analysis of streets I want to look at lots, those pieces of property surrounded by walls that were presumably owned by individuals and used for family housing and sometimes for businesses. These properties are shown on the map as outlined by walls that appear much less regular than for instance, the lots in Priene that are 30’ x 80’ (Attic) while the lots in Olynthos are 58’ x 57.5’ (Common).

In the West Side area, I measured lot lines (walls) that divided the block in half and found some consistency. Measurements ranged from 15.4 meters to 16 meters, while through-the-block walls measured from 32.6 meters to 34.5 meters. Lot widths were more variable, ranging from 8.45 meters to 14.2 meters.

In the East Side area, I found that half block walls measured between 15.7 meters and 17.3 meters while through-the-block walls measured 33 meters to 33.8 meters. At first glance in both areas, it looks like there is no pattern, but the measurements demonstrated to me that there had been some effort made initially to divide the property up into consistent pieces. Over time the pieces were subdivided or combined to form the pattern shown on the map.

Streets

One of the exciting features of Pompeii is that the streets are just as they were in AD 79 as far as width and construction materials are concerned. One can walk down the streets and see the same view that the residents of Pompeii would have seen.

In the western area identified above, there are six streets that run northwest/southeast and two that run generally southwest/northeast (Figure 17). One of the streets in each direction is a major road, while the others are narrower. While the measure tool on Eric Poehler’s map may be subject to some error (on my part), I believe it is sufficient to compare street widths in Pompeii to those in other ancient Mediterranean cities.

Figure 17. Streets i n the West Side of Pompeii shown on Table 3, PBMP 2017

In the western area I have simply identified the width of streets running northwest/southeast by number (1–6). The two that run perpendicular to them are numbered 7 and 8. While I realize that everything in Pompeii has been named and numbered by various researchers, I believe that this is the simplest way to index street data. The first data set is what I call “right-of-way”, the distance from insulae wall to insulae wall (Table 3).

Table 3. Street Rights-of-Way in West Side Area

Street	Oscan feet	Roman common feet	Meters
1	13.6	12.7	3.75
2	10.7	9.9	2.94
3	27.4	25.5	7.54
4	13.6	12.6	3.73
5	18.1	16.8	4.97
6	17.6	16.4	4.84
7	12.8	11.9	3.52
8	26.6	24.7	7.31

The numbers above exhibit more variation than do the insulae dimensions, and I cannot speculate as to the reasons.

The second data set is what I term “carriage way”, or the space between the sidewalk curb stones (Table 4). This is the area available for use by carts and wagons, large groups of people, herds of animals and so forth. Presumably, a large crowd of people or animals might spill over on to the sidewalks from time to time, but in general pedestrians could expect to use the sidewalks without interference, and to avoid the drainage and dirt present in the carriage ways.

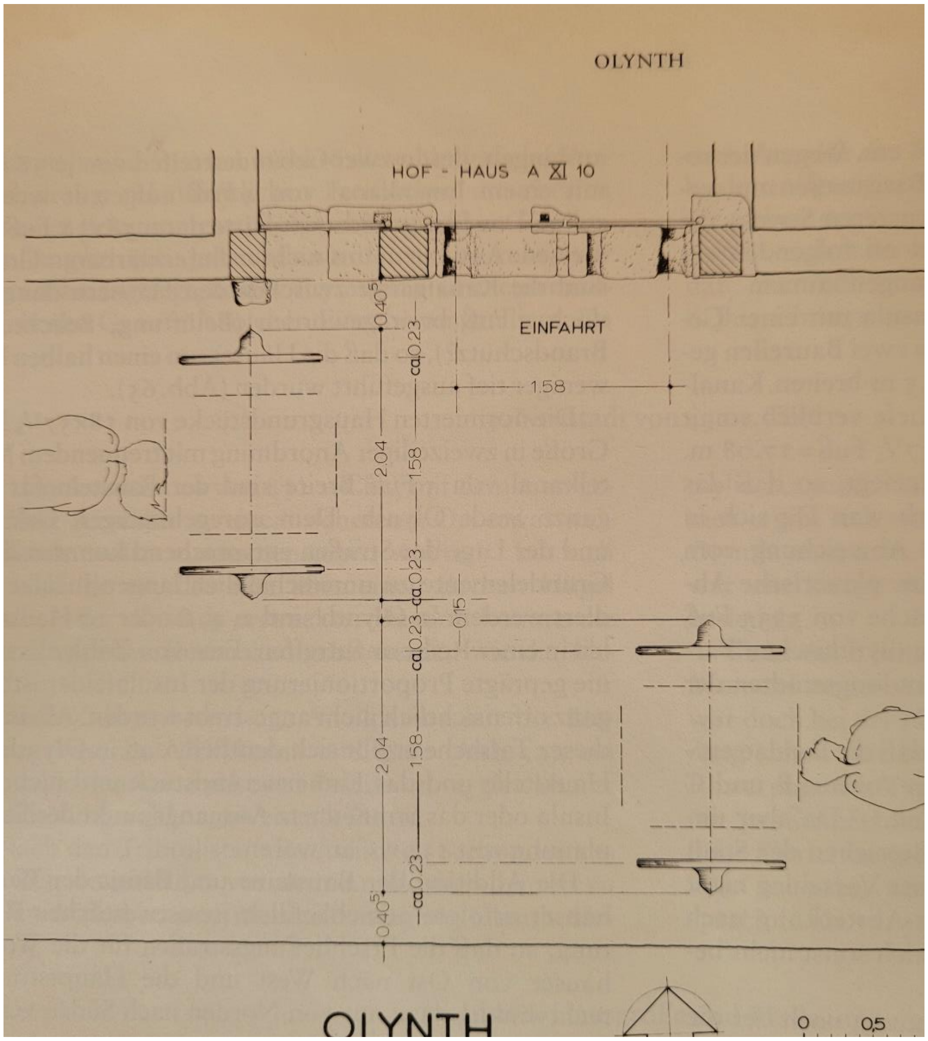
Table 4. Carriage Way Widths in West Side Area

Carriage Ways

Street	Oscan feet	Roman common feet	Meters
1	7.7	7.2	2.13
2	8.4	7.8	2.32
3	12.2	11.4	3.36
4	4.4	4.1	1.2
5	10.7	9.9	2.94
6	11.1	10.4	3.07
7	5.2	4.9	1.44
8	11.7	10.8	3.21

It is difficult to discern a pattern in this area of Pompeii. The blocks look regular, but the roads vary from tiny (four feet) to barely adequate (11 feet). Hoepfner and Schwander have an illustration in their book (p. 78) that shows two wagons passing each other in a 17-foot street. Seventeen feet allows for the wheels, axels and hubs, plus minor obstructions in the carriageway such as curb blocks. (Figure 18)

Figure 18. Diagram Showing Spacing for Two Wagons to Pass, "Haus und Stadt" 1994



Dr. Judith Weller (1999) states that the wheel-to-wheel spacing of a typical Roman wagon was 1.8 meters (6.08 Roman feet). This corresponds well with the illustration above in which the axel hub-to-axel hub distance is shown as 2.04 meters (6.89 Roman feet) and the wheel to wheel spacing is shown as 1.85 meters (6.25 Roman feet). Looking at the carriageway distances in my sample streets above make it clear that it would be difficult for two wagons to pass each other. I believe that when wagons met on the street that they may had have to use the sidewalk space as well as the road, or "take turns."

Lawrence (2011) mapped streets in Pompeii into four categories based on the depth of their ruts. Although Roman streets were often made of basalt, a hard igneous stone found in volcanic areas, the iron-rimmed wagon wheels of the time created ruts. His categories were deep ruts, moderate ruts, faint ruts, and no ruts. He concluded that over time the limited major streets of the city carried most of the wagon traffic while side streets were often blocked with fountains, benches, and other obstructions.

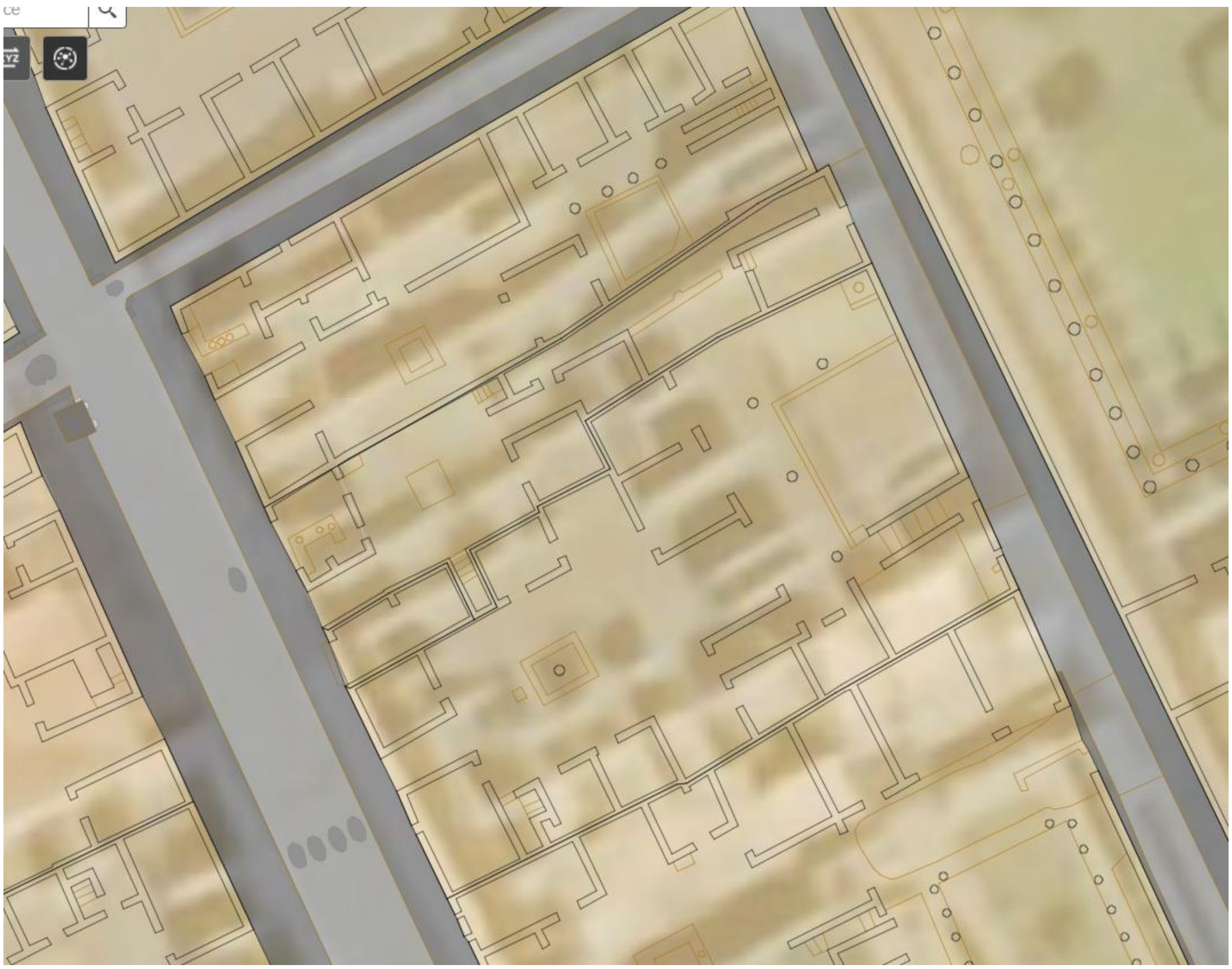
I believe that the street network in Pompeii was cramped, much more so than the four Greek cities examined earlier.

Sidewalks

Sidewalks were created by installing curb blocks 30 cm in height, and ramming earth behind them to create a raised space for pedestrians and merchants. There was tremendous variation in widths – the sidewalks of Pompeii were much less regular than the sidewalks we expect in U.S. cities. Below I show a small portion of the western area discussed above (Figure 19). The sidewalks are shown in a darker shade from the carriageways.

Note that the sidewalks vary in width and are not always present on both sides of the street. Also note the set of steppingstones that allowed pedestrians to cross the street in certain places without getting their feet wet or dirty.

Figure 19. Sidewalks in a Portion of the Western Park of Pompeii, PBMP 2017



Next, we will look at streets in the eastern portion of Pompeii discussed earlier. This area was developed later, in part to accommodate Sulla's army veterans (Table 5, Figure 20).

Table 5. Street Rights-of-Way in the Eastern Portion of Pompeii

Rights-of-way

Street	Oscan feet	Roman feet	Meters
1	13.2	12.3	3.63
2	10.8	10.0	2.97
3	12.8	11.9	3.53
4	12.7	11.8	3.49
5	11.9	11.0	3.26
6	12.3	11.4	3.37
7	13.8	12.8	3.80
8	15.2	14.2	4.19
9	12.7	11.8	3.48
10	25.9	24.0	7.11
11	18.1	16.8	4.98
12	20.0	18.6	5.51

Figure 20. Streets in the Eastern Part of Pompeii shown on Table 5, PBMP 2017

The right-of-way for street 10 is wide, at 24 Roman feet. This is the main road from the eastern gate to the Forum, and is now popularly known as the Via dell'Abbondanza, or street of shops.

At first glance it appears that the streets could have been laid out in Roman feet since six of them are between 11 and a bit over 12 feet. But that is purely speculative and not substantiated by literature. The Romans were excellent surveyors, and if they had intentionally laid out the streets and insulae the variation from street to street would have been minimal.

Table 6. Carriage Way Widths in the Eastern Portion of Pompeii

Carriage Way

In the eastern portion of town that I have looked at, the carriage way dimensions are as follows:

Street	Oscan feet	Roman feet	Meters
1	11.9	11.1	3.28
2	8.5	7.9	2.35
3	8.7	8.1	2.39
4	12.9	12.0	3.56
5	12.1	11.3	3.34
6	6.6	6.1	1.82
7	6.7	6.3	1.85
8	14.6	13.6	4.02
9	17.5	16.3	4.81
10	14.8	13.8	4.07
11	10.3	9.6	2.84
12	20.1	18.7	5.53

The figures above are representative samples of the carriage way widths. There is considerable variation, often related to the presence or absence, and width of the sidewalks.

Once again, I can only speculate that the public space allocation was directly related to the activities of populations in 79 AD and before.

Below, I show a blow-up of a section of street 10, the Via dell'Abbondanza. (Figure 21) The carriage way in this block is a consistent width, affected only by a sidewalk jut-out and steppingstones. The width, 13.8 Roman feet, is wide by Pompeii standards, but not wide enough for two wagons or chariots to pass comfortably. Looking at the previous drawing, the axel-to-axel width of a cart was 204 centimeters, or 6.89 Roman feet. Two carts passing each other would occupy the entire street.

Figure 21. Blow-Up of a Section of the Via dell'Abbondanza, PBMP 2017

To the modern reader the streets seem too narrow to be practical for moving goods such as food, water and building materials. It is likely, however, that goods were often transported on pack animals. In 2014 I observed donkeys being used in Ioulis on the island of Kea in Greece. Ioulis is a small village that is the administrative center for the island. It has narrow steep streets that the donkeys navigated carrying 100 pounds or more of bottled water. It was apparent that this ancient method of transport worked well in an environment in which motor vehicles could not operate.

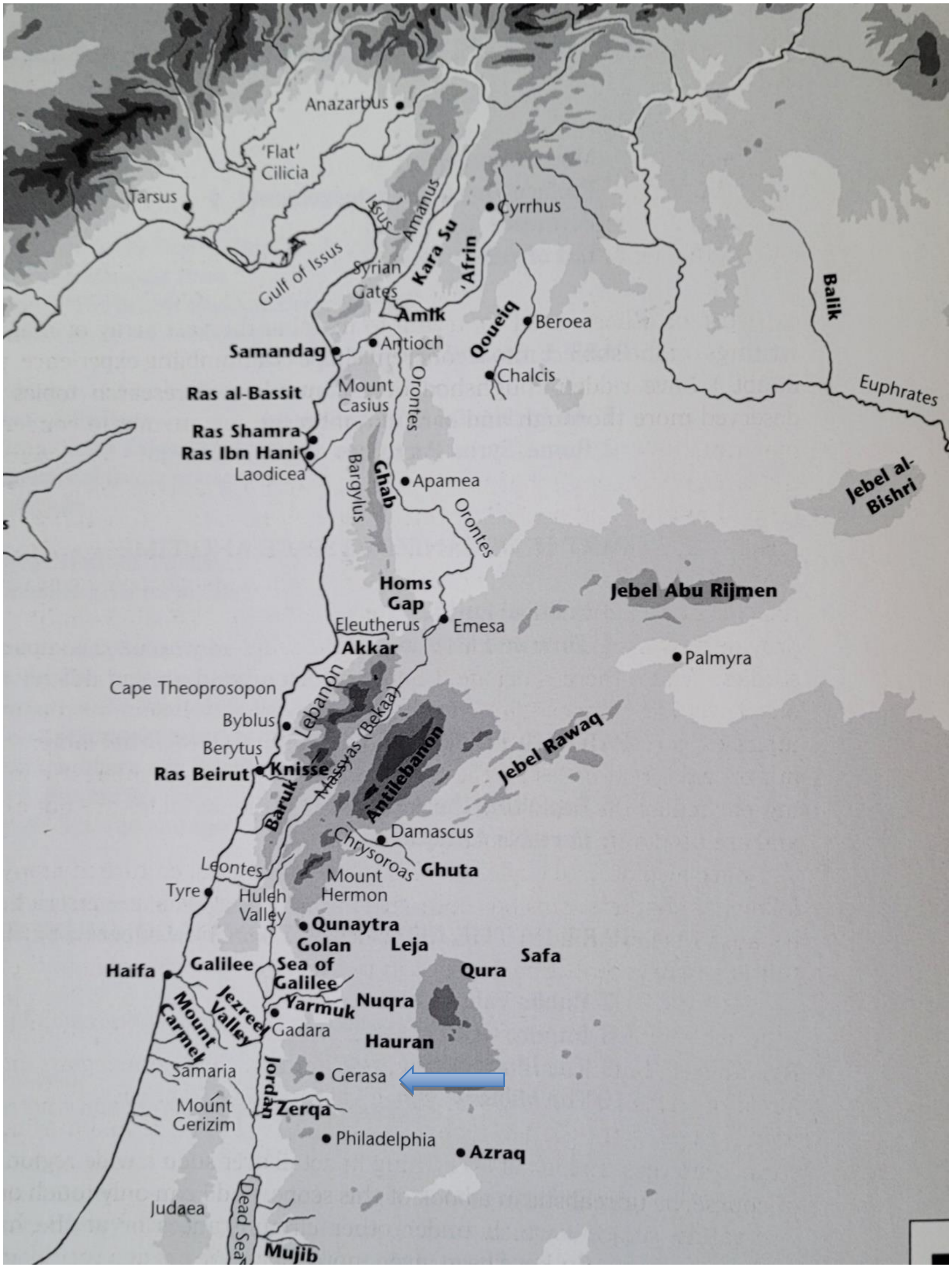
Gerasa (Jerash)

Jerash, or Gerasa, located east of the Jordan River, north of Philadelphia (Amman), is one of the cities of the Decapolis, a title that was given by scholars to a group of cities on the eastern frontier of the Roman Empire in the southeastern Levant in the first centuries BC and AD. They formed a group because of their language, culture, location, and political status, with each functioning as autonomous polis (city-state) dependent on Rome. They are sometimes described as a league of cities, although some scholars believe that they were never formally organized as a political unit.

Kennedy (2007) combines lists from Pliny the Elder and Ptolemy to come up with the names of probable cities of the Decapolis. He states "In short, we appear to have as many as thirteen Decapolis cities. One (Scythopolis) lies west of the R. Jordan and at leas four (Raphana, Damascus, Canatha, Hippos) lie north of the Yarmuk. The largest group by far – seven or eight – lie in Northwest Jordan." (p. 10)

The map below (Figure 22) from Butcher, 2003, shows the location of Gerasa in the ancient Roman province of Syria and its relationship to other cities of the time.

Figure 22. Location of Gerasa in Roman Syria, Butcher (2003)



According to Wharton (1995) the city was built in the valley of the Chrysohoas River. The city walls enclosed over 200 acres of land. The eastern side of the valley had gentle slopes while the western side was steeper.

Jerash was laid out in a grid. The main approach to the city was from the south in the direction of Philadelphia (Amman). Well before visitors arrived at the city gate, they passed through a massive arch. Beyond the arch were a group of monuments, including the Temple of Zeus, the South Theater, and an oval forum. The forum anchored the south end of the wide colonnaded cardo maximus, which ran north and south parallel to the river. Its northern terminus featured a massive gate, and its major intersections were marked by monumental arches with perpendicular passages.

Figure 28 is the survey done near the end of three campaigns that excavated Gerasa between 1928 and 1934. This was a joint effort by Yale University and the British School Archaeology, and the American Schools of Oriental Research.

Figure 29 comes from “Mapping Gerasa: a new and open data map of the site”, 2019, Lichtenberger, Raja and Scott, Cambridge University Press. The map was created from lidar and aerial photography data, correcting errors in earlier maps that were compiled from survey data. The map can be blown up and scaled, like the interactive map of Pompeii, although not with the same precision.

The cardo and decamanus are clearly visible in both figures, as are the hippodrome and oval piazza. The “conjectural buildings” hint at a layout that originally was a grid, but the remotely sensed features do not display a discernible pattern. According to Kennedy (1998) the perimeter wall was probably for “decoration and prestige, not defense” (p. 57) since it encloses a large area and is not robustly built.

There is a huge arch just south of the city that is clearly intended to impress visitors arriving from that direction. It is 450 meters south of the south gate in the wall (p. 60). The arch survives intact and is still impressive today.

Also south of the city are the remains of a structure built as a hippodrome (chariot racecourse). According to Kennedy (p. 62) the hippodrome quickly fell into disrepair in the 3rd century and was probably not extensively used. The city also had two theaters within the walls that still exist and may have been important in civic life.

The map below (Figure 23) shows that there was much less development east of the river than to the west, although the perimeter wall encloses a large area there as well.

Figure 23. Survey of Gerasa made during the 1928–1934 Excavations, Robinson 1934

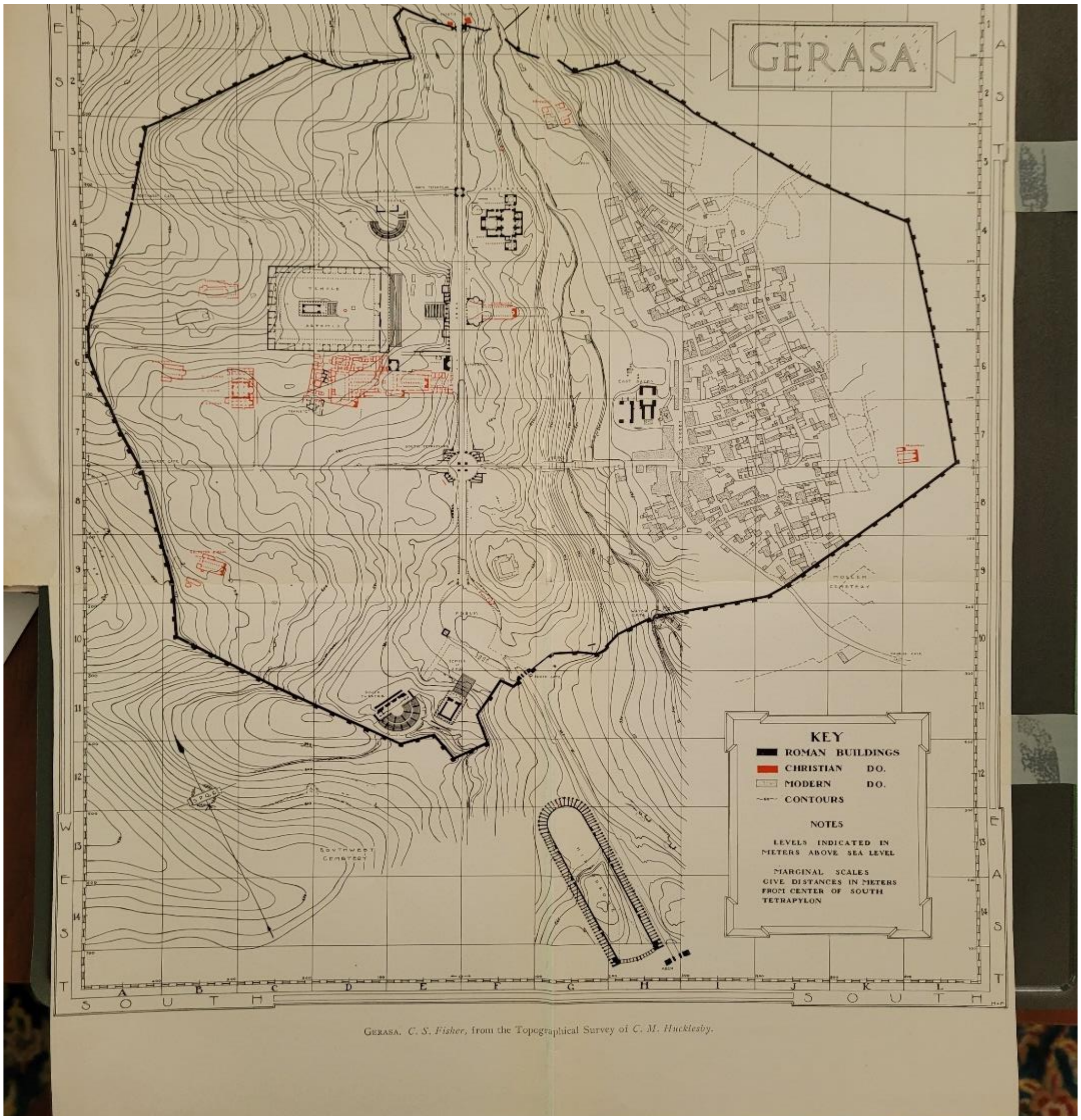
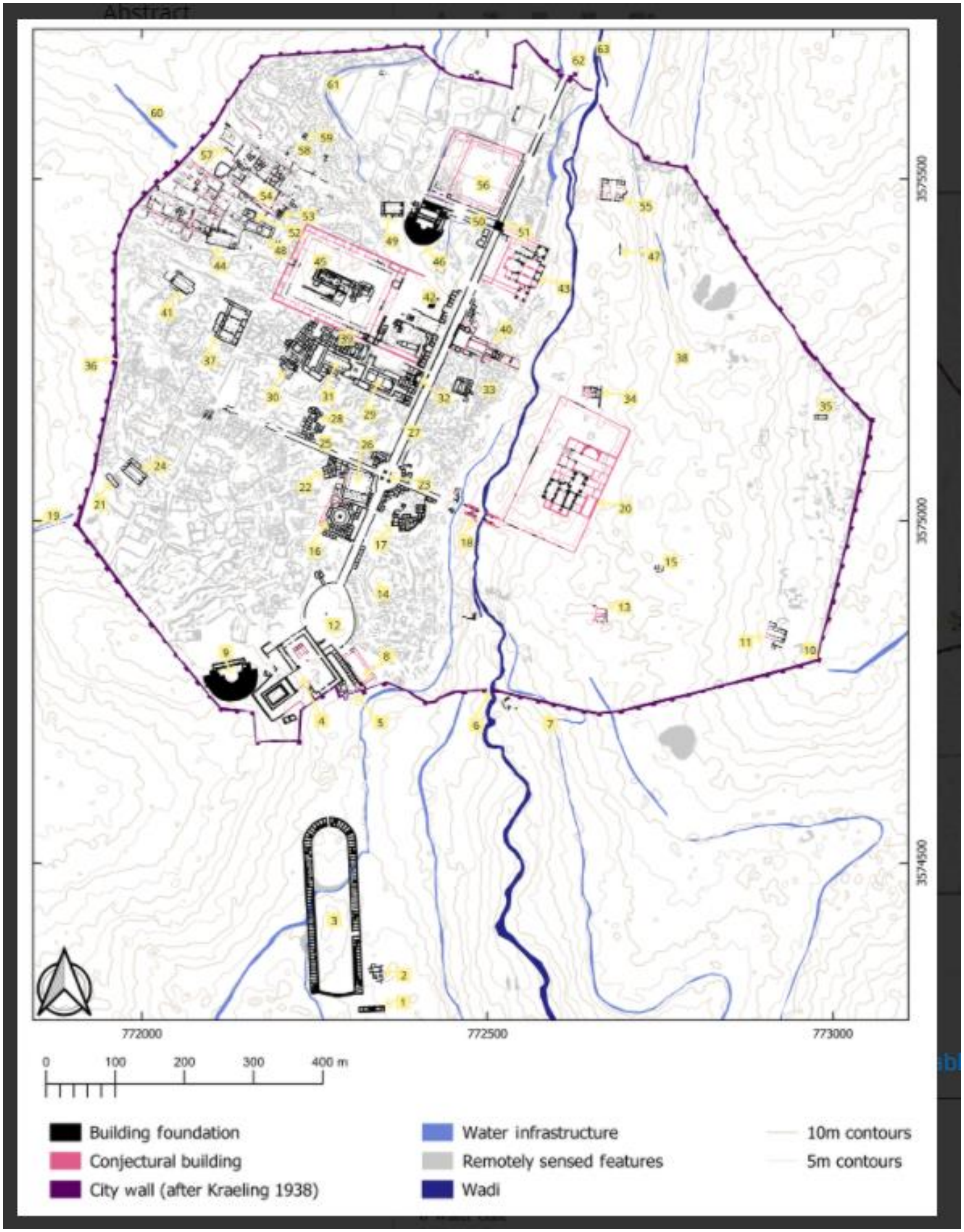


Figure 24. Layout of Ancient Gerasa from the 2019 Lidar Map



The cardo scales at 12.5 meters, or 42 Roman common feet. That is adequate for wagons to pass each other, or to support a civic procession. The decamanus scales to 8.33 meters or 28 Roman feet, also adequate for wagons to pass each other.

Gerasa was a small city in which, during the Empire period, a great deal of resources went into making the community look impressive. The wide main roads, the colonnaded "piazza", the lengthy wall, the huge arch that greeted visitors as they walked towards town, and the truncated hippodrome that Kennedy states may never have been used for chariot races, all indicate a community that was making a statement about itself.

Gerasa was intended to look impressive with an emphasis on wide main streets, monuments, and civic structures. The city's residential areas may have been laid out in a grid, but it is difficult to discern from the archaeological record. The central features, however, are clearly the result of a plan that incorporated the concepts of an "ideal" city in Roman Syria.

Figure 25. Artist's View of Gerasa, National Geographic, 2018

The view of Gerasa above (Figure 25) was commissioned by National Geographic in 2018. It is easy to imagine walking through the Hadrianic arch, past the hippodrome, through the city gate, into the forum and north along the colonnaded cardo.

Leptis Magna

Leptis, or Lepcis, Magna in Libya was established as a Phoenician colony in the 7th Century BC but reached its peak as part of the Roman region of Tripolitania. In Roman antiquity it was known both as Leptis and Lepcis in Latin, the latter being the usual form used in the city itself, reflecting the pre-Roman name Lpay. Maga, 'Great', distinguished it from the smaller town of Leptiminus in Tunisia. Deriving its wealth from the olive oil

> produced in its hinterland, Leptis Magna's prosperity was already reflected in its splendid public buildings of the 1st and 2nd centuries AD. However, in AD 193, Lucius Septimius Severus, a Roman senator whose family originated there, seized the imperial throne in a civil war. Severus' patronage further increased the city's status and enhanced its appearance with a building program worthy of an emperor's birthplace. (Polland, 2014, pg. 104)

Leptis Magna had a favorable port location on the coast of North Africa where there are relatively few safe anchorages between Alexandria and Carthage. Its wealth and importance, however, was based on its rich agricultural lands. Olive oil was a significant export and source of income.

The following images (Figure 26 and 27) show reconstructions of Leptis Magna at its height, and what remains today.

Figure 26. Central Leptis Magna and Harbor, World History Encyclopedia 2012

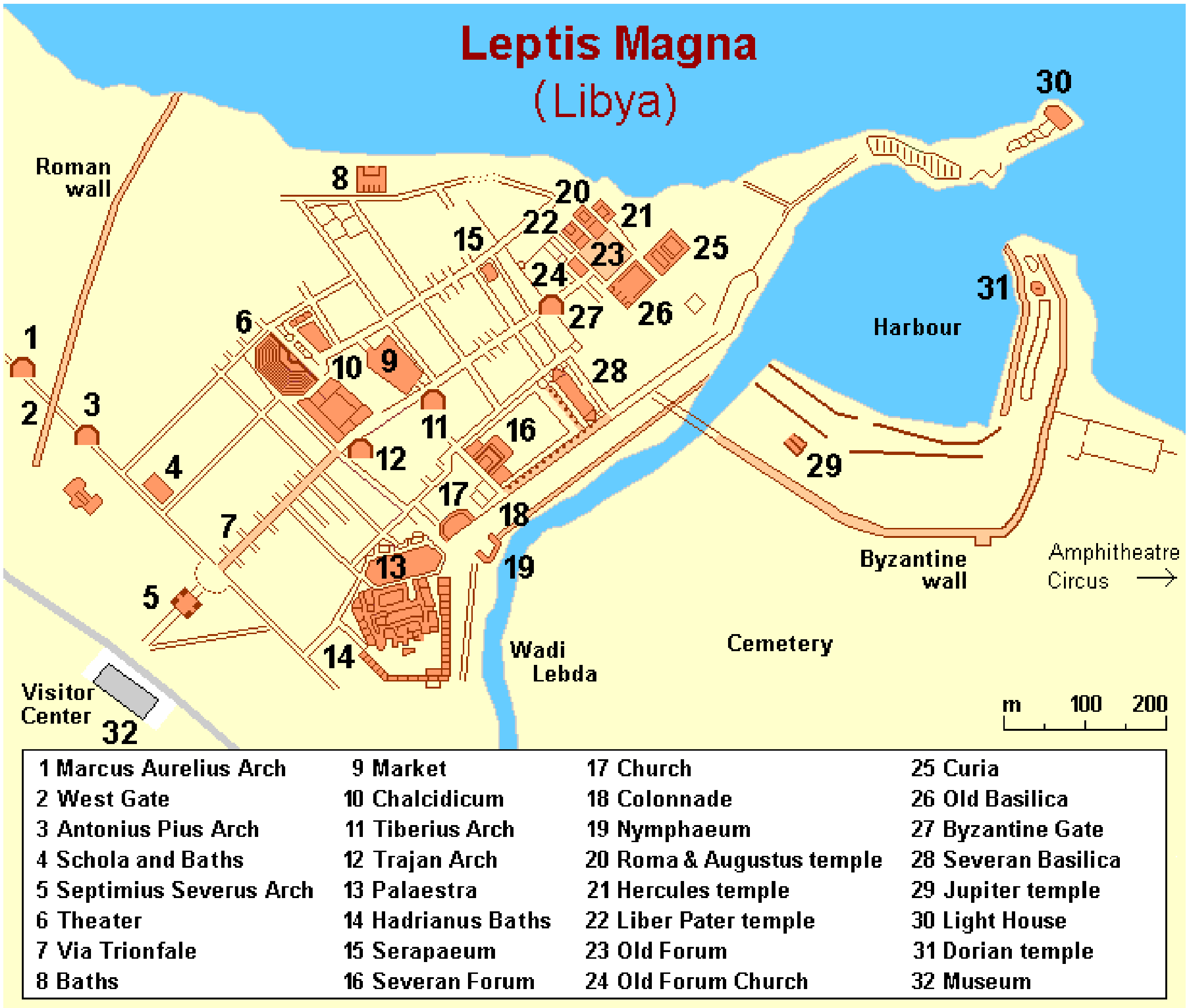
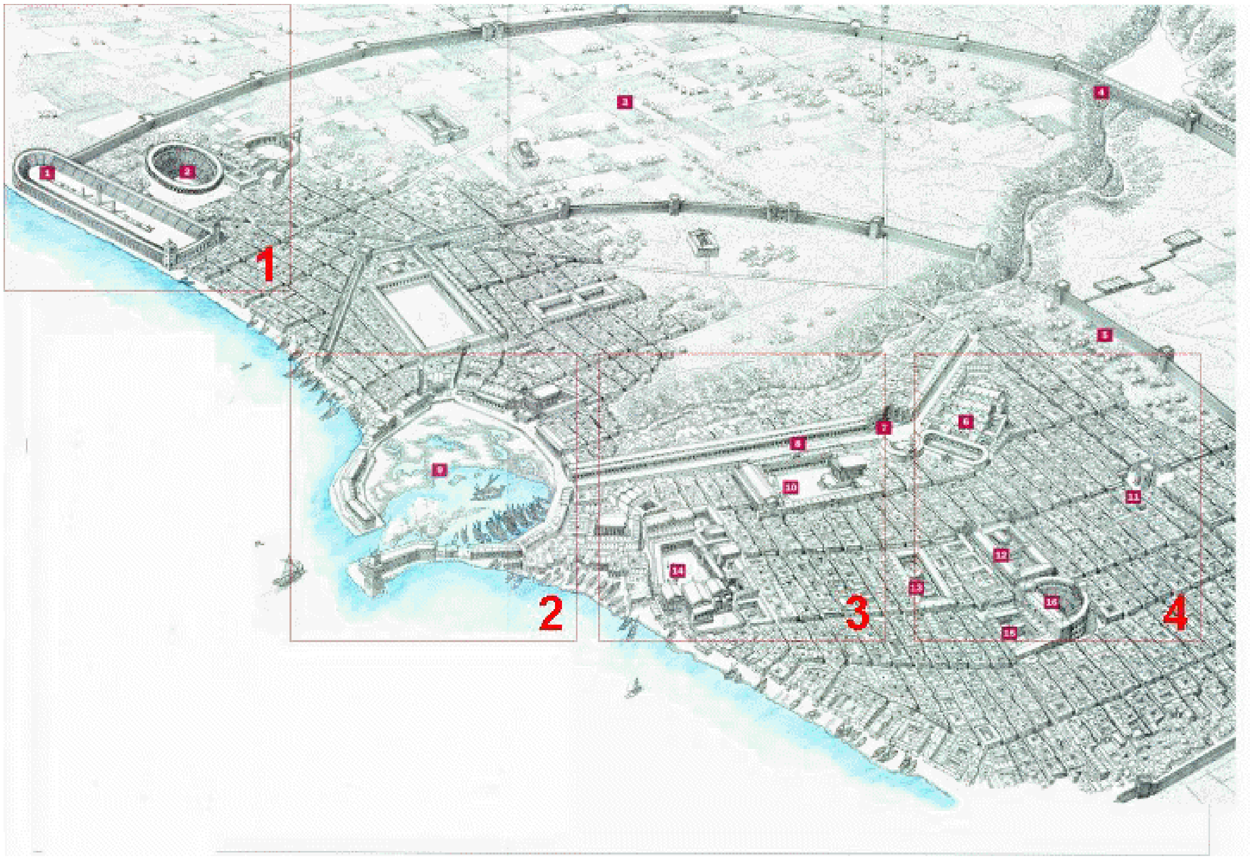


Figure 27. Two Aerial Views of Ancient Leptis Magna "A" above and "B below, Temehu – Libya's On-Line Museum



The first image above (Figure 26) shows the location of the buildings and monuments that were excavated (uncovered) during the early 20th century and comprise the world heritage site designated in 1982. This was the urban core of the city adjacent to the harbor.

The harbor lies at the mouth of the Wadi Lebda that provides a sheltered anchorage. It was established as a port by the Phoenicians in the 7th century BC. After becoming a Roman colony in the late Republic, incremental improvements were made to the harbor, culminating in the circular form seen today that was done during and just after the reign of Septimus Severus.

The second map (Figure 27 A) shows a reconstruction of the urban core during the height of the city's wealth and influence. The core had a modified grid form, with a decamanus leading from the Severan forum to the harbor. The road, which is lined with columns, scales at 12.5 meters, or 42 Roman feet.

The third map (Figure 27 B) shows Leptis Magna from the water and is a better representation of the ancient city than those that focus just on the urban core. It extends the view south to take in the circus and shows the outer as well as the inner walls.

According to Norwich (2014) "An amphitheater was built on the eastern limits of the city in AD 56. In the reign of Hadrian (AD 117–138), an aqueduct was constructed that provided water to a magnificent public bath building, one of the largest outside Rome itself at that time; the same was true of the circus, a venue for chariot races, completed in AD 162. By this time, Leptis Magna was a substantial city, with a defensive circuit enclosing an area of around 425 ha (1,050 acres)" (p 106)

Norwich later states that "Leptis Magna's incorporation into the Vandal kingdom in AD 455 may not have had a major impact on the city and the area was recovered for the Eastern (Byzantine) Roman empire by Belisarius in AD 533. But by this time Leptis Magna was little more than a fortified harbor (which subsequently silted up), and the area enclosed by the Byzantine fortifications had shrunk to only 18 ha (44 acres) compared to the much greater expanse of the earlier city." (p 109)

By the 7th century AD Leptis Magna had been abandoned and was soon covered in desert sand and mud from the wadi. An encapsulation of the history starts with the Phoenicians founding a harbor at the mouth of the Wadi. This was followed by a long Roman period in which the city was developed in a modified grid, punctuated by magnificent buildings and monuments. During this period, the fertile interior area was heavily farmed, and some wealthy landowners lived on rural estates (now vanished).

After Roman military protection was withdrawn, the agricultural areas were raided by Berber tribes and the wealth of the city declined drastically. The harbor saw less traffic and began to silt in.

Shortly after World War II, the famous archaeologist, J.B. Ward-Perkins spent time in Leptis Magna cataloguing and drawing the monuments in detail. While he wrote articles about his work, he did not write a comprehensive book that encompassed all his fieldwork. In 1993, Bari Jones and Roger Ling published a book, "The Severan Buildings of Lepcis Magna" that presented much of what Ward-Perkins had written and drawn.

In my research on Leptis Magna, the following passage, attributed to Ward-Perkins by Jones and Ling, is the best description of how Leptis Magna developed that I have found. Jones and Ling state it was taken from an unpublished manuscript of a 1972 lecture.

> Before examining these Severan monuments, it is important to understand the framework into which the new buildings had to be fitted. From deep trial excavations in the Old Forum and the Theatre, Lepcis is known to have been founded by the Carthaginians as a

trading station beside a small natural anchorage at the mouth of the Wadi Lebda (Carter 1965; Di Vita 1969; De Miro & Fiorentini 1977). The earliest remains now visible are those of the Old Forum (*Forum Vetus*), which was laid out on a neatly orthogonal plan on the landward side of the old Punic settlement sometime in the latter part of the first century BC. The subsequent development was rapid and, although each individual extension was laid out on neatly orthogonal lines, the city planners never managed to look quite far enough ahead, with the result that the individual quarters were in some cases many degrees out of alignment with their neighbors. During the first century the main development took place westwards and southwards. The lower ground to the east, towards the wadi, lay vacant until the construction of the great Hadrianic bath-building, which was dedicated in 126. This established an entirely new alignment, and it was followed later in the century by an exercise ground (*palaestra*) and by a street, laid out along the edge of the wadi so as to link the main cross-streets of the old town with the point where the great coast road from Carthage to Alexandria crossed the wadi.

Such, in brief outline, was the situation when it was decided to embark upon the great new Severan building scheme. A cardinal feature of the project was to be the construction of a large, artificial harbor basin at the mouth of the wadi. To link this harbor with the rest of the city and with the main coastal road, a new colonnaded street was to be laid out up the west bank of the wadi to a piazza established at the junction of the earlier street and the road leading up to the theatre; and alongside it there was to be built a new civic center, comprising a grandiose forum with a temple to the south and a no less grandiose basilica at the northern end. This central group of buildings is generally henceforth referred to simply as the Colonnaded Street, the Forum and the Basilica.

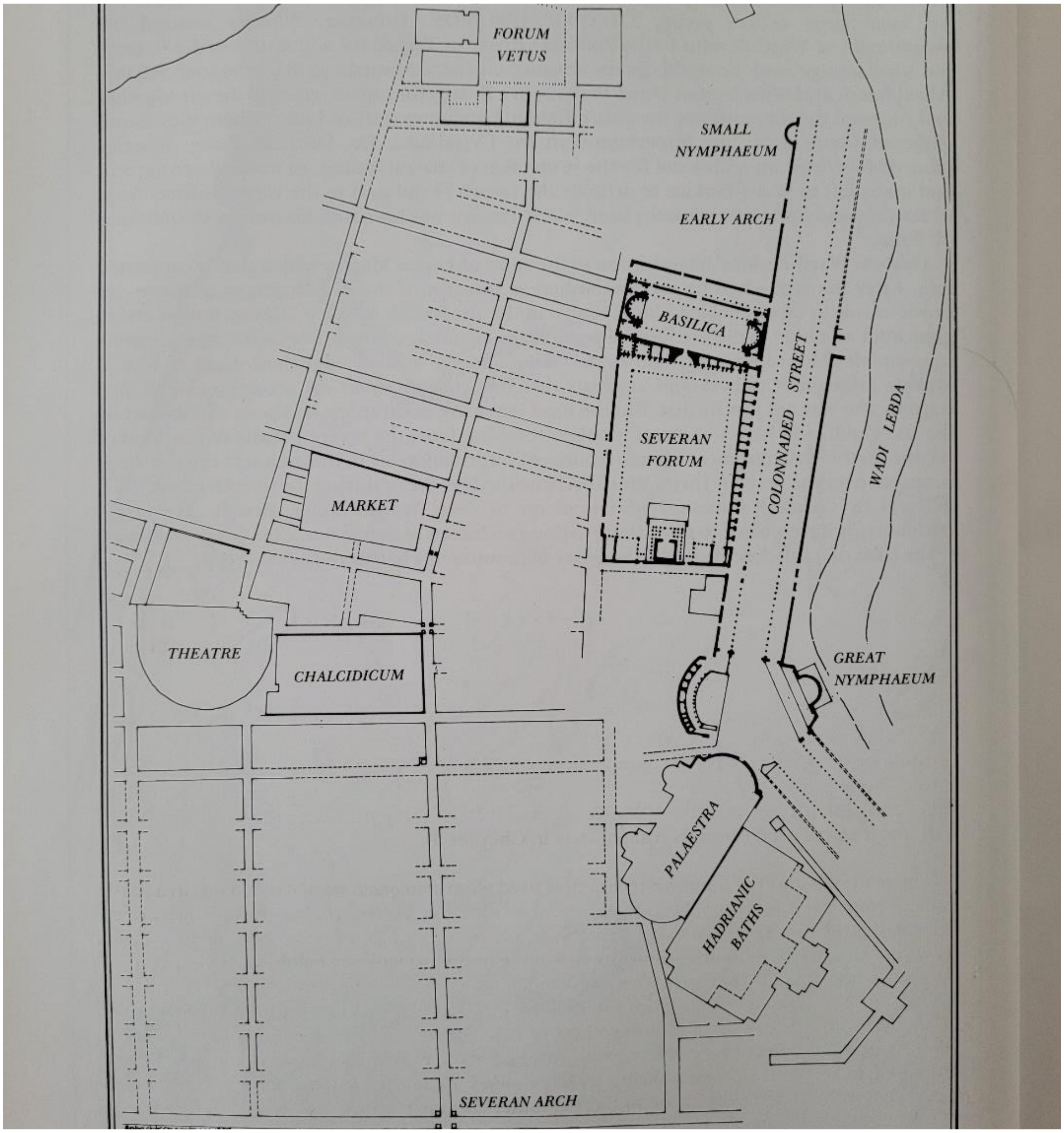
In addition to his detailed drawings of the monuments, Ward-Perkins made scaled maps of the streets in the historic core of the city. The following is a map titled "Lepcis Magna: plan of the central area, showing the Severan buildings." There is a 1987 date on the map which is probably the date that it was copied for eventual inclusion in the 1993 book.

The width of the two major north/south streets scale to 10 meters (33.7 Roman feet). The regular blocks scale to 100 x 25 meters (337 x 84 Roman feet), a 1:4 ratio. This is entirely consistent with the Romans putting a Roman "stamp" on the city, along with the monuments, temples, baths, amphitheater, and circus that left visitors with no doubt that they were entering a Roman city.

In this instance, visitors came from the north and south along the "great coast road" and from the sea. The Severan Arch greeted visitors from the interior.

Leptis Magna was not developed on a vacant site by the Romans, but the result of years of redevelopment and expansion was a modified grid pattern with axial thoroughfares that represented the Roman ideal city form. The emperor Septimus Severus (193–211) was born in Leptis Magna, and according to Ward-Perkins (1951) he favored his birthplace by paying for various monuments, including the arch. It is likely, therefore, that layout of the city at its height was the result of a plan (Figure 28).

Figure 28. Ward-Perkins Map of Central Leptis Magna, 1951



CHAPTER III: CITIES OF THE 19TH CENTURY U.S.

At the beginning of the 19th Century the U.S. consisted of the original thirteen colonies, the Northwest Territories and, in 1803, the 530 million acres of the Louisiana Purchase.

On May 20, 1785, Congress enacted a Land Ordinance which became one of the significant pieces of legislation passed by the federal government. The Ordinance created rules for the orderly survey, sale, and settlement of the public domain, with settlement to occur only on surveyed land. Land ceded by the states and purchased from the Indians was to be divided into six-mile square townships created by lines running north and south intersecting at right angles with east-west lines. Townships were to be arranged in north-south rows called ranges. Most townships were to be subdivided into 36 one-mile square sections. Each range, township, and section were to be numbered in a regular, consistent sequence. The first north-south line was to be the western boundary of Pennsylvania, and the first east-west line (called the Geographer's Line or Base Line) was to begin where the Pennsylvania boundary touched the north bank of the Ohio River. A section (one square mile or 640 acres) was the smallest unit for sale, and some townships were to be sold in their entirety. The minimum price was one dollar per acre to be paid in cash or in land warrants of equivalent value. No land would be sold on credit. The Ordinance's other provisions had long term consequences. In each township, section number 16 was reserved for the support of public schools. Sections number 8, 11, 26, and 29 in every township were reserved for future sale by the federal government when, it was hoped, they would bring higher prices because of developed land around them. (Knepper, 2002)

This ordinance codified the use of a grid system for the entire country at the time and provided for the grid to be extended as the country grew. While the purpose of the Ordinance was to make settlement of the frontier orderly and profitable for the federal government, it reinforced the notion of the grid as the most desirable means of dividing property. This notion was apparently transferred to city and town layout as many cities and hundreds of towns founded on the frontier were laid out in grids (Choay, 1969).

The three cities I chose to illustrate the grid system in the U.S. are Manhattan (New York), Denver, Colorado and San Francisco, California.

Manhattan

New York City was founded by the Dutch in 1624, who called it New Amsterdam. They colonized the lower end of Manhattan and fortified it with Fort Amsterdam. The road pattern in this area is characterized by streets that do not intersect at right angles in all cases and is distinct from the grid developed further north.

The colony was semi-autonomous, and its most famous governor was Peter Stuyvesant, who arrived in 1647. In 1667 English navy vessels sailed into the harbor and demanded that the colony be ceded to England. This was done peacefully, and the city (now named New York) stayed in English hands until the end of the American Revolution in 1783.

The New York grid story is a fascinating illustration of city planning in the U.S. Shortly after the Revolutionary War and the ratification of the Constitution it became apparent to the government in New York that New York City was going to grow rapidly. Leaders projected that the city would reach 400,000 people by 1860, whereas it reached *800,000* by that date (Kimmelman, 2012). According to the U.S. Census the population in 1810 was 96,373 and by 1860 had reached 813,669, an increase of 744% in 50 years. There was another rapid 50-year growth period between 1890 (1,515,301) and 1940 (7,454,995) of 392% which coincided with large numbers of immigrants coming through the Ellis Island welcome and control station. Many of these immigrants were bound for other parts of the U.S., but enough stayed in New York that it contributed substantially to the growth. Since then, the city population has grown slowly. The Census Bureau figure for 2020 was 8,804,190, an increase of only 18% since 1940.

Private Spaces

I picked two areas in New York that can be traced through history and retain their original grid pattern. Chelsea is in the southwest portion of Manhattan not far from the Hudson River. The second area is known as the Upper East Side east of Central Park.

When thinking about city development in the U.S., and New York in particular, is important to keep in mind that the Sanborn Maps illustrate a city that was developed prior to the widespread introduction of the electric elevator. Thus, buildings were limited to 3–5 floors because that was as high as most people were willing to walk multiple times per day. The wealthy lived in townhouses with several floors that occupied single lots. The poor lived in five-story tenement buildings with several apartments on each floor (see NYC Tenement Museum at 91 Orchard Street on the Lower East Side). After the October 11, 1887, patent of the electric elevator with automatic opening and closing doors (U.S. Patent office patent US 371,207A) "skyscrapers" became feasible and changed the New York landscape. Going up allowed Manhattan, which was fully developed by 1887, to increase in population by almost 400%, as cited above.

In 1807 the Commissioners of New York, appointed by the State Legislature, approved a map of Manhattan that would accommodate the rapid expected growth. The 1807 map became the basis for the adopted Plan of 1811 drawn by John Randel, Jr., who started surveying the existing roads and buildings in Manhattan in 1808 and finished in 1811. The grid was laid over this base survey to form a plan that showed the proposed layout for Manhattan as far north as 155th street. Randel spent the next nine years mapping and setting monuments for the proposed street corners in the grid. The result, delivered in 1820, was a set of 92 Farm Maps drawn at a scale of 1" =100' that showed the proposed grid overlaid on all existing roads, property lines and buildings. It highlighted the public/private conflicts that would need to be resolved as the new streets were developed.

The 1811 Plan for Manhattan did not establish private property lines. The space within each block was left for subdivision later. As we will show, this arrangement differed from Denver and San Francisco in that the streets in those cities were laid out at the same time as the private property was subdivided.

I have shown four views of Chelsea. The first is the Sanborn Map for 1890 Chelsea (Figure 29). The second is a Google Earth aerial of the same area (Figure 30), followed by the current Assessor's map (Figure 31). Next, I take one block and highlight the lot layout from the 19^{th} Century as compared to the 21^{st} Century (Figures 32 and 33).

The maps are a bit confusing because the Sanborn Maps are laid out horizontally while the Google Earth aerial view and the Assessor's maps are oriented north/south, with the grid 29 degrees northeast of true north.

Figure 29. Chelsea, Manhattan, 1890, Sanborn Maps, Vol. 5 Map 89

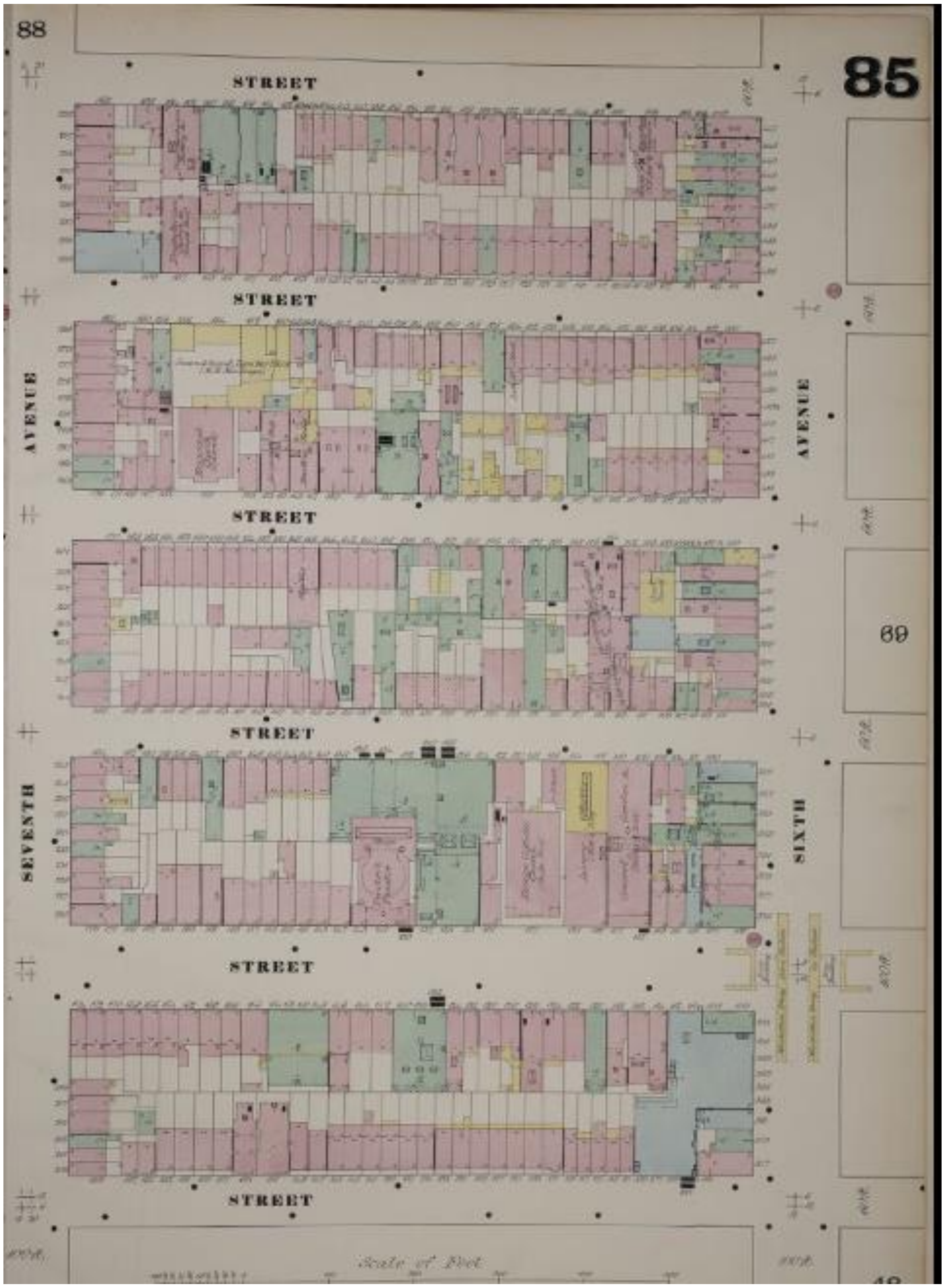


Figure 30. Chelsea, Manhattan, 2020: Google Earth

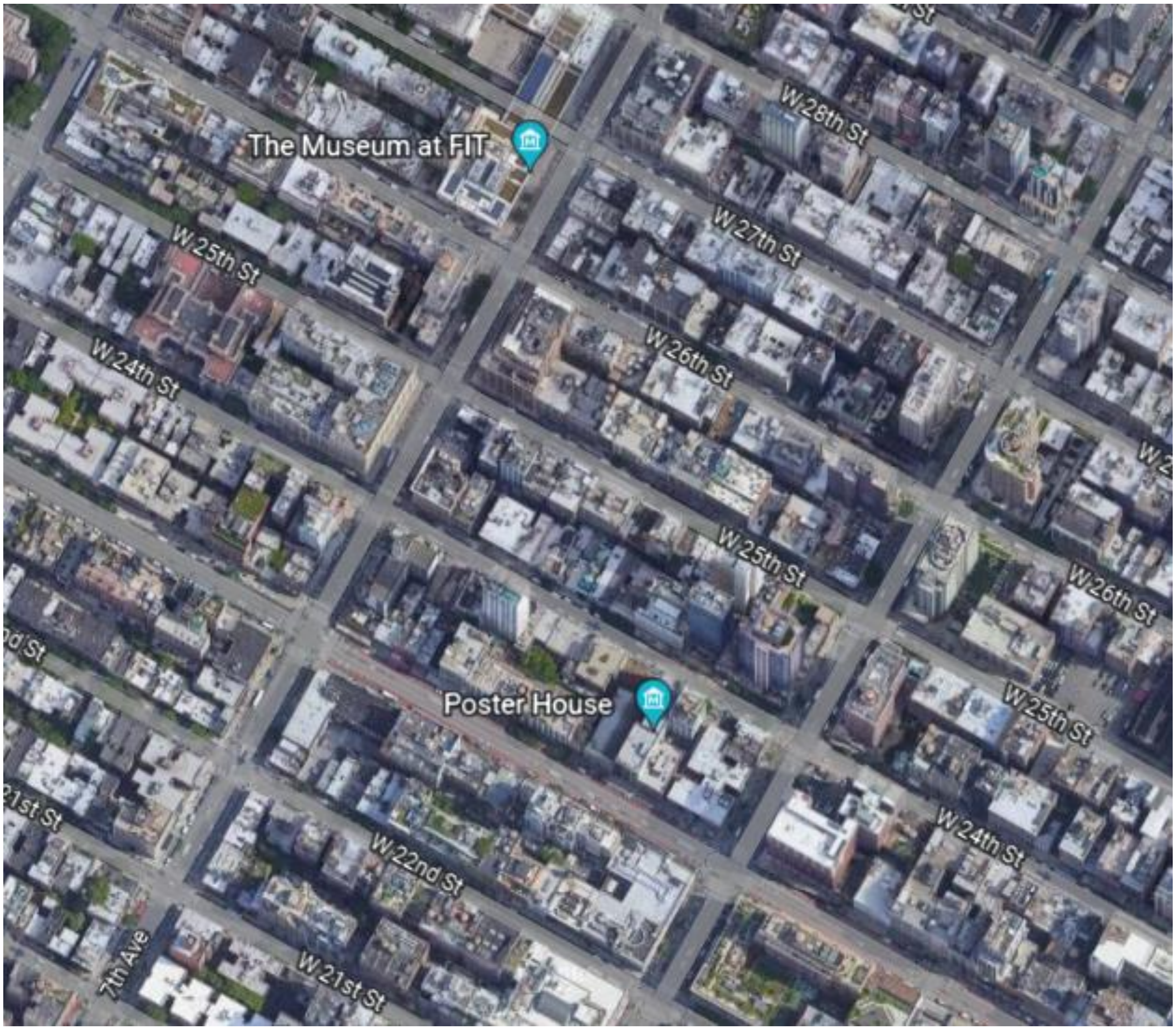


Figure 31 Chelsea, Manhattan, Property Lines. NYC Assessors office, 2020

Next, I show a block in Chelsea as it appeared in 1890 (Figure 32) and as it appears today (Figure 33).

Figure 32. Typical Block in Chelsea, Manhattan, 1890, Sanborn Maps Vol. 5 Map 89

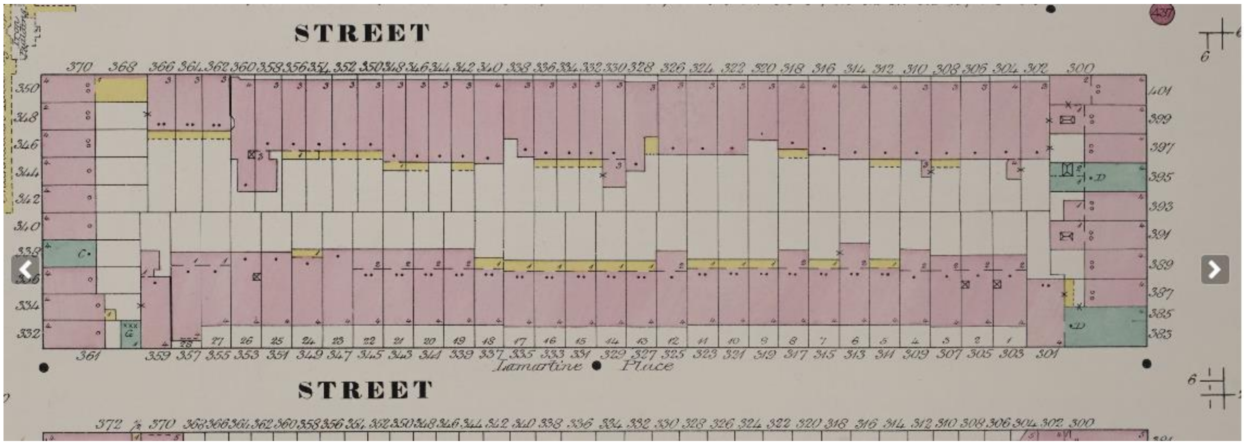


Figure 33. Typical Block in Chelsea, Manhattan, 2020, NYC Assessor's Office

There are no dimensions shown on the Sanborn Map, but they were drawn to scale. Originally the lots were laid out in a regular fashion inside the block. The block itself was 197.5' wide by 800' long. The typical lot was 25' wide by 98.75' long. When you first look at the 1890 map and compare it to the 2020 map it seems that none of the original lot lines remain.

Upon closer inspection, however, some of the new lots are multiples of the original lots, such as 50’, 75’ or 100’ and there are seven of the 25’ lots remaining.

Next we look at three views of a portion of the Upper East Side. First (Figure 34) is the Sanborn Map from 1896. Next (Figure 35) is a Google Earth view of the same area. Third (Figure 36) is a current view of the property lines.

Figure 34. Upper East Side, Manhattan, 1896, Sanborn Maps Vol. 8, Map 163

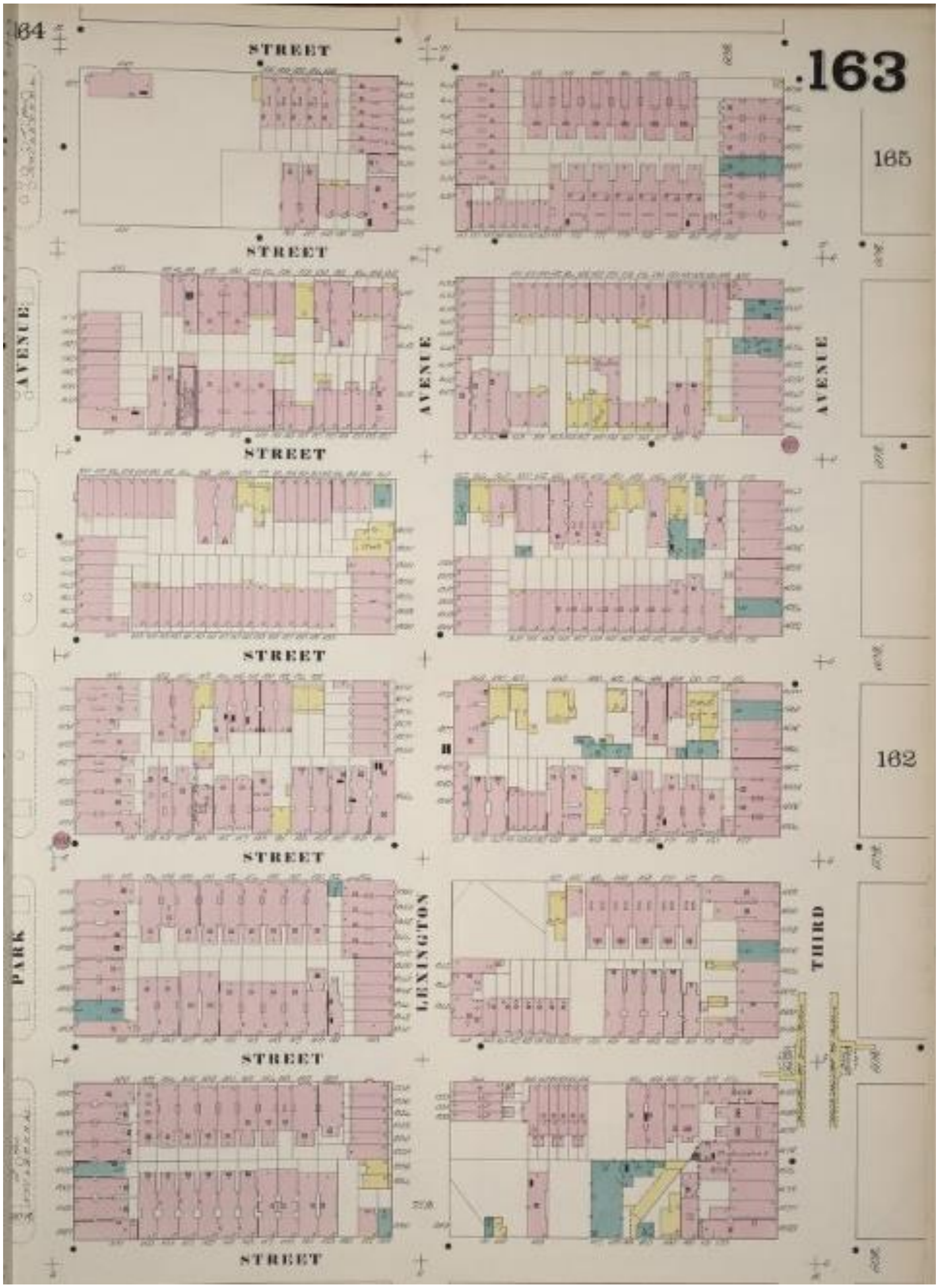


Figure 35. Upper East Side, Manhattan, 2020, Google Earth

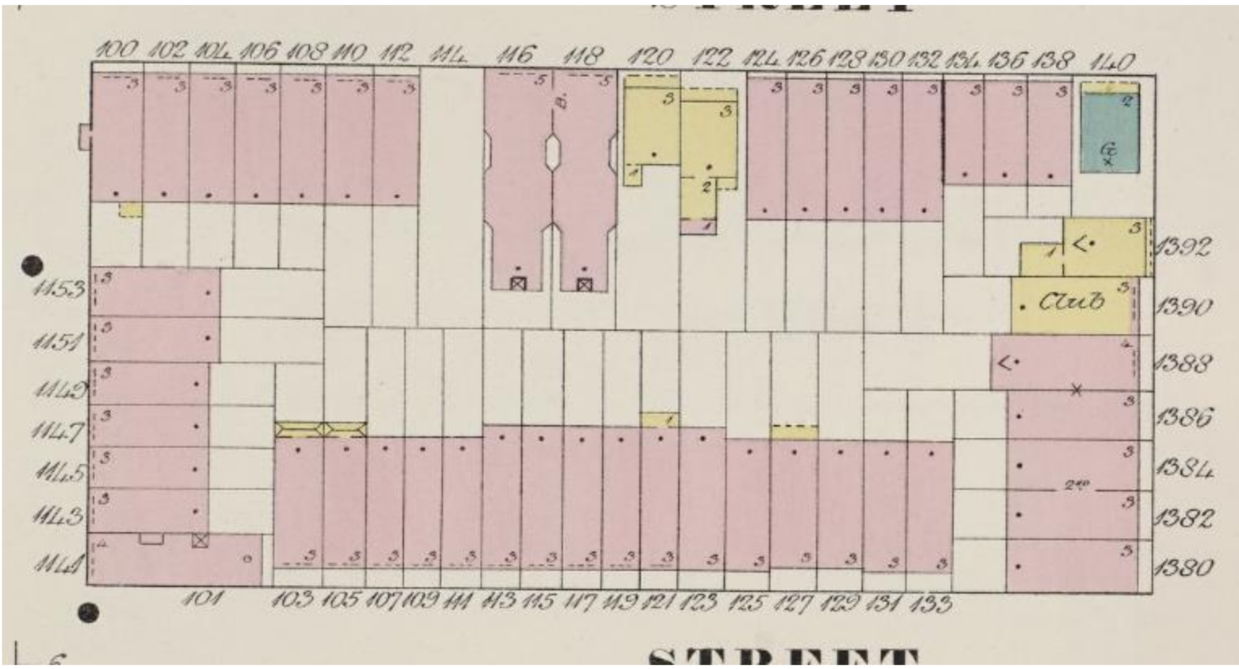
Figure 36. Upper East Side, Manhattan, Property Lines, NYC Assessors office, 2020

Below I have shown a "typical" block for the Upper East Side (Figure 37). It is 405' long by 201.42' wide. Blocks to the east are 420' by 201.42 and I suspect that a portion of this block was "stolen" when Park Avenue, with its large median, was constructed. Now, let us compare it to the same block as shown on the 1896 Sanborn Map (Figure 38).

Figure 37. Typical Block, Upper East Side, NYC Assessors office, 2020

As you can see, the parcels are, for the most part, still recognizable. The Sanborn Maps do not have lot dimensions on them, but the pattern is the same as in the Assessor's maps that do have dimensions.

Figure 38. Typical Block, Upper East Side 1896: Sanborn Maps



The "typical" lot facing East 91st Street is either 15' or 17.5' by 100.71'. A typical lot facing East 92nd Street is a wider (25') but the same length. Whoever did the layout divided the block equally since 100.71' plus 100.71' equals the 201.41' block width. By 1896 all the lots had been developed, presumably with row houses. Since then, some of the lots have been consolidated to house larger structures such as the apartment building at Park and 91st.

Public Spaces

The development of the New York City grid created two types of public spaces, the street, and the sidewalk. Together these form the right-of-way that is owned by the city and is open for public use. Looking at the map above, one can see that some of the row houses were set back slightly from the right-of-way line, creating a small private space in front of the street. In looking at photographs from the late 19th century it appears that this space was used for steps leading up to the front door and down to the basement level. So, effectively, the homes were built out to the street.

In New York, the rights-of-way were created by the 1811-1820 survey, which preceded street and sidewalk construction. Thus, it was up to the city to apportion the amount of land used for each. I looked through the city's on-line databases and called City Planning to inquire if they had a list of street and sidewalk widths available. They do not, and I have therefore used the Google Earth measure function to spot check streets in the two areas (Table 7).

Table 7. Street, Sidewalk and Right-of-Way Widths, Upper East Side

Street	Street Width	Sidewalk Width	Right-of-Way
22nd Street	34'	13'	60'
23rd Street	60'	20'	100'
24th Street	34'	13'	60'
25th Street	34'	13'	60'
26th Street	34'	13'	60'
27th Street	34'	13'	60'
6th Avenue	66'	17'	100'
7th Avenue	60'	20'	100'

Note that the sidewalk dimension needs to be doubled and added to the street width to equal the right-of-way dimension. Also note that the public street space in Manhattan is often divided into spaces for motor vehicles to operate, motor vehicles to park, buses to operate, buses to load and unload, bicycles to operate, and for trucks to load and unload. It is still the same curb-to-curb pavement that is allocated to vehicles but subdivided into types of vehicles and activities to give each a "share of the pie."

The right-of-way dimensions are from the city, and the street/sidewalk dimensions are spot measurements using Google Earth.

Table 8. Street, Sidewalk and Right-of-Way Widths, Chelsea

Street	Street Width	Sidewalk Width	Right-of-Way
88th Street	30'	15'	60'
89th Street	30'	15'	60'
90th Street	30'	15'	60'
91st Street	34'	13'	60'
92nd Street	30'	15'	60'
93rd Street	34	13'	60'
94th Street	30'	15'	60'
Third Avenue	70'	15'	100'
Lexington Avenue	52'	12'	76'
Park Avenue	112'	14'	140'

As with the Upper East Side, the Right-of-Way dimensions are from the City Maps of the City of NY, and the street and sidewalk dimensions were measured by me using Google Earth (Table 8). Those dimensions were taken at isolated spots and cannot verified by official city sources. Nevertheless, I have found that the Google Earth photos and measure tool are accurate to within one foot.

The 1811 plan anticipated standard right-of-way widths for the Streets and wider, more variable widths for the Avenues. When the streets and avenues were constructed there seem to have been standards that were adhered to. Park Avenue was an anomaly. It has a 140' right-of-way, a 112' street width that includes a 24' median and 14' sidewalks. Park Avenue also supports two-way traffic, unlike the Streets that are all one-way (today).

Today, Manhattan has the greatest population density of any urban area in the U.S., 67,000 people per square mile (U.S. Census), which is 5.5 times the density in 1890. As we saw above, the city was laid out to accommodate 2–5 story townhouses as the principal dwelling type. Today, redevelopment has produced many taller buildings housing many more people in each block. This is significant because the street and lot layout of the 19th Century anticipated a use of the land that has since changed dramatically. My original thesis is that given an undeveloped area and the mission to create a city, a grid is often the result. In the case of Manhattan, the land use today is nothing like what was envisioned. Would knowledge of the future have changed the 1811 Plan?

Denver

The Denver area was settled in the 1850s after gold was discovered along the South Platte River and several of its tributaries. The gold played out quickly, and mining operations moved to areas in the foothills and mountains to the west. The community and several neighboring communities began to supply the dry farming and ranching industries to the east with manufactured products and helped to ship farm products to eastern and midwestern markets. In the 1870s entrepreneurs built a railroad north from Denver to connect to the transcontinental railroad that passed through Cheyenne, Wyoming. At about the same time, another rail line was completed from Kansas west into Denver.

With its new transportation routes in place, Denver quickly became a shipping hub, and even a destination for tourists. In 1876 Denver became a state and in 1894 a new capitol building was built.

If we look at the U.S. Census figures we can see that Denver experienced several periods of rapid growth (Table 9).

Table 9. Population Growth in Denver, CO 1880 - 2020

Year	Population	Change	Percent Increase
1880	35,629		
1890	106,713	71,084	200%
1900	133,859	27,146	25.4%
1910	213,381	79,522	59.4%
1920	256,491	43,110	20.2%
2020	715,522	459,031	179%

While the table makes it appear that Denver only grew 179% in the 100 years between 1920 and 2020, it is good to keep in mind that the metro area now has a population of four million and that there are numerous cities surrounding and contiguous with Denver.

Denver is in the high plains east of the Rocky Mountains. It was relatively unconstrained by terrain – a review of the 1903 map for the city shows that the major land use determinants were the railroads, the Platte River and Cherry Creek. Denver was a rail hub and there was a large marshalling yard along the Platte River with numerous warehouses served by rail spurs. In recent years, the spurs and marshalling yard have been removed and the warehouse district has been redeveloped as Lower Downtown (LoDo).

The study areas in Denver that I chose were platted (mapped and developed) between 1900 and 1910 when the city population grew almost 60%. People were moving into Denver in large numbers and developers reacted by planning new neighborhoods on vacant land. The result was an organized grid that eventually spread to encompass much of the metro area.

I used the Sanborn Insurance maps from 1904 (Library of Congress online) to look at the grid at that time and compared it to a modern street map (AAA 2018) to find two representative areas that have retained their original street layout. Both are in central Denver near City Park that was platted at the same time as the adjacent neighborhoods.

Figure 39. Area 1, Denver, 2018, StreetLookup.com

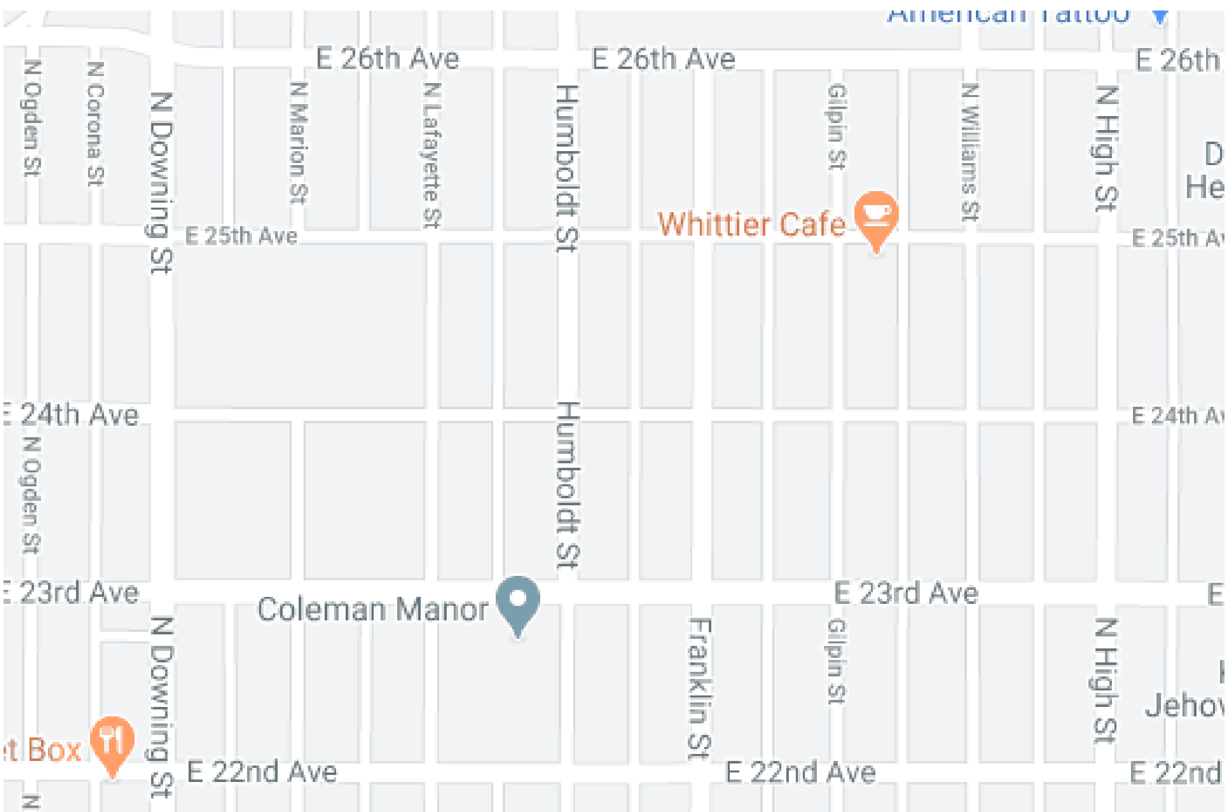


Figure 40. Area 1, Denver, 1904, Sanborn Maps, Vol. 3

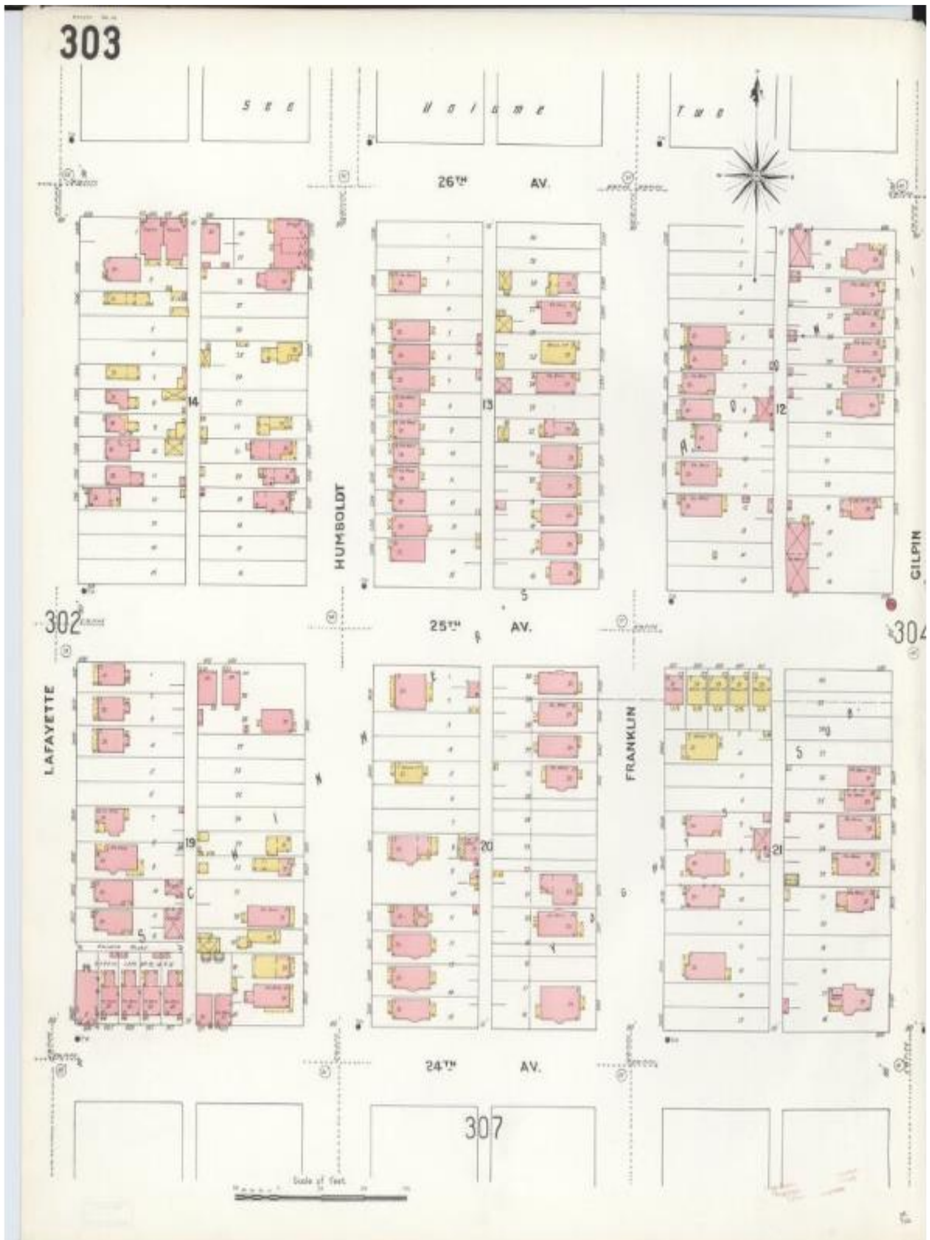


Figure 41. Area 1 Parcel Map, Denver, 2020, City Assessor's Office

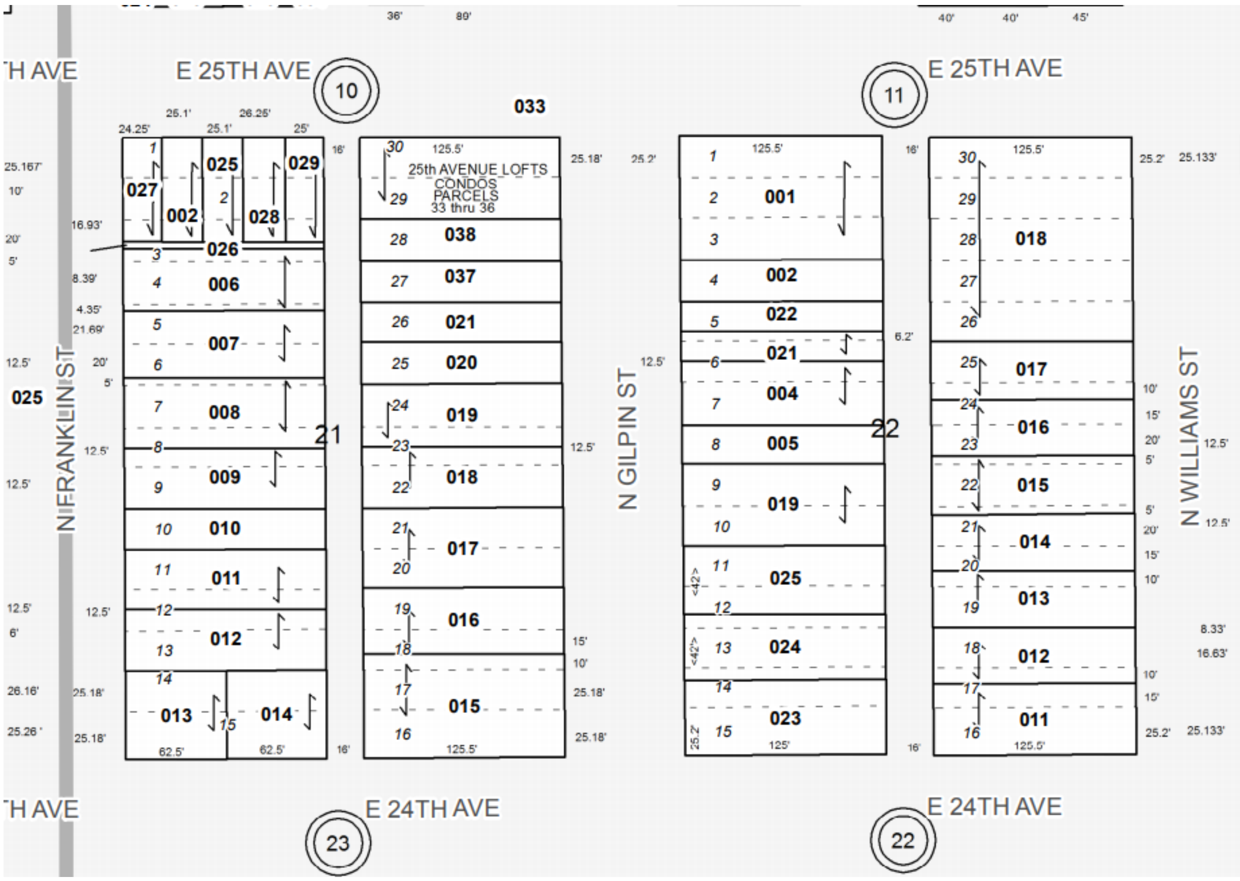


Figure 42. Area 1 Aerial View, Denver, 2020, Google Earth

The first map (Figure 39) shows the entirety of Area 1 that was used to capture measurements of public and private spaces. The second map (Figure 40) shows how a representative portion of the area looked in 1904. The streets and alleys are clearly shown. The lots that had been developed by 1904 have outlines of the structures portrayed since Sanborn supplied this information to insurance companies. The third map (Figure 41) shows a representative portion of the area today, with the current lot lines, streets and alleys shown. The last map (Figure 42) is a Google aerial photo of the same area in which the homes, sidewalks, streets, and alleys are visible.

For the most part the parcels in this area have been developed as single-family residences. The private spaces are the lots, extending from just behind the sidewalk to the edge of the alley. The homes are built back from the sidewalk, leaving a front yard. In the back of the lot the garages or other out-buildings are built to the edge of the 16' alley. The alley is public and may be used by the city for garbage collection, utility maintenance or other purposes.

From the sidewalk (public) to the edge of the street is a wide strip of property that is part of the right-of-way but maintained by the property owners.

> "Parking Strip" means that part of the public street or avenue, or right-of-way not covered by sidewalks, lying between the property line and the curb or that portion of the street or avenue being used for vehicular traffic. Definition from City of Sedre-Wolley, WA 2014

As we will see in the discussion of 19th Century San Francisco, the public/private delineation may be clearly defined, or blurry as in the examples from Denver.

Private Spaces

The following list shows block widths and blocks lengths for Area 1. The source of this data is the Denver City/County Assessor's office. The Assessor's office maintains property records, beginning with the layout when the area was first platted and showing how property lines within each block have changed over time. This information, plus ownership information, is used to collect property taxes.

East/West streets

East 22nd Ave., East 23rd Ave., East 24th Ave., East 25th Ave., and East 26th Ave.

North/South streets

N. Ogden St., N. Downing St., N. Marion St., N. Lafayette St., N. Humboldt St., N. Franklin St., N. Gilpin St., N. Williams St., N. High St., and N. Race St.

The block width (east/west direction) consists of two lines, each 125-126.5’ long separated by a public alley that is 16’ in width (total 266’). The block length (north/south direction) is 375’, divided into 15 lots that are each 25’ wide by 125’ in length.

Figure 43. Area 2, Denver, 2018, StreetLookup.com

Figure 44. Area 2, Denver, 1903, Sanborn Maps, Vol. 2

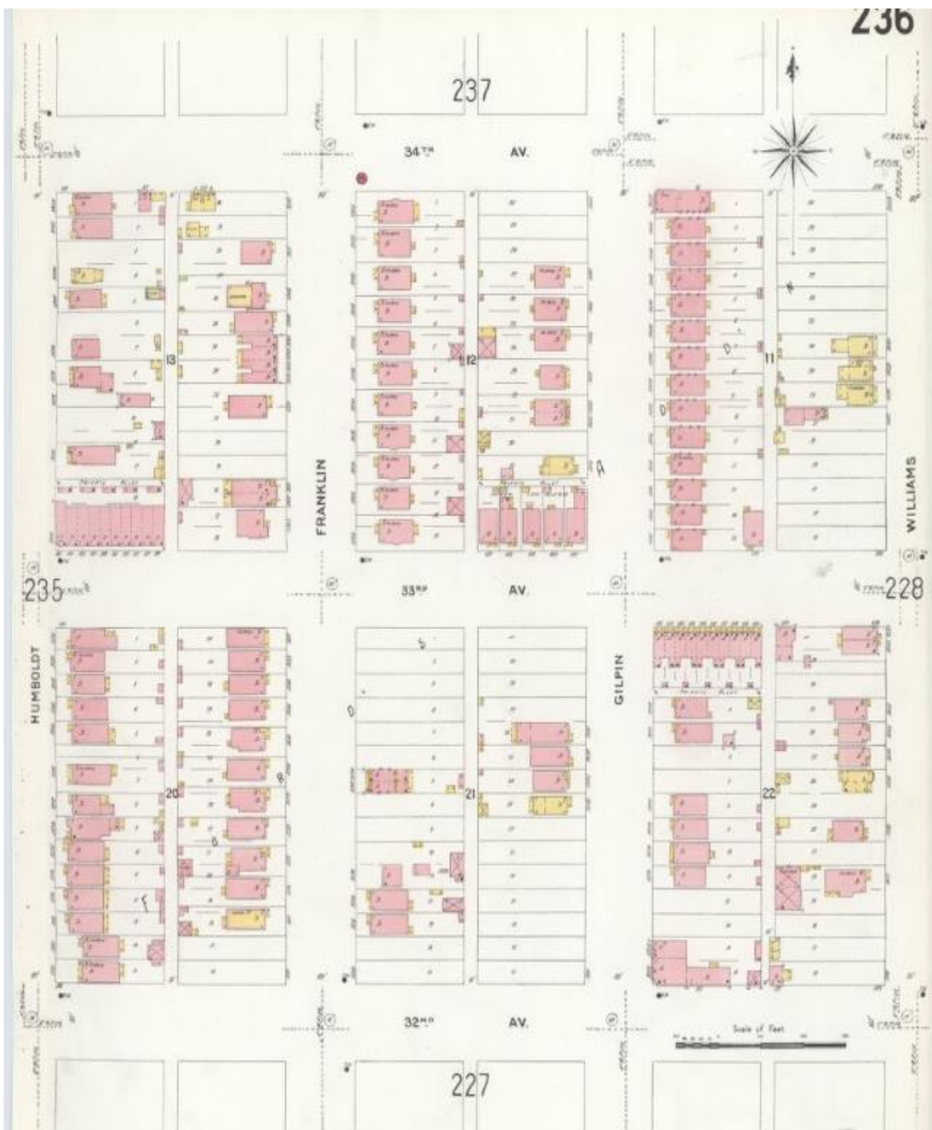


Figure 45. Area 2 Parcel Map, Denver, 2020, Denver City Assessor's Office

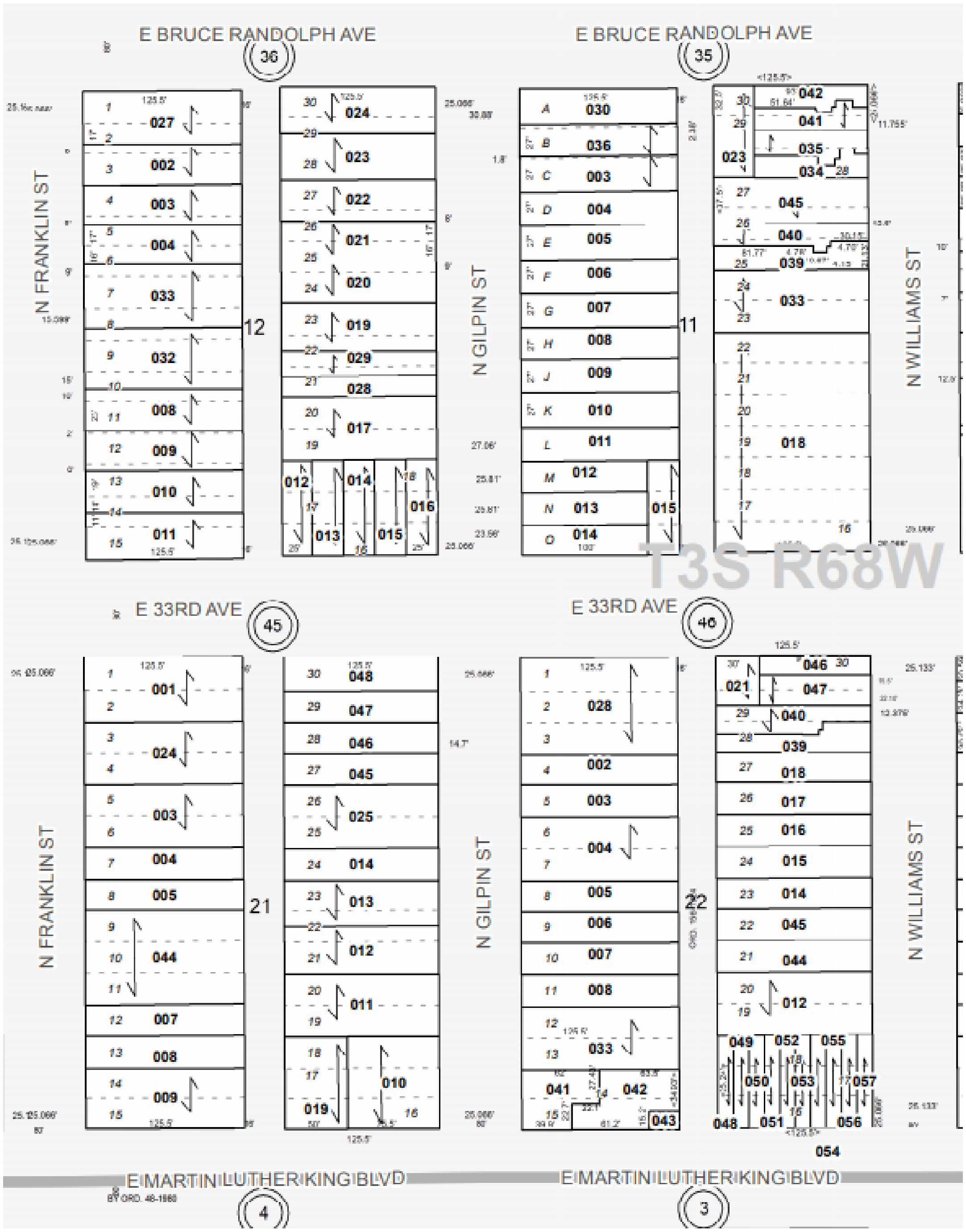
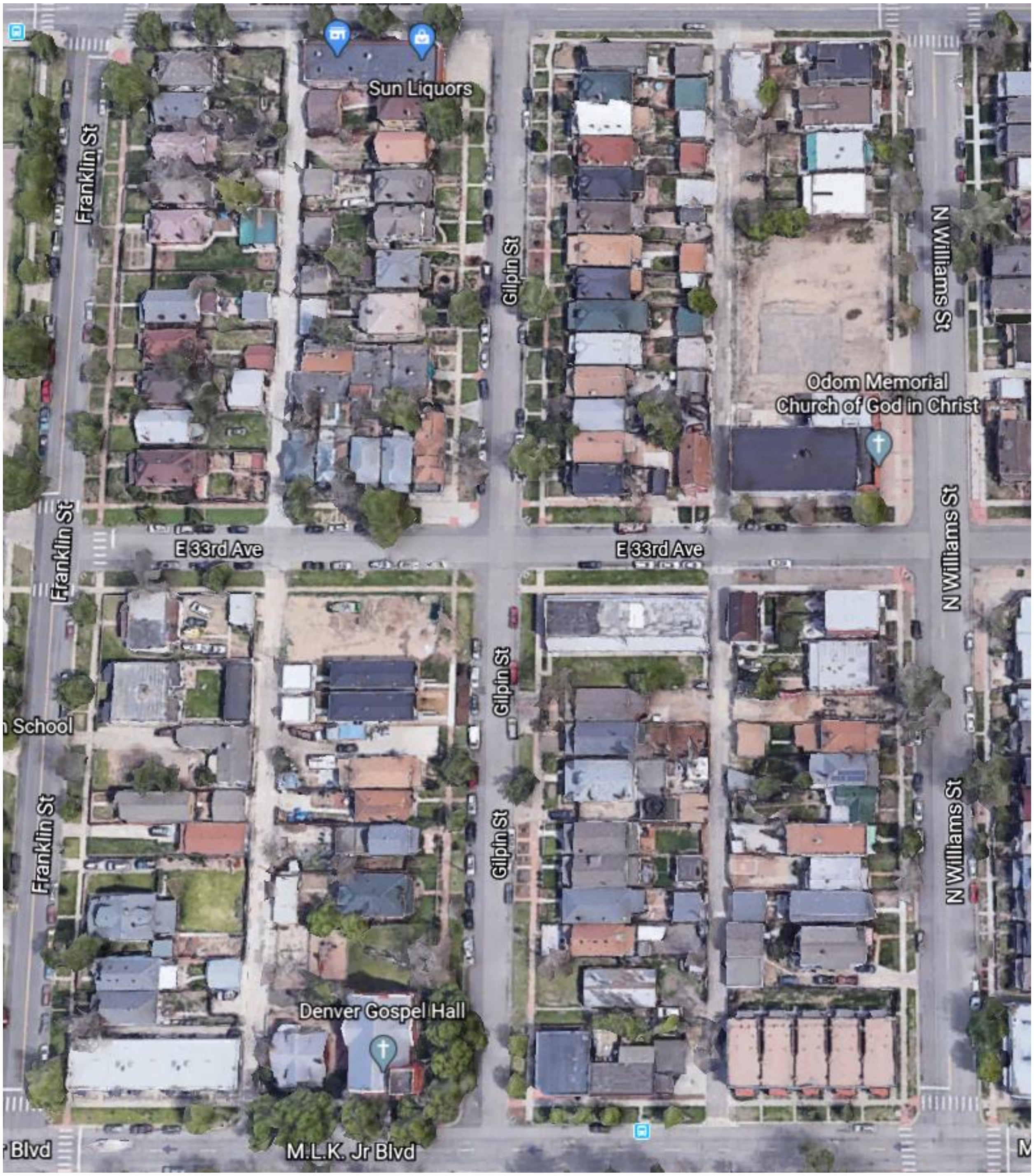


Figure 46. Area 2 Aerial View, Denver, 2020, Google Earth



The first map (Figure 43) shows all of Area 2 that was used for street and property measurements. The second map (Figure 44) shows a portion of the same area as it looked in 1903 according to Sanborn. The lots that had been developed at that time have outlines of the houses. The third map (Figure 45) shows current property lines according to the City Assessor's office. The last illustration (Figure 46) is a Google maps aerial photo of part of Area 2 in which the structures, alleys, sidewalks, and streets can clearly be seen.

Area 2

East/West streets

East Martin Luther King Ave. (32^{nd}), East 33^{rd} Ave., East Bruce Randolph Ave. (34^{th}), East 35^{th} Ave., and East 36^{th} Ave.

North/South streets

N. Marion St., N. Lafayette St., N. Humboldt St., N. Franklin St., N. Gilpin St., and N. Williams St.

The block width in Area 2 is also 125' + 125' + 16' for a total of 266'. The range of the two halves is 124.95'-125.04'. The block length is also 375' with the original blocks having been divided into 15 25' lots.

The property division and development pattern in Area 2 is similar to Area 1. The lots are laid out with an east-west orientation, and back up to a 16' alley that runs north/south. The development is denser since some of the structures are close together and have no side yards. The front yards are slightly shallower than in Area 1 so that more of the lots are covered with structures. These two areas illustrate that the same-sized pieces of private property can be developed in different styles.

It is interesting to compare the Sanborn maps that show the original lot lines to the Assessor's maps from 2021. Most of the original 25'-wide lots have been combined or recombined into larger pieces of property. The Assessor's maps show the original lines as dashes, thus maintaining a record of the original layout. The narrow lots from 1900 may have been intended to be sold singly or as multiples. The single-family residences that occupy most of the lots today fit better on wider lots than they would have on single 25' wide lots as originally platted.

Public Spaces

In addition to the private spaces created by the plats reviewed above, the property division created three types of public spaces, streets, alleys, and sidewalks. The following tables (Table 10 and Table 11)) give the widths of these spaces and show a consistent thought pattern about how public access to private property should be developed and maintained.

As mentioned above, however, the area listed as "sidewalk" in the Assessors Maps consists of a five-foot concrete walkway along the edge of the property line and an 11'-16' strip of public land between the street-side edge of the walkway and the curb line of the street. For purposes of taxation and ownership, this is public land. The adjoining property owners maintain the space and may view it as "theirs" to landscape as they deem appropriate.

Table 10. Area 1 Street, Sidewalk, and Right-of-Way Widths

Street Intersection	Street Dimension	Sidewalk	Right of Way	Alley
East/West Streets				
E. 22nd Ave @ Downing	48	16	80	
E. 22nd Ave @ Franklin	48	16	80	
E. 22nd Ave @ Gilpin	48	16	80	
E. 22nd Ave @ High	48	16	80	
E. 22nd Ave @ Humboldt	48	16	80	
E. 22nd Ave @ Lafayette	48	16	80	

Street Intersection	Street Dimension	Sidewalk	Right of Way	Alley
E. 22nd Ave @ Marion	48	16	80	
E. 22nd Ave @ Ogden	48	16	80	
E. 22nd Ave @ Race	48	16	80	
E. 22nd Ave @ Williams	48	16	80	
E. 23rd Ave @ Downing	36	22	80	
E. 23rd Ave @ Franklin	36	22	80	
E. 23rd Ave @ Gilpin	36	22	80	
E. 23rd Ave @ High	36	22	80	
E. 23rd Ave @ Humboldt	36	22	80	
E. 23rd Ave @ Lafayette	36	22	80	
E. 23rd Ave @ Marion	36	22	80	
E. 23rd Ave @ Ogden	36	22	80	
E. 23rd Ave @ Race	36	22	80	
E. 23rd Ave @ Williams	36	22	80	
E. 24th Ave @ Downing	36	22	80	
E. 24th Ave @ Franklin	36	22	80	
E. 24th Ave @ Gilpin	36	22	80	
E. 24th Ave @ High	36	22	80	
E. 24th Ave @ Humboldt	36	22	80	
E. 24th Ave @ Lafayette	36	22	80	
E. 24th Ave @ Marion	36	22	80	
E. 24th Ave @ Ogden	36	22	80	
E. 24th Ave @ Race	36	22	80	
E. 24th Ave @ Williams	36	22	80	
E. 25th Ave @ Downing	48	16	80	
E. 25th Ave @ Franklin	36	22	80	
E. 25th Ave @ Gilpin	36	22	80	
E. 25th Ave @ High	48	16	80	
E. 25th Ave @ Humboldt	48	16	80	
E. 25th Ave @ Lafayette	48	16	80	
E. 25th Ave @ Marion	48	16	80	
E. 25th Ave @ Ogden	48	16	80	
E. 25th Ave @ Race	48	16	80	
E. 25th Ave @ Williams	36	22	80	
E. 26th Ave @ Downing	36	22	80	
E. 26th Ave @ Franklin	48	16	80	

Street Intersection	Street Dimension	Sidewalk	Right of Way	Alley
E. 26th Ave @ Gilpin	36	22	80	
E. 26th Ave @ High	36	22	80	
E. 26th Ave @ Humboldt	36	22	80	
E. 26th Ave @ Lafayette	40	20	80	
E. 26th Ave @ Marion	36	22	80	
E. 26th Ave @ Ogden	36	22	80	
E. 26th Ave @ Race	36	22	80	
E. 26th Ave @ Williams	36	22	80	
North/South Streets				
Downing St. @ E. 24th Ave.	36	22	80	16
Downing St. @ E. 24th Ave.	36	22	80	16
Downing St. @ E. 24th Ave.	36	22	80	16
Downing St. @ E. 24th Ave.	36	22	80	16
Franklin St. @ E. 24th Ave.	36	22	80	16
Franklin St. @ E. 25th Ave.	36	22	80	16
Franklin St. @ E. 26th Ave.	36	22	80	16
Gilpin St. @ E. 23rd Ave.	36	22	80	16
Gilpin St. @ E. 24th Ave.	36	22	80	16
Gilpin St. @ E. 25th Ave.	36	22	80	16
Gilpin St. @ E. 26th Ave.	36	22	80	16
High St. @ E. 23rd Ave.	36	22	80	16
High St. @ E. 24th Ave.	36	22	80	16
High St. @ E. 25th Ave.	36	22	80	16
High St. @ E. 26th Ave.	36	22	80	16
Humboldt St. @ E. 23rd Ave.	40	20	80	16
Humboldt St. @ E. 24th Ave.	40	20	80	16
Humboldt St. @ E. 25th Ave.	40	20	80	16
Humboldt St. @ E. 26th Ave.	40	20	80	16
Lafayette St. @ E. 23rd Ave.	40	20	80	16
Lafayette St. @ E. 24th	40	20	80	16

Street Intersection	Street Dimension	Sidewalk	Right of Way	Alley
Ave.				
Lafayette St. @ E. 25th Ave.	40	20	80	16
Lafayette St. @ E. 26th Ave.	40	20	80	16
Marion St. @ E. 23rd Ave.	36	22	80	16
Marion St. @ E. 24th Ave.	36	22	80	16
Marion St. @ E. 25th Ave.	36	22	80	16
Marion St. @ E. 26th Ave.	36	22	80	16
Ogden St. @ E. 23rd Ave.	30	20	70	16
Ogden St. @ E. 24th Ave.	30	20	70	16
Ogden St. @ E. 25th Ave.	30	20	70	16
Ogden St. @ E. 26th Ave.	30	20	70	16
Race St. @ E. 23rd Ave.	30	25	80	16
Race St. @ E. 24th Ave.	30	25	80	16
Race St. @ E. 25th Ave.	30	25	80	16
Race St. @ E. 26th Ave.	30	25	80	16
Williams St. @ E. 23rd Ave.	36	22	80	16
Williams St. @ E. 24th Ave.	36	22	80	16
Williams St. @ E. 25th Ave.	36	22	80	16
Williams St. @ E. 26th Ave.	36	22	80	16

Table 11. Area 2 Street, Sidewalk and Right-of-Way Widths

Street Intersection	Street Dimension	Sidewalk	Right of Way
East/West Streets			
E. 32nd Ave (M.L. King) @ N. Franklin St.	36	22	80
E. 32nd Ave (M.L. King) @ N. Gilpin St.	36	22	80
E. 32nd Ave (M.L. King) @ N. Humboldt St.	36	22	80
E. 32nd Ave (M.L. King) @ N. Lafayette St.	36	22	80
E. 32nd Ave (M.L. King) @ N. Marion St.	36	22	80
E. 32nd Ave (M.L. King) @ N. Williams St.	36	22	80
E. 33rd Ave @ N. Franklin St.	36	22	80
E. 33rd Ave @ N. Gilpin St.	36	22	80

Street Intersection	Street Dimension	Sidewalk	Right of Way
E. 33rd Ave @ N. Humboldt St.	36	22	80
E. 33rd Ave @ N. Lafayette St.	36	22	80
E. 33rd Ave @ N. Marion St.	36	22	80
E. 33rd Ave @ N. Williams St.	36	22	80
E. 34 Ave (Bruce Randolph) @ N. Franklin St.	48	16	80
E. 34 Ave (Bruce Randolph) @ N. Gilpin St.	48	16	80
E. 34 Ave (Bruce Randolph) @ N. Humboldt St.	48	16	80
E. 34 Ave (Bruce Randolph) @ N. Lafayette St.	48	16	80
E. 34 Ave (Bruce Randolph) @ N. Marion St.	48	16	80
E. 34 Ave (Bruce Randolph) @ N. Williams St.	48	16	80
E. 35th Ave @ N. Franklin St.	48	16	80
E. 35th Ave @ N. Gilpin St.	48	16	80
E. 35th Ave @ N. Humboldt St.	36	22	80
E. 35th Ave @ N. Lafayette St.	36	22	80
E. 35th Ave @ N. Marion St.	36	22	80
E. 35th Ave @ N. Williams St.	36	22	80
E. 36th Ave @ N. Franklin St.	30	15	60
E. 36th Ave @ N. Gilpin St.	30	15	60
E. 36th Ave @ N. Humboldt St.	30	15	60
E. 36th Ave @ N. Lafayette St.	30	15	60
E. 36th Ave @ N. Marion St.	30	15	60
E. 36th Ave @ N. Williams St.	30	15	60
North/South Streets			
N. Franklin St. @ E. 32nd St. (M.L. King)	48	16	80
N. Franklin St. @ E. 33rd St.	48	16	80
N. Franklin St. @ E. 34th St. (Bruce Randolph)	48	16	80
N. Franklin St. @ E. 35th St.	48	16	80
N. Franklin St. @ E. 36th St.	48	16	80
N. Gilpin St. @ E. 32nd St. (M.L. King)	36	22	80
N. Gilpin St. @ E. 33rd St.	36	22	80

Street Intersection	Street Dimension	Sidewalk	Right of Way
N. Gilpin St. @ E. 34th St. (Bruce Randolph)	36	22	80
N. Gilpin St. @ E. 35th St.	36	22	80
N. Gilpin St. @ E. 36th St.	36	22	80
N. Humboldt St. @ E. 32nd St. (M.L. King)	36	22	80
N. Humboldt St. @ E. 33rd St.	36	22	80
N. Humboldt St. @E. 34th St. (Bruce Randolph)	36	22	80
N. Humboldt St. @ E. 35th St.	36	22	80
N. Humboldt St. @ E. 36th St.	36	22	80
N. Lafayette St. @ E. 32nd St. (M.L. King)	36	22	80
N. Lafayette St. @ E. 33rd St.	36	22	80
N. Lafayette St. @E. 34th St. (Bruce Randolph)	36	22	80
N. Lafayette St. @ E. 35th St.	36	22	80
N. Lafayette St. @ E. 36th St.	36	22	80
N. Marion St. @ E. 32nd St. (M.L. King)	36	22	80
N. Marion St. @ E. 33rd St.	36	22	80
N. Marion St. @ E. 34th St. (Bruce Randolph)	36	22	80
N. Marion St. @ E. 35th St.	36	22	80
N. Marion St. @ E. 36th St.	36	22	80
N. Williams St. @ E. 32nd St. (M.L. King)	48	16	80
N. Williams St. @ E. 33rd St.	48	16	80
N. Williams St.@ E. 34th St. (Bruce Randolph)	48	16	80
N. Williams St. @ E. 35th St.	48	16	80
N. Williams St.@ E. 36th St.	48	16	80

With few exceptions, the right-of-way widths in both Areas 1 and 2 are 80'. Ogden is 70' and East 36th Street is 60.' Within the right-of-way the street widths vary from 30' (two-lane) to 48' (four-lane). The width of the sidewalk/parking strip varies accordingly so that all the public space is contained within the right-of-way. The layout seems to have been done so that the streets were either laid out originally to be of varying widths or have been widened to accommodate increases in traffic.

As I mentioned above, the sample areas in Denver were laid out just before and just after 1900 to accommodate a rapidly expanding population. The land was flat and there were few natural constraints. The street pattern, therefore, could be considered an “ideal” form at that time.

The streets seem wide in comparison to cities in the ancient Mediterranean basin or to New York. In chapter Two I showed a diagram of the wheelbase of two typical Greek freight wagons passing each other in a 17’ (5.38 meter) street. In that illustration the outside-to-outside hub dimension is 204 centimeters, or 6.7 feet. The wheelbase is 158 centimeters or 5.2 feet. Typical dimensions for American freight wagons of the late 19^{th} Century are similar. According to Hill (2013), the standard wagon box was 4 feet wide by 9’–11’ feet long. The wheelbase was approximately 5.5 feet. Hill states that this type of wagon was “known to have been used as early as the First Century B.C.” The article offers a photograph of an excavated wagon from 100 B.C. in Germany that is very much like those used 2000 years later.

I mention this because the standard freight wagon was certainly a design parameter that was a consideration in city layout. Either streets needed to be 20’ wide to handle two-way vehicle traffic, or 10’ to accommodate one-way traffic. Much narrower than that and the movement of goods would need to rely on humans or pack animals. Given the widths of the streets in Denver, the designers not only wanted to encourage two-way wagon traffic but wanted to allow for growth in the amount of traffic that could be handled.

San Francisco

San Francisco is located on the western side of San Francisco Bay at the northern end of what is known as the Peninsula. The Spanish established the Presidio of San Francisco there in 1776 and followed with a mission shortly thereafter. After independence from Spain in 1821, the area became part of Mexico. Mexico ceded the area to the United States at the end of the Mexican American War in 1848.

In 1849 the first of the "forty-niners" arrived seeking gold in the Sierra Nevada foothills. By 1849 the city had a population of 25,000, and in 1850 California was granted statehood. The U.S. Army fortified the entrance to San Francisco Bay and built a military base at the Presidio, an indication of the importance of the area to national defense.

San Francisco Bay was the largest safe anchorage on the West Coast between Los Angeles and Portland. The Pacific Railroad, the western portion of the Transcontinental Railroad, was completed in 1869. This connected the west to the rail networks of the Midwest and East Coast. Incidentally, it dramatically decreased the time needed for settlers to reach California. The city grew rapidly through trade, banking and manufacturing and was the eighth largest city in the U.S. by 1890.

San Francisco is physically constrained by the Bay to the north and east and by the Pacific Ocean to the west. To the south the San Mateo County line (San Francisco is also a county) confined expansion in that direction. The result is that almost the entire city had been platted by 1899 and the population stood at 440,000 by the time of the 1906 earthquake (Hansen 2013).

I used the Sanborn Insurance maps from 1899 to look at the grid at that time and compared it to a modern street map (AAA 2016) to find two representative areas that have retained their original street layout. Both are in the northern part of the city, one in the Nob Hill District (Figure 47) and one in the Richmond District (Figure 48). Although they are approximately 2.2 miles apart, they are connected by California Street. The grid in Richmond is closer to true north while the grid in Nob Hill is angled several degrees to the west of north.

Figure 47. Nob Hill, San Francisco, 2015, Where Traveler Interactive Maps

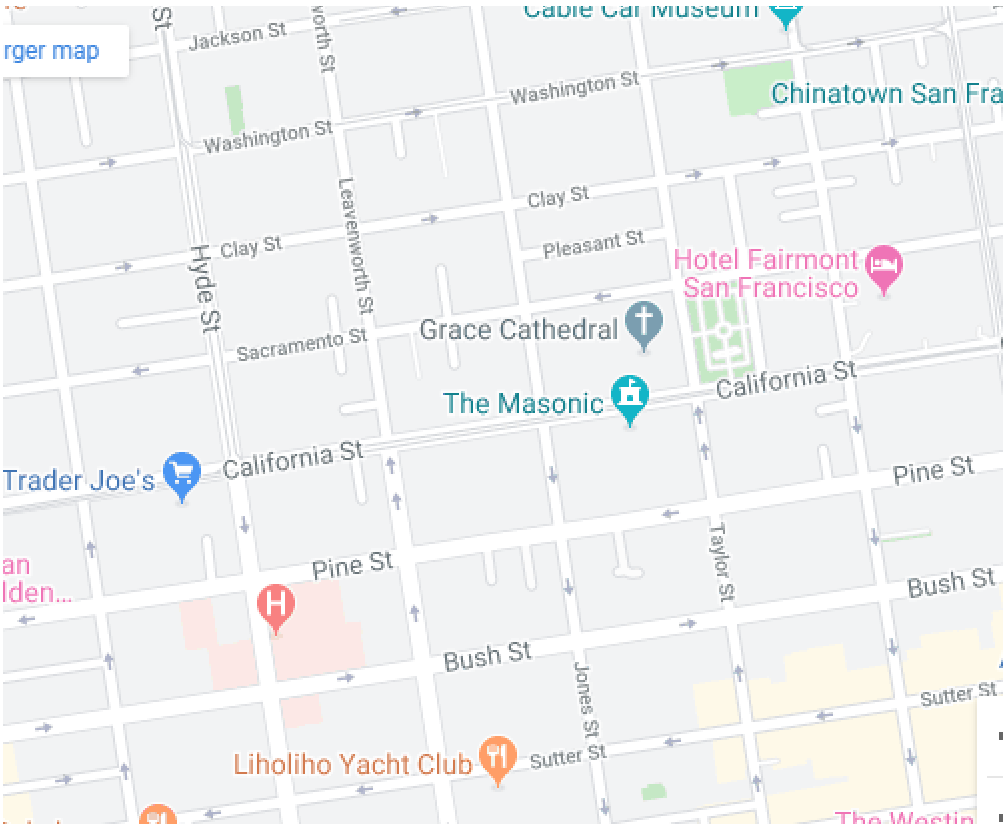


Figure 48. Richmond, San Francisco, 2015, Where Traveler Interactive Maps

Private Spaces

The following lists show block widths and block lengths for Nob Hill and Richmond. The source of the data is the San Francisco City/County Assessor's Office. That office is responsible for keeping accurate property records so that tax bills can be sent out. Within each block are parcel numbers that identify individual bounded properties. These are "private" spaces (even when owned by government) as distinguished from the "public" spaces of the streets and sidewalks.

Nob Hill

East-West Streets

Washington, Clay, Sacramento, California, Pine, Bush, and Sutter

Block Width, measured in N/S direction: 275'

Block Length, measured in E/W direction: 412.5'

North-South Streets

Larkin, Hyde, Leavenworth, Jones, Taylor and Mason

Block Width, measured in N/S direction: 275'

Block Length, measured in E/W direction: 412.5'

Richmond

East-West Streets

California/Cornwall, Clement, Geary, Anza, Balboa, and Cabrillo

Block Length, measured in N/S direction: 600'

Block Width, measured in E/W direction: 240'

North-South Streets

9th, 8th, 7th, 6th, 5th, 4th, 3rd, 2nd, and Arguello Blvd.

Block Length, measured in N/S direction: 600'

Block Width, measured in E/W direction: 240'

Both Nob Hill and Richmond are rectangular so the north-south and east-west roads intersect each other to form blocks. The blocks are perfectly uniform, even though the dimensions are substantially different in the two areas.

As I will show below, the public spaces (streets and sidewalks) vary in size and there is a clear hierarchy of importance. The private spaces, however, do not. When the city was platted, what was the intent of the surveyors? Barth (1975) says:

> Upon their unpromising hills the builders of San Francisco superimposed a gridiron of streets, facilitating the sale and resale of lots in advance of actual settlement, and thus assuring them the benefits of real estate speculation for the promotion of undeveloped districts. In the absence of resources and talents, they stressed practical and inexpensive

solutions, and the simple consideration that right angles were the easiest for a surveyor to measure strengthened their faith in the usefulness of the time-tested rectangular plan. The countless transfers of real estate and the division of lots, made easier by the geometry of the gridiron system, strengthened the economic heart of their young city (p 211–212).

I have displayed a "typical" block from Richmond to see if Barth's view is reasonable. As you can see, the "standard" parcel is 25' by 120'. In one case, two 25' foot lots were combined into one 50' by 120' lot. A look at the aerial view of this, and other blocks in Richmond show townhouses that are built out to the street but have back yards of varying depths. The four corner lots are nearly identical – the short sides are either 29' or 26.667' while the long sides are 75'. The regularity of the property division certainly supports Barth's view that it made real estate sales and speculation easy and predictable.

I include the same block at it appeared in 1897. Some of the lot pattern is recognizable and some has changed. I checked a representative sample of construction dates for the townhouses that now occupy the lots shown on the current Assessor's property map. A large portion were built between 1907 and 1915, shortly after the 1906 earthquake and fire. My assumption was that this "urban renewal" allowed the property lines to be rearranged to create the efficient pattern we see today. According to Siodla (2015), however, Richmond was not part of the razed area that was subject to extensive redevelopment. Nevertheless, the lot pattern we see today was created shortly after 1906, so the earthquake and fire may have been a convenient reason to replat the block.

Siodla's article demonstrates that the razed areas were rebuilt at a higher density than the unburned areas because the fire eliminated many of the barriers to redevelopment. He also states "Most of the damages from the fire were insured, and many insurance companies paid out settlements in excess of their obligations (Tobriner, 2006). Furthermore, San Francisco's capital markets were substantial and well-functioning at this time. Thus, capital was largely available in reconstruction" (p 50). The fire and earthquake stimulated a building boom that undoubtedly affected the entire city's real estate market to some extent.

In looking at the Sanborn map from 1897 (Figure 49) very few of the original parcels had been built upon. After the post-fire replating the block filled up quickly and today retains the layout it acquired shortly after 1906 (Figure 50). Figure 51 is a current aerial view of the same block. It shows the post-fire townhouses (1907-1915).

Figure 49. Richmond Parcel Map, San Francisco, 1899, Sanborn Maps

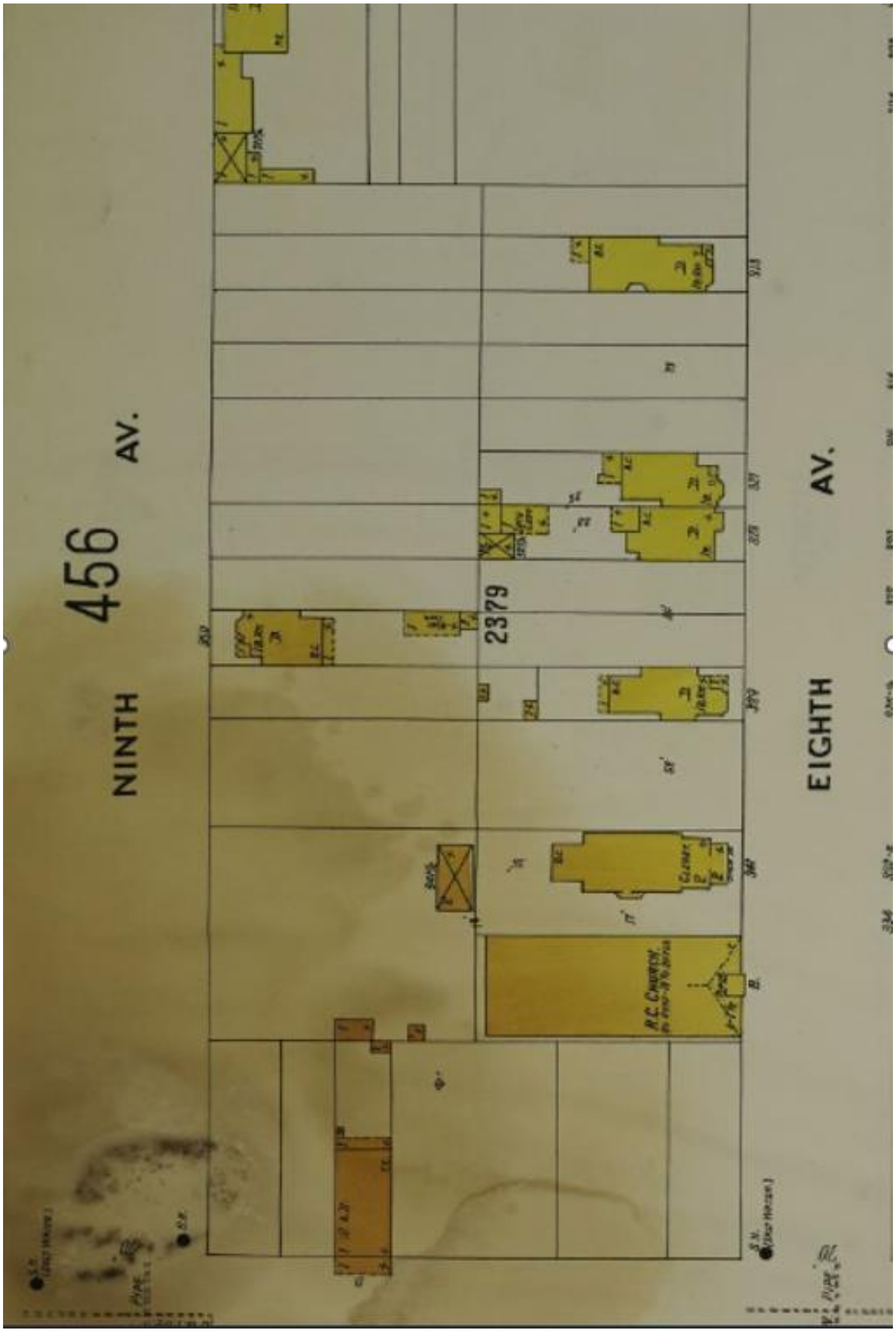


Figure 50. Richmond Parcel Map, San Francisco, 2020: City Assessor's Office

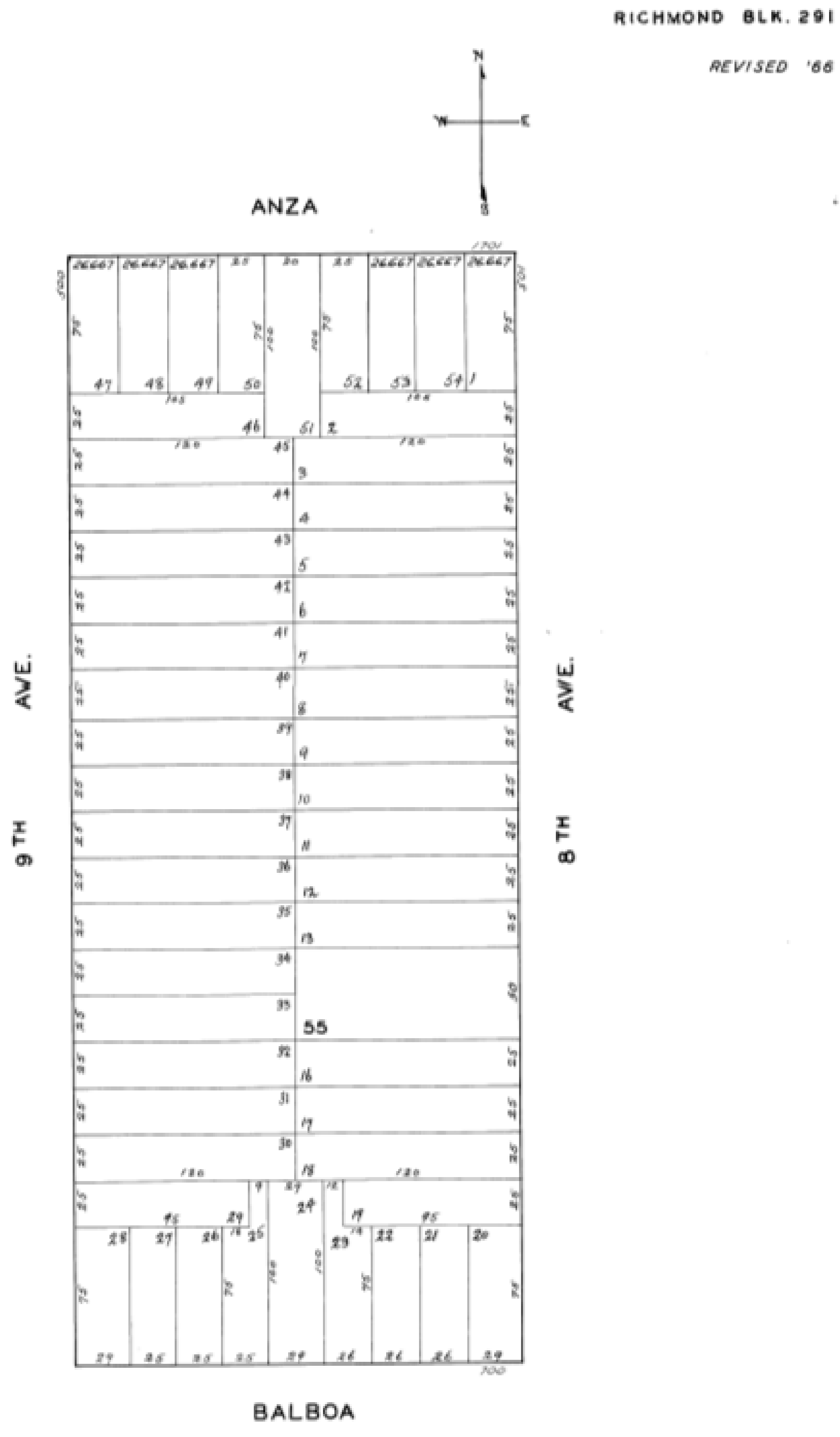
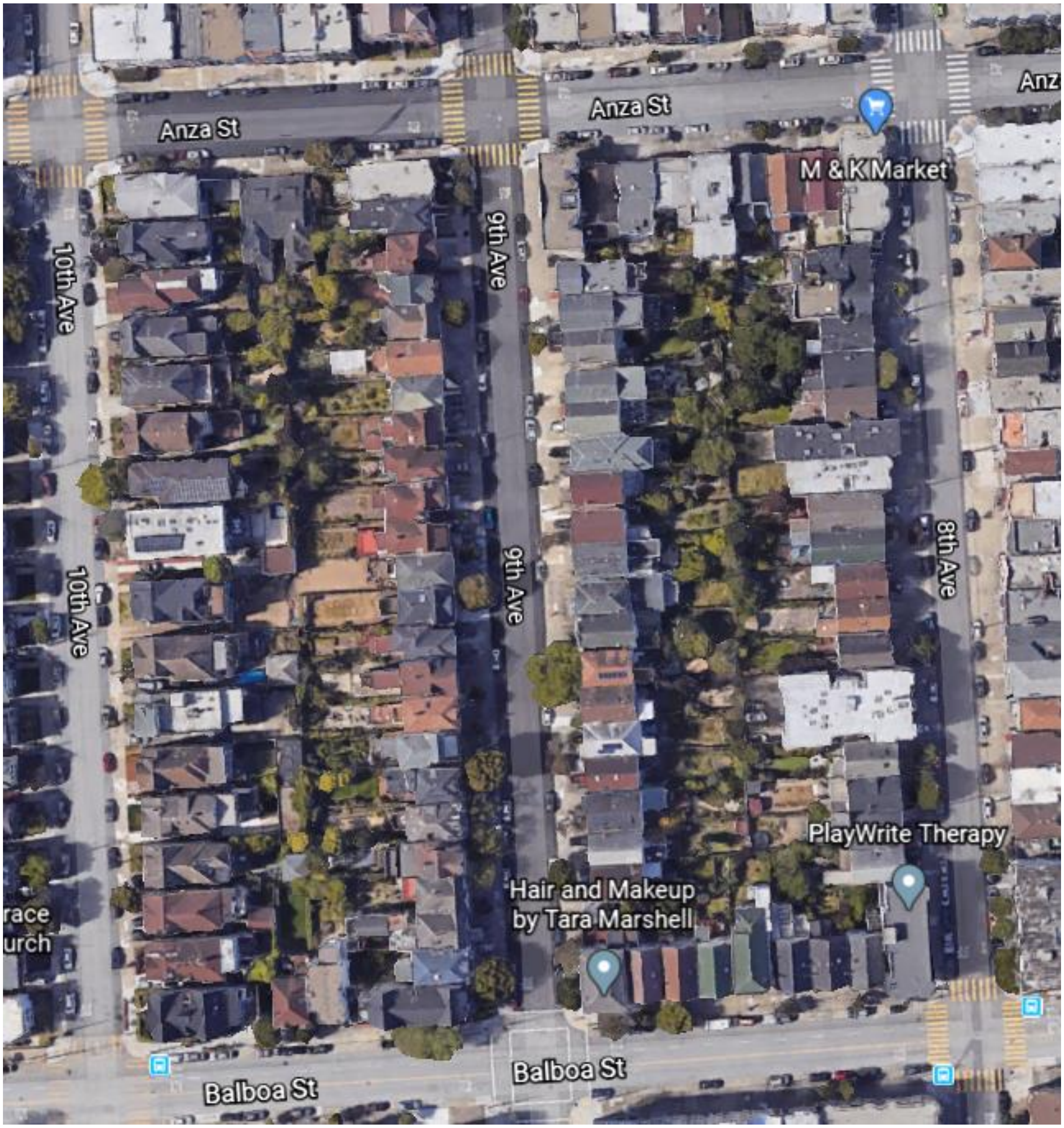


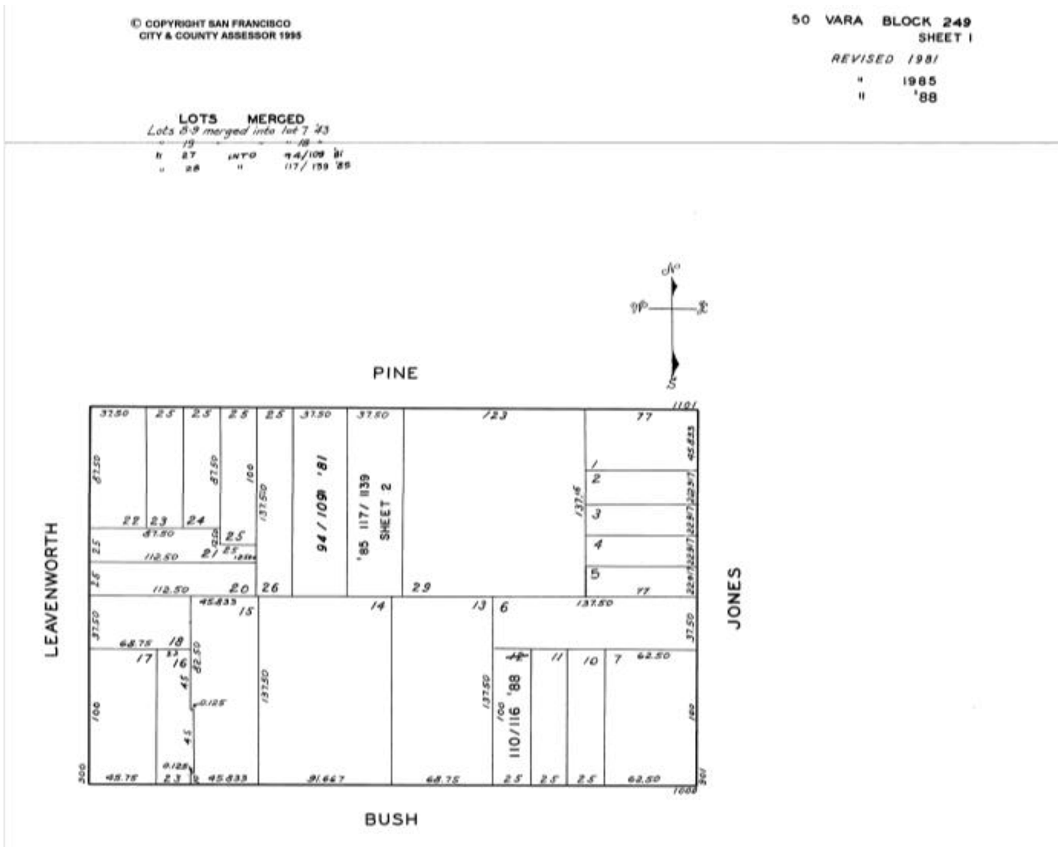
Figure 51. Richmond Aerial View, San Francisco, 2020, Google Earth



The next map is a "typical" block from Nob Hill. The property division is much less regular. I show the Assessor's Map for the current property lines (Figure 52) and the 1899 Sanborn map for the same block (Figure 53). I had to rotate the 1899 map to match the current property map. There are remnants of the original lots that had frontages of either 25' or 37.5'.

The block is much closer to square than the Richmond block and appears to have been difficult to divide into identical parcels. Note that the center dividing line in Richmond runs N/S while the dividing line in Nob Hill runs E/W. In Nob Hill, the parcels are split along the block width (E/W) line which is 412.5'. The surveyors clearly had a more difficult time creating identical parcels for sale. They created four that are 22.917' by 77', four that are 25' by 100', and three that are 25' by 87.5' or 137.5'. There are two parcels that are 37.5' by 137.5' that may have been original. The remaining property is divided into larger lots of varying size. This block is typical for Nob Hill but does not seem to be as efficient in dividing property as the blocks in Richmond.

Figure 52. Nob Hill Parcel Map, San Francisco, 2020, San Francisco Assessor's Office



It should be noted that Nob Hill was in the razed area after the earthquake and fire of 1906. This means that the area burned after the earthquake and was cleared of debris. This is the area that Siodla (2015) studied to see if redevelopment resulted in higher densities. As you can see in the 1899 Sanborn map (Figure 53), this block had been completely developed, unlike the block in Richmond. But these buildings were all destroyed in the fire, leaving a clear area for redevelopment. I checked the Assessor's office records for construction dates and found that most buildings were built between 1907 and 1920, confirming that redevelopment was rapid and that parcels bore little resemblance to the pre-1906 configuration.

Figure 53. Nob Hill Parcel Map, San Francisco, 1899, Sanborn Maps

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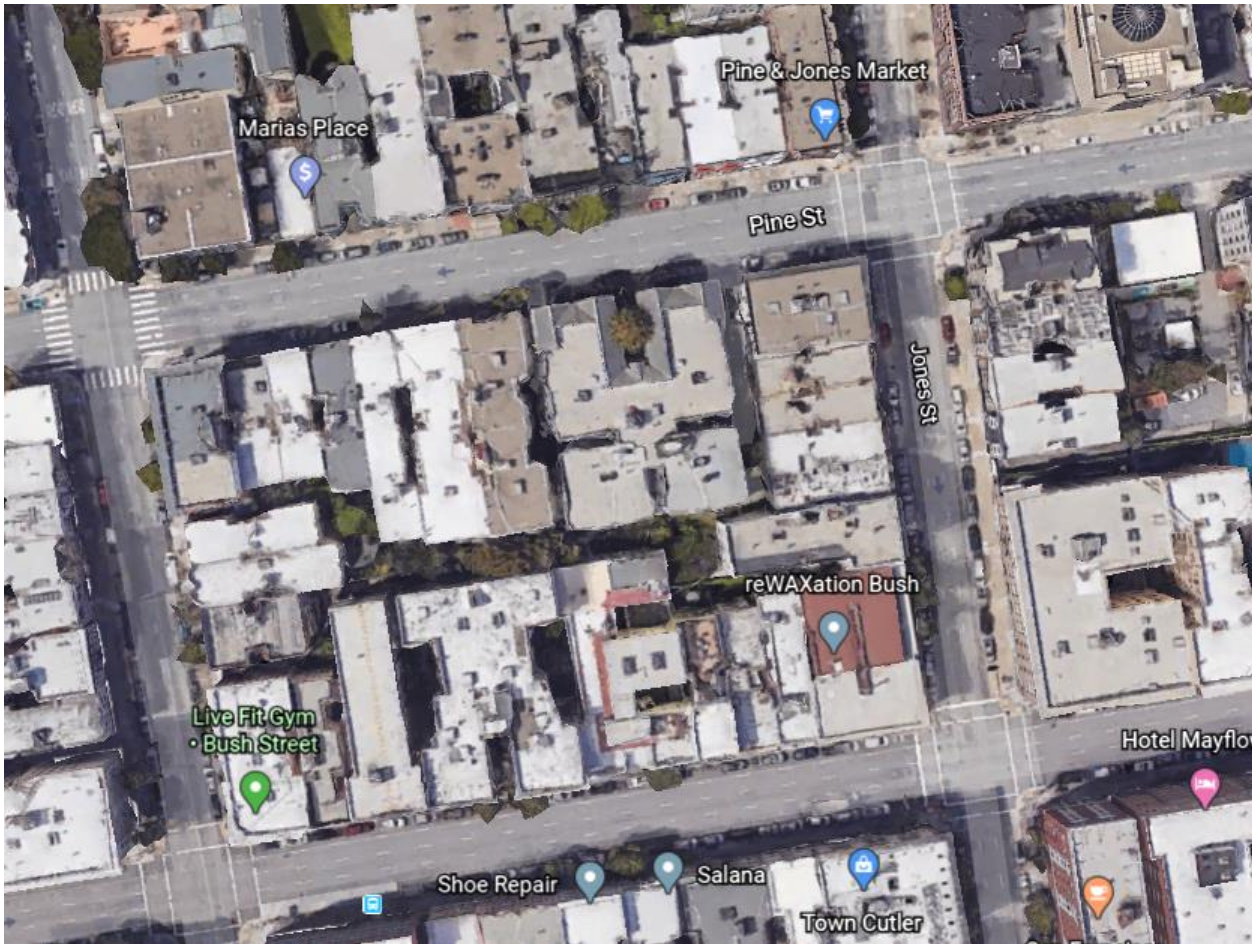
Figure 54. Nob Hill Aerial View, San Francisco, 2020, Google Earth



The next map is a current aerial view of the same block in Nob Hill (Figure 54). Note that there is very little interior area in the block, unlike the Richmond block that has back garden space behind the buildings. In other respects, the development is similar. The buildings are built to the front property line, which is the back edge of the sidewalk. Essentially, all space is either private or public, and the demarcation between the two is clear. Next, we look at how the public space is divided and used.

Public Spaces

In addition to the private spaces reviewed above, the plats for Areas 1 and 2 created public spaces, streets, and sidewalks. To capture these measurements, I used maps from the San Francisco Public Works department and measurable aerial images from the City's GIS system. These are displayed on the following tables.

Table 12. Nob Hill Street, Sidewalk and Right-of-Way Widths

East/West streets

East West Streets	North South Streets	Street Dimension	Right of Way	Sidewalk
1 Washington	1 Larkin	34.13	64.13	15
	2 Hyde	34.17	64.17	15
	3 Leavenworth	34.31	64.31	15
	4 Jones	34.27	64.27	15
	5 Taylor	37.66	67.66	15
	6 Mason	36.75	66.75	15
2 Clay	1 Larkin	38.90	58.90	10
	2 Hyde	39.06	59.06	10
	3 Leavenworth	38.85	58.85	10
	4 Jones	38.96	58.96	10
	5 Taylor	40.14	60.14	10
	6 Mason	39.78	59.78	10
3 Sacramento	1 Larkin	39.46	59.46	10
	2 Hyde	39.96	59.96	10
	3 Leavenworth	39.27	59.27	10
	4 Jones	38.68	58.68	10
	5 Taylor	38.68	58.68	10
	6 Mason	38.78	58.78	10
4 California	1 Larkin	72.67	96.67	12
	2 Hyde	72.71	96.71	12
	3 Leavenworth	72.67	96.67	12
	4 Jones	72.00	96.00	12
	5 Taylor	72.00	96.00	12
	6 Mason	72.00	96.00	12
5 Pine	1 Larkin	58.28	78.28	10

East West Streets	North South Streets	Street Dimension	Right of Way	Sidewalk
	2 Hyde	58.46	78.46	10
	3 Leavenworth	57.42	77.42	10
	4 Jones	58.75	78.75	10
	5 Taylor	56.75	80.75	12
	6 Mason	56.75	80.75	12
6 Bush	1 Larkin	58.58	78.58	10
	2 Hyde	58.71	78.71	10
	3 Leavenworth	59.75	79.75	10
	4 Jones	59.33	79.33	10
	5 Taylor	48.75	68.75	10
	6 Mason	48.92	68.92	10
7 Sutter	1 Larkin	56.83	80.83	12
	2 Hyde	55.12	79.12	12
	3 Leavenworth	56.56	80.56	12
	4 Jones	56.58	80.58	12
	5 Taylor	56.50	80.50	12
	6 Mason	56.81	80.81	12

North South Streets	East West Street	Street Dimension	Right of Way	Sidewalk
1 Larkin	1 Washington	53.67	83.67	15
	2 Clay	53.71	83.71	15
	3 Sacramento	53.75	83.75	15
	4 California	53.75	83.75	15
	5 Pine	38.54	68.54	15
	6 Bush	38.75	48.75	15
	7 Sutter	44.71	68.71	12
2 Hyde	1 Washington	56.33	80.33	12
	2 Clay	56.35	80.35	12
	3 Sacramento	56.75	80.35	12
	4 California	56.75	80.75	12
	5 Pine	56.63	80.63	12
	6 Bush	57.13	81.13	12
	7 Sutter	56.54	80.54	12
3 Leavenworth	1 Washington	53.92	83.92	15
	2 Clay	53.79	83.79	15
	3 Sacramento	53.67	83.67	15

East West Streets	North South Streets	Street Dimension	Right of Way	Sidewalk
	4 California	53.67	83.67	15
	5 Pine	56.54	80.50	12
	6 Bush	56.50	80.50	12
	7 Sutter	56.71	80.71	12
4 Jones	1 Washington	53.75	83.75	15
	2 Clay	53.71	83.71	15
	3 Sacramento	56.63	80.63	12
	4 California	53.63	83.63	15
	5 Pine	56.38	80.38	12
	6 Bush	56.79	80.79	12
	7 Sutter	56.04	80.04	12
5 Taylor	1 Washington	53.08	83.08	15
	2 Clay	51.46	81.46	15
	3 Sacramento	51.75	81.75	15
	4 California	54.00	84.00	15
	5 Pine	53.75	83.75	15
	6 Bush	54.25	84.25	15
	7 Sutter	53.54	83.54	15
6 Mason	1 Washington	53.71	83.71	15
	2 Clay	53.50	83.50	15
	3 Sacramento	58.75	78.75	10
	4 California	53.48	83.48	15
	5 Pine	53.69	83.69	15
	6 Bush	53.63	83.63	15
	7 Sutter	53.50	83.50	15

View these dimensions as if you are driving down the street from west to east or from north to south. Each intersection is a data point that tells you how wide the street is and how wide the sidewalks are. The sidewalk number is doubled and added to the street width to get the total width of the right-of-way (public) space. One thing to note is that the numbers are consistent. There are streets with approximately 50-foot rights-of-way that run east/west. There are streets with rights-of-way that are close to 70 feet that run north/south. California, which runs east/west is an outlier with a right-of way that is close to 80 feet. It traverses most of northern San Francisco and was clearly intended to be a major (axial) road.

Table 13. Richmond Street, Sidewalk and Right-of-Way Widths

East West Streets

East West Streets	North South Streets	Street Dimensions	Sidewalk	Right of Way
1 California/ Cornwall	9th	50.17	15	80.17
	8th	50	15	80
	7th	50	15	80
	6th	50	15	80
	5th	50	15	80
	4th	50	15	80
	3rd	49.67	15	79.67
	2nd	49.79	15	79.79
	Arguello	49.92	15	79.92
2 Clement	9th	49.92	15	79.92
	8th	50	15	80
	7th	50.13	15	80.13
	6th	50.17	15	80.17
	5th	50.08	15	80.08
	4th	50.13	15	80.13
	3rd	50.08	15	80.08
	2nd	50.08	15	80.08
	Arguello	50.08	15	80.08
3 Geary	9th	94.92	15	124.92
	8th	95	15	125
	7th	95	15	125
	6th	95	15	125
	5th	94.94	15	124.94
	4th	95	15	125
	3rd	95	15	125
	2nd	95.04	15	125.04
	Arguello	95	15	125
4 Anza	9th	50	15	80
	8th	50.04	15	80.04
	7th	50	15	80
	6th	50	15	80
	5th	50	15	80

East West Streets	North South Streets	Street Dimensions	Sidewalk	Right of Way
	4th	49.96	15	79.95
	3rd	39.95	15	79.95
	2nd	40	15	80
	Arguello	39.75	15	79.75
5 Balboa	9th	49.83	15	79.83
	8th	49.83	15	79.83
	7th	49.96	15	79.96
	6th	50	15	80
	5th	50	15	80
	4th	50	15	80
	3rd	50	15	80
	2nd	50	15	80
	Arguello	59.15	10	79.15
6 Cabrillo	9th	50.17	15	80.17
	8th	49.67	15	79.67
	7th	49.67	15	79.67
	6th	49.67	15	79.67
	5th	49.67	15	79.67
	4th	50	15	80
	3rd	50	15	80
	2nd	50	15	80
	Arguello	50	15	80

North South Streets	East West Streets	Street Dimensions	Sidewalk	Right of Way
9th	California/ Cornwall	40	15	70
	Clement	40	15	70
	Geary	40.21	15	70
	Anza	40.21	15	70.21
	Balboa	40	15	70
	Cabrillo	40	15	70
8th	California/ Cornwall	40.06	15	70.06
	Clement	40	15	70
	Geary	40.06	15	70
	Anza	40.06	15	70.6
	Balboa	40	15	70
	Cabrillo	40	15	70
7th	California/ Cornwall	40.27	15	70.27

North South Streets	East West Streets	Street Dimensions	Sidewalk	Right of Way
	Clement	40	15	70
	Geary	39.95	15	69.95
	Anza	39.96	15	69.96
	Balboa	40	15	70
	Cabrillo	40	15	70
6th	California/ Cornwall	39.75	15	69.75
	Clement	39.79	15	69.79
	Geary	40	15	69.79
	Anza	40	15	70
	Balboa	40	15	70
	Cabrillo	40	15	70
5th	California/ Cornwall	39.62	15	69.62
	Clement	39.79	15	69.79
	Geary	40.02	15	70.02
	Anza	40.02	15	70.02
	Balboa	40	15	70
	Cabrillo	40	15	70
4th	California/ Cornwall	40.08	15	70.08
	Clement	39.46	15	69.46
	Geary	39.63	15	69.46
	Anza	39.63	15	69.63
	Balboa	40	15	70
	Cabrillo	40	15	70
3rd	California/ Cornwall	39.88	15	69.88
	Clement	39.81	15	69.81
	Geary	39.77	15	69.77
	Anza	40	15	70
	Balboa	40	15	70
	Cabrillo	40	15	70
2nd	California/ Cornwall	39.75	15	69.75
	Clement	39.79	15	69.79
	Geary	39.92	15	69.92
	Anza	40	15	70
	Balboa	40	15	70
	Cabrillo	40	15	70
Arguello	California/ Cornwall	56	22	100
	Clement	56	22	100
	Geary	56	22	100
	Anza	56	22	100
	Balboa	56	22	100

North South Streets	East West Streets	Street Dimensions	Sidewalk	Right of Way
	Cabrillo	56	22	100

As with the Nob Hill streets, these numbers should be read as if you are traveling from west to east on the east west streets, and from north to south on the north south streets. Each intersection is a data point that indicates how wide the street and sidewalks are, and what the rights-of-way are. Most of the east west streets have approximately 80' rights-of-way and 50' street widths. The outlier in Richmond is Geary with a 125' right-of-way and a 95' street. Geary was intended, and is still used, as an axial thoroughfare.

The north south streets generally have 40' streets and 70' rights-of-way. The outlier is Arguello that has a 56' street and a 100' right-of-way. Throughout both Nob Hill and Richmond, the sidewalks are 15' in width. On Balboa at Arguello the sidewalk is 10', but the aerial photo revealed an intersection improvement that was made after Nob Hill was platted. That improvement shaved off a portion of the sidewalk and "gave" it to the street. The sidewalk dimensions seem generous by today's standards, but I was able to look at numerous photos from the 1906 earthquake and determine that the sidewalks then were the same as they are today (Hansen and Hansen 2013).

An interesting fact about the San Francisco grid is that it was imposed on a landscape of steep hills and is reminiscent of Priene in Turkey. Today there are areas in the Marina district, North Beach and Fisherman's Wharf that are flat, but these were developed by filling in portions of the bay. The native environment was hilly (Data SF 5' contour interval map 2022). The city also publishes a map of areas that exceed 20% slopes that appears to encompass a third of the total land.

Because the grid was laid out rapidly there was almost no attempt to grade the land before development, and the people of San Francisco had to compensate for the steepness by building a cable car system that is still in use today. In several cases tunnels were bored through the steeper hills, maintaining the grid while making travel easier.

Conclusions

We have looked at three major cities from the 19th Century to see if there are underlying organizational principles that guided the layout of the streets, sidewalks, and lots. It helps to keep in mind the concept, introduced earlier, that cities are the largest and most complex artifacts created by man. What "map in the mind" was at work that resulted in these artifacts, and how can it be described.

Private Spaces

The measurements given above for private spaces are block length/width and lot length/width. For the most part the block measurements in all three cities have not changed since they were laid out, so the intent of the surveyors is clear. The lot sizes and configurations have changed over time as property has been bought and sold and the land developed and redeveloped. Therefore, I relied on the Sanborn maps since these recorded the lot sizes closer to when they were first laid out. I converted the measurements into ratios thinking that these might reveal the principles that were used.

<u>Blocks (long sides divided by short sides)</u>

New York (Chelsea) – 1:4

New York (Upper East Side) – 1:2

Denver Area 1 – 1:3

Denver Area 2 – 1:3

San Francisco (Richmond) – 1:2.5

San Francisco (Nob Hill) – 1:1.5

Denver is a little deceiving because the block widths consist of two halves divided by a 16' alley. If we ignore the alley the ratio is 1:1.4. In any event, we have block ratios that are regular in each city and range from a high in Chelsea of 1:4 to a low of 1:1.5 in Nob Hill. The preferred ratio appears to be between 1:2 and 1:3.

<u>Lots (long sides divided by short sides)</u>

New York Area 1 (Chelsea) – 1:4

New York Area 2 (Upper East Side) – 1:4 or 1:6.7

Denver Area 1 – 1:5

Denver Area 2 – 1:5

San Francisco (Richmond) – 1:4.8

San Francisco (Nob Hill) – varies from 1:4 to 1:5.3

In all three cities the favored lot width, with some exceptions, was either 15' or 25'. The ratio of width to depth was 1:4 to 1:5. With a narrow range, preferred block size and an even narrower range of preferred lot sizes, it is interesting to look at how efficient property division was in the three cities.

For each city above I looked at a typical block to see how well it worked in creating typical lots. The block in Chelsea in Manhattan was very efficient. All four frontages were used, and the configuration produced a maximum number of 25' by 97.5' lots. The lots on the short frontages were shallower but still fit well into the overall pattern.

The block in the Upper East Side in Manhattan is also efficient. The lots facing 92nd Street are a regular 25' wide by 101.7' in depth, while the lots facing 91st Street are 15' or 17.5' wide. The block ratio in this area is 1:2, versus 1:4 in Chelsea, meaning that a larger percentage of the lots face the shorter sides of the block.

The streets in Manhattan were surveyed years prior to being constructed and lots laid out within the blocks. It is interesting to wonder whether John Randel had an image of the lot configuration in mind when he did the street surveying.

The two areas in Denver exhibit identical dimensions in block size and lot size. The blocks are 375' by 125.5' and come in pairs separated by a 16' alley. In New York and San Francisco, lots back up to each other and there is no separation. In Denver, all the lots face North/South streets. The cross-street frontages were not used for lot fronts. The streets and lots were laid out simultaneously, so it appears that the regularity of development was intentional and conformed to a "map in the mind" that was normative in Denver in the late 19th century.

Richmond and Nob Hill in San Francisco are a study in contrasts. Richmond has a 1:2.5 block ratio while Nob Hill is 1:1.5. The lot width ratio in Richmond is 1:4.8 and all the lots are consistently 25' by 120'. In Nob Hill, the lot widths vary between 22' and 25' and the lengths vary from 87.5' to 132.5' and the ratios vary from 1:4 to 1:5.3. A look at the typical lots for each area is striking. Richmond is efficient at creating similar-size parcels while Nob Hill is not.

CHAPTER IV: NEW URBANIST COMMUNITIES OF THE LATE 20TH AND EARLY 21ST CENTURIES

As I stated in the Introduction, the Charter of the New Urbanism was published in 1994 and was a synthesis of ideas that were being promoted by several design professionals, including Andres Duany, Elizabeth Plater-Zyberk, Peter Calthorpe, Stefanos Polyzoides and Daniel Solomon, who believed that development practices in the mid-to-late 20th century were producing car-centric, pedestrian unfriendly results. They advocated a return to development practices of the late 19th and early 20th centuries when design was focused on the pedestrian rather than the automobile.

The New Urbanists had a difficult task – design neighborhoods that feel like the 19th and early 20th centuries while recognizing that post-World War II development is almost completely organized around the automobile.

Below I will review three New Urbanist communities and compare their development patterns to the development patterns analyzed for New York, Denver, and San Francisco, and to the patterns for cities in the ancient Mediterranean Basin. With cities built in the past I have inferred intent from the artifact of the development patterns themselves. With the New Urbanist communities, it is possible to look at their master plans and design standards and read what their intentions were.

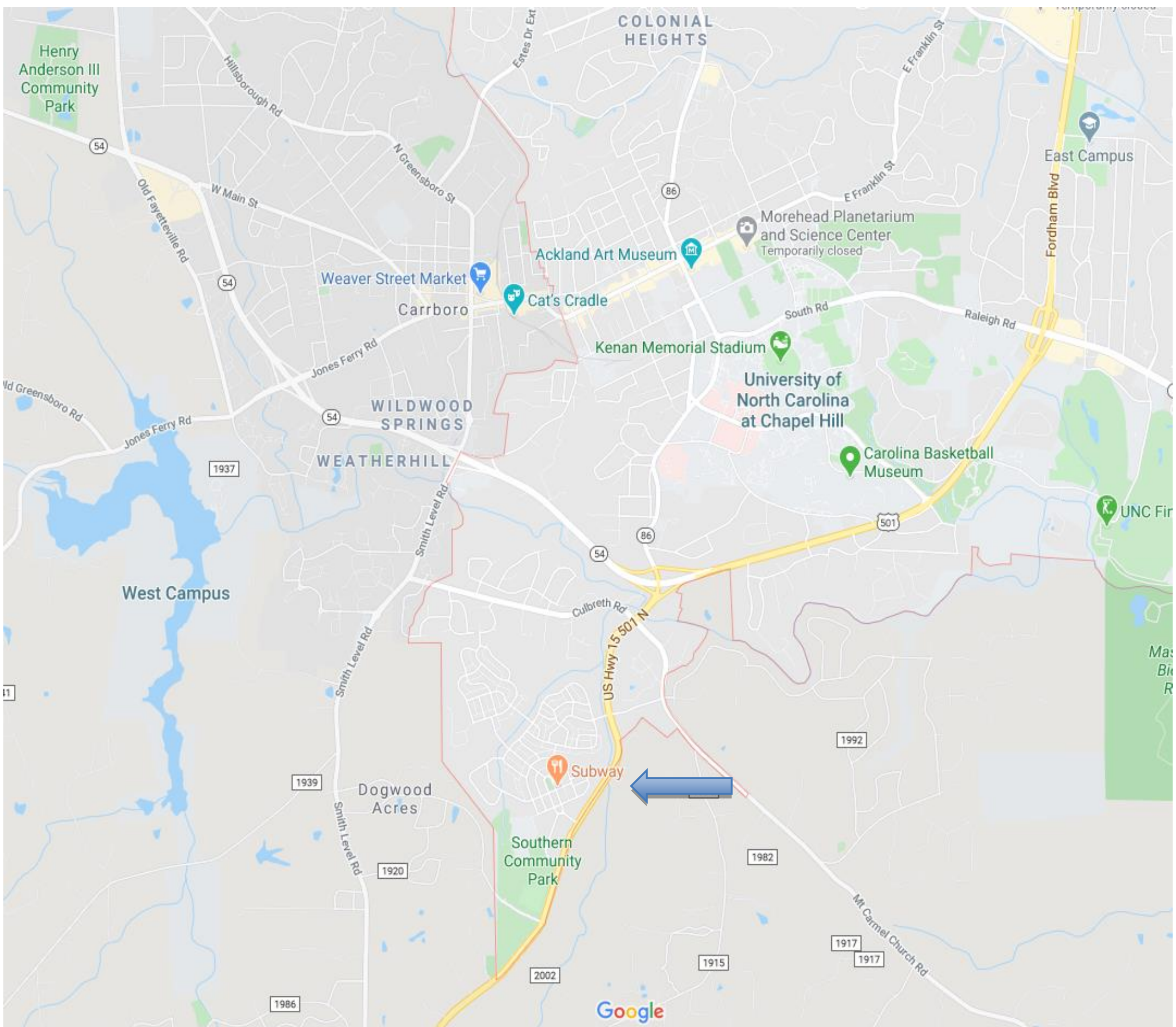
Southern Village, Chapel Hill, NC

Southern Village is located south of the 54/501 Bypass that runs from Carrboro along the southern edge of the original Town of Chapel Hill before turning north and east towards Research Triangle Park (Figure 55). According to an article published by the Chapel Hill

Historical Preservation Society (2006), “In 1989, local leaders began to plan the town’s southern quadrant, at that time largely undeveloped. This planning process strove to avoid suburban sprawl, preserve environmentally sensitive areas and promote public transportation.”

The article then explains that D.R. Bryan, a developer, was interested in planning a community that followed new urbanist principles advocated by Andres Duany and Elizabeth Plater-Zyberk whose firm, DPZ in Miami, had designed several early new urbanist communities.

Figure 55. Location of Southern Village in Chapel Hill, NC, Google Maps



> D.R and Jim [Earnhardt] studied many North Carolina neighborhoods that pre-dated World War II – Cameron Park and Hayes Barton in Raleigh, Dilworth in Charlotte. One useful model, partly because of its topography, was West End, Winston-Salem's first streetcar neighborhood. . . . We ended up patterning Southern Village after these early 20th century neighborhoods that were characterized by wide sidewalks, rear alleys, and a corner grocery that people could walk to. We were determined to build a community that was for people rather than for cars. (2006 p. 2)

The article contains a timeline for the development of Southern Village. A Master Plan was submitted to the Town in 1992, road construction began in 1994, the first home was occupied in 1995, several non-residential structures, such as a church, day care, elementary school, park and ride lot, theater and Market Street town center were all completed between 1996 and 1999. The last new home was sold in 2003.

According to Southern Village Vitals 2001 provided by the Chapel Hill Planning Department, the development is 312 acres in total, with 80,000 sq. ft. of commercial space, 120,000 sq. ft. of office space, 525 single family homes, 150 townhouses, 225 condominiums, and 250 apartments. Below is a map of Southern Village (2005) from the Chapel Hill Chamber of Commerce showing the completed project (Figure 56).

Figure 56. Southern Village Master Plan, 2005, Chapel Hill Chamber of Commerce

It is evident that Southern Village was not developed in a grid pattern, even though the builders said they drew inspiration from early 20th century neighborhoods in several North Carolina cities that were generally laid out in grids. D.R. Bryan did, however, include sidewalks along all streets and served most of the single-family homes and townhouses with alleys. The

Village Core district is a modern interpretation of a traditional town square shopping district commonly found in midwestern and western towns.

Shown below is the Healdsburg, California town square that was laid out in the 19th Century that is still the heart of downtown and is an excellent example of the form (Figure 57).

Figure 57. Healdsburg, CA Town Square, Healdsburg Chamber of Commerce

Below I will report on the design standards that Bryan included in his submittal to the Town in support of the Master Plan. The Master Plan is a document that was recorded in the Orange County Register of Deeds office on November 16, 1993, Deed Book 481, pages 481-489. It formalizes the relationship between the developer and the Town with regards to the development of Southern Village. I will first present what the developer said he intended to do and then compare that to three blocks in the development as constructed. Two blocks contain single-family homes, and one block contains town homes.

Design Standards

A. Blocks (p. 22) "Blocks of a generally rectangular shape should be the main organizing feature around the Village Core District. A generally rectangular shape shall also be used in Village Green Districts within each Neighborhood District. The blocks may become somewhat curvilinear if topography dictates as the distance increases from these areas.
B. Lots – Buildings – Setbacks (p. 22-23)
    a. The blocks in all districts shall be subdivided into lots, designed to create, and encourage a variety of lot sizes, within each district. Lot sizes shall remain flexible within certain guidelines for each district so that the village concept can evolve.
    b. All lots shall share a frontage line with a street or a defined "green."
    c. All buildings shall have the main entrance opening to a street or "green", with the exception of accessory buildings or outbuildings.
    d. Height of buildings is measured at the front of buildings, exclusive or basements and foundations.
    e. Enfront is defined as: To face or be opposite across streets."

The design standards go on to limit lot widths, building heights, lot building coverage and building setbacks.

C. Roads – Streets – Alleys (p. 29)
    a. The TND [traditional neighborhood district] shall have a public street hierarchy of "Through Streets, "Neighborhood Streets" and "Alleys" designed to slow traffic as it passes through the TND. Slowing traffic shall be accomplished by lowering speed limits from 35 mph to 10-20 mph, permitting on-street parking, adding crosswalks, and narrowing the roadway by widening sidewalks or adding planting areas.
    b. Through Streets shall be designed to accommodate Mass Transit, with major access points in the Village Core and potentially in Village Green areas within each Neighborhood District. Neighborhood Streets should not be designed to accommodate Mass Transit.

c. New streets shall extend the pattern of existing streets and shall be a *general grid-like pattern to best disperse traffic and maximize connections between streets and neighborhoods."* (Emphasis added)

The design standards specify street lighting, intersections, driveway locations and other details related to street layout. On page 31 there is an "Application Chart" that lists travel lane widths, parking lane widths, total pavement widths, right-of-way widths and sidewalk widths for the different street types in the hierarchy of roads (local, neighborhood, through, alley, and apartment) (Table 14). My three sample blocks in the development are bounded by neighborhood streets and contain alleys. I compare the field-measured dimensions to the published design standards shown below.

Table 14. Road Standards, Southern Village, Chapel Hill, NC

2. APPLICATION CHART

KEY	ROAD TYPE	TRAFFIC LANES	PARKING LANES	TOTAL WIDTH (F TO F)	ROW WIDTH	RADII	SIDEWALKS	LOCATION OF USAGE
A	LOCAL	2 @ 9.5'	1 @ 7'	26'	45'	20'	1 @ 5'min	NEIGHBORHOOD DISTRICT
B1	NEIGHBORHOOD	2 @ 10'	2 @ 7'	34'	50'	20'	1 @ 5'min	NEIGHBORHOOD DISTRICT VILLAGE GREEN
B2	NEIGHBORHOOD	2 @ 13'	1 @ 8'	36'	50'	20'	1 @ 5' CONSIST.	NEIGHBORHOOD DISTRICT VILLAGE GREEN
C	THROUGH	2 @ 10'	2 @ 7'	34'	60'	30'	1 @ 5'min.	NEIGHBORHOOD DISTRICT VILLAGE GREEN
D1	THROUGH	2 @ 10'	2 @ 8'	36'	60'-65'	30'	1 @ 12' min. AT STOREFRONT 1 @ 5' min. OTHERS	VILLAGE CORE LINK TO NEIGHBORHOOD DISTRICT
D2	THROUGH	3 @ 12'	0	40'	60'-65'	30'	1 @ 12' min. AT STOREFRONT 1 @ 5' min. OTHERS	VILLAGE CORE LINK TO NEIGHBORHOOD DISTRICT
D3	THROUGH	3 @ 12'	1 @ 7.5'	45'	60'-72'	30'	1 @ 12' min. AT STOREFRONT 1 @ 5' min. OTHERS	VILLAGE CORE LINK TO NEIGHBORHOOD DISTRICT
E	ALLEY NEIGHBORHOOD DISTRICT VILLAGE CORE	----	----	12'	16' EASE-MENT	BASED ON ROUTE PLAN	----	NEIGHBORHOOD DISTRICT VILLAGE CORE
F	ALLEY VILLAGE CORE	-------	----	22'@C/G 20' W/ DITCH	24'@C/G 30' W/ DITCH	BASED ON ROUTE PLAN	----	VILLAGE CORE
G	APARTMENT	2 @ 10'	1 @ 8'	30'	50'	20'	----	VILLAGE CORE APARTMENT DISTRICT PUBLIC GREEN

Area 1 is an irregular block bounded by Hillspring Lane and Highgrove Drive. The map below (Figure 58) was obtained from the Orange County GIS system which shows the tax parcels, public rights-of-way, easements, and other factors that affect property. For property dimensions I used the Orange County plat book records, Plat Book 84, pages 7 and 8 and Plat Book 85, page 101. For street and sidewalk widths, alley widths, right-of-way widths and building setbacks I collected field data on July 15, 2020.

Figure 58. Area 1, Southern Village, Chapel Hill, NC

Results

Street widths:	26.5’ (measured curb face to curb face)
Sidewalk widths:	5.0’
Right-of-way widths:	52.0’ (measured from the house side of the sidewalk on one side of the street to the house side of the sidewalk on the other side of the street)
Alley:	12’ (note that according to the Application Chart the alley width is 12’ while the easement is 16’)

Setbacks:	Variable from 11' to 30'. This appeared to be a function of topography and the presence of the alley behind the homes.
Lot sizes:	The typical lot on Hillspring Lane is 55' by 117.5', a length to width ratio of 1:2.14. In the curves there are a few lots that are larger or longer. The longest lot on Hillspring Lane has a ratio of 1:3.04. Lots on Highgrove Drive range in width from 45' to 65'. The lot lengths range from 133' to 139'. The variation in lot lengths seem to be driven by the road curves. The variation in lot widths may reflect the Design Standard shown above that "encourages a variety of lot sizes" (p. 22).
Block Length:	914' (I measured the length directly down the center of the block from one street R/W to the opposite R/W.)
Block Width:	241', measured through the center of the block.
Ratio:	1:3.8

Let us look at the aerial photography for area 1 (Figure 59). These are single-family homes, and the front setbacks are typical for suburban development in Orange County. As mentioned above, the front setbacks on the south side of Highgrove Drive are larger than those on the north side. It appeared to me that the developers had a choice to make on the south side. The topography is steep, and the house could either be close to the road or close to the alley. The latter option was taken since the alley is higher in elevation. This gives residents an opportunity to park in the garage off the alley and access the house at grade. It saves them from parking on the street and climbing stairs to the front door.

A close look at the alley reveals trash and recycling bins, so it appears that the Town uses the alley for trash pickup. There is little evidence of the "back garden" spaces seen behind the townhouses in San Francisco. The alley is, for the most part, devoted to the movement and storage of vehicles.

Figure 59. Area 1 Aerial View, Southern Village, 2020, Orange County GIS

Area 2 (Figure 60) is a rectangular grid of lots, streets and alleys intended to support townhouses. The street, sidewalk and right-of-way measurements are identical to those of Area 1.

Street widths:	26.5’ (measured curb face to curb face)
Sidewalk widths:	5.0’
Right-of-way widths:	52.0’ (measured from the house side of the sidewalk on one side of the street to the house side of the sidewalk on the other side of the street)
Alley:	The rights-of-way for the alleys are 24’. Note that these are publicly dedicated rights-of-way rather than being easements. The pavement widths are 18’, sufficient to accommodate two-way traffic.

Figure 60. Area 2, Southern Village, Chapel Hill, NC, Orange County Register of Deeds

Setbacks: Setbacks are consistently 7’ from the edge of the sidewalk

Lot sizes: The lots in area 2 were recorded in Orange County Plat Book 82, page 69. The lots fronting Glade Street, Nolen Lane and Westside Drive are between 22’ and 32’wide, with the majority being either 22’, 26’ or 28’ by 105.3’ long, yielding a width to length ratio of 1 to 4. The lots fronting Highgrove Drive are generally 22' wide by 102' long, a ratio of 1 to 4.6.

Block length:	480'
Block width:	240'
Ratio:	1:2

Figure 61. Area 2 Aerial View, Southern Village, 2020, Orange County GIS

The alleys within the blocks are clearly visible (Figure 61). The Orange County GIS Department has given the alleys names, but in fact no names were shown on the subdivision plat, and there are no street signs. Every unit has a garage, and most are attached to the homes. I suspect that most residents park in the garages since there is room on the street for only one car per home.

Area 3 (Figure 62) is a small block bounded by Meeting Street and Parkside Circle. The street, sidewalk and right-of-way measurements are identical to those of the previous two areas.

Street widths:	26.5' (measured curb face to curb face)
Sidewalk widths:	5.0'
Right-of-way widths:	52.0' (measured from the house side of the sidewalk on one side of the street to the house side of the sidewalk on the other side of the street)
Alley:	the alleys are 12' wide, contained within a 16' easement
Setbacks:	Setbacks are consistently 7.5' from the edge of the sidewalk
Lot sizes:	The lots in area 3 were recorded in Orange County Plat Book 71, pages 177, 178, and 179. The lots fronting Parkside Circle are either 36' or 45' wide by 100' long, yielding a width to length ratio of 1 to 2.6 to 2.8. The lots on Meeting Street are 66' wide by 100' long, yielding a width to length ratio of 1 to 1.5.
Block length:	480'
Block width:	240'
Ratio:	1:2

Figure 62. Area 3, Southern Village, Chapel Hill, NC, Orange County Register of Deeds

Let us look at the aerial photography for Area 3 (Figure 63). The asphalt alleys are hard to pick out, but the concrete driveways from the alleys to the garages are visible. When the photo was taken there were no cars parked on the street, but there were three cars parked in driveways.

Figure 63. Area 3 Aerial View, Southern Village, 2020, Orange County GIS

According to the Master Plan referenced above and the Chapel Hill Historical Preservation Society (2006) the intent in Southern Village was to re-create development patterns from the late 19th and early 20th centuries. The intent was also to create a variety of lot sizes and neighborhoods that would, along with the Village Green (Master Plan 1993) form a Village "as an alternative to typical subdivision development, promoting mixed use development with a village atmosphere (p 7)."

How do the sample patterns shown above compare to our 19th century city examples? I believe that the areas 1 and 3, which are single-family, are analogous to the two samples in Denver, which are also single-family.

In both Denver sample areas, the street rights-of-way are 80' and contain either a 36' or 48' street, plus a 16' or 22' sidewalk/parking strip area. The house setbacks ranged from 18' to

25’ as measured from Google Earth aerial photography. We can conclude that the layout in Denver was more expansive than in Southern Village, meaning that more space was dedicated to public spaces.

The block ratios are 1:4, compared to 1:2 and 1:3.8 in Southern Village. The lot ratios in Denver are 1:5, as compared to 1:2.14 to 1:3.04 (Area 1) and 1:5 (Area 3) in Southern Village. The alleys in Denver are 16’, the same as Southern Village. I conclude, therefore, that the private spaces are close in size and proportions in the two communities that are separated by 1,700 miles in distance and 90 years in time.

Area 2 in Southern Village, which was developed into townhouses, is analogous to the samples in New York and San Francisco. In New York, the street widths in Area 1 (Chelsea) are commonly 34’ with 13’ sidewalks contained within a 60’ right-of-way. There are several larger streets that are 60’ wide with 20’ sidewalks contained within a 100’ right-of-way. These are larger than in Southern Village where the streets serving the townhouses are 26.5’ wide with 5’ sidewalks within a 52’ right-of-way.

In Area 2 (Upper East Side) the streets are commonly 30’–34’ wide with 13’–15’ sidewalks within a 60’ right-of-way.

In San Francisco Area 1 (Nob Hill) the East/West streets are typically 51’–57’ wide within a right-of-way of 80’–84’ and have 12’–15’ sidewalks. The North/South streets are 52’–57’ wide within a right-of-way 80’–84’ and have 12’–15’ sidewalks.

In Area 2 (Richmond) the East/West streets are 50’ wide within a 79’–80’ right-of-way with 15’ sidewalks. The North/South streets range from 51’– 57’ in width within an 80’–84’ right-of-way and have 12’–15’ sidewalks.

It is not surprising that the streets serving townhouses in New York and San Francisco are wider than in Southern Village. After all, the people who laid out the two cities were expecting large numbers of people and large volumes of traffic. Southern Village is geographically constrained and is built out. The population and traffic levels probably have not varied significantly from 2003 when the last house was sold to today (2022).

As I discussed above, the block and lot patterns in New York, San Francisco and in Southern Village are similar.

<u>Block Ratios</u>

New York	San Francisco	Southern Village
1:2 – 1:4	1:2.5 – 1:5	1:2

<u>Lot Ratios</u>

New York	San Francisco	Southern Village
1:4	1:4 – 1:5	1:4 – 1:4.6

Before leaving Southern Village, I would like to look at a measurement that reflects the New Urbanist philosophy espoused by D.R. Bryan (2006). “We were determined to build a community that was for people rather than for cars.” (p. 2) This measurement is the ratio of street width to sidewalk width. It is a direct reflection of the importance placed on vehicles versus pedestrians at the time the areas were developed.

In Chelsea (New York) most of the north/south streets have a street to sidewalk ratio of 1.3:1. The east/west streets, 6th Avenue and 7th Avenue are much wider, but also have wider sidewalks. The ratio for 6th is 1.9:1 and for 7th the ratio is 1.5:1.

In the Upper East Side (New York) the east/west streets are either 1:1 or 1.3:1. The north/south streets are wider, with 3rd Avenue having a ratio of 2.33:1 and Lexington Avenue having a ratio of 2.17:1.

In Richmond (San Francisco) the east/west streets are variable. The ratios on Washington range from 1.14:1 to 1.26:1. Clay and Sacramento average 1.95:1. The ratio for California, an arterial, is 3:1. Pine and Bush average 2.95:1. The north/south streets are also variable. The ratios on Larkin run from 1.29:1 to 1.86:1. The ratio for Hyde is 2.37:1, while Leavenworth, Jones, Taylor, and Mason are 1.79:1.

In Nob Hill (San Francisco) the east/west streets are all 1.67:1 except for Geary, an arterial, where the ratio is 3.17:1. The north/south streets are consistently 1.33:1.

Let us compare that to the townhouse area in Southern Village. There, the streets are 26.5' wide with two 5' sidewalks, a ratio of 2.65:1. The comparison is not entirely fair – in New York and San Francisco all the public space is either street or sidewalk. In Southern Village there is a 6' parking strip between the sidewalk and street on both sides of the street. The parking strip is not available to cars, but it is landscaped so it is not walkable space. The intent of the parking strip, however, is to buffer the sidewalk from the street, so the space is beneficial to pedestrians. If we "give" that space to the sidewalk we have a ratio of 1.2:1. This ratio is comparable to the local (non-arterial) streets in New York and San Francisco where the ratio is 1.3:1.

The two single-family areas in Southern Village are comparable to the two study areas in Denver. There, the streets range in width from 30' to 48', with the most common being 36'. As in Southern Village, the sidewalks are 5' in width, but the parking strips are very wide, ranging from 11' to 20', with the majority being 17'. If, as above, we "give" the parking strip to the nonautomotive space we derive ratios from 1.5:1 for several arterials to .06:1 to .08:1 for local streets. The most common ratio is 0.8:1. I think the parking strips in Denver are an anomaly and there is no record of why they are so wide.

Central Park, Denver, CO

Our second New Urbanist community was originally called Stapleton because it is located on land formerly occupied by Stapleton International Airport in Denver. The airport occupied 4,700 acres of which 2,935 acres were sold to Forest City Enterprises for development (Hudson 2005). The remainder of the property is public open space along two streams that had been piped under the airport but were restored to a natural condition during redevelopment.

The story of how the airport was demolished is interesting. The non-profit development corporation contracted with a firm in nearby Arvada to remove a minimum of 175 acres of pavement/year (Proctor 2002). The contractor set up a crusher at the end of one of the runways and crushed the concrete to generate aggregate for paving projects. They also generated larger pieces of concrete, popularly called Staplestone, for use in retaining walls. The work was done at no cost to the development corporation because the recycling contractor was able to sell the aggregate for a profit. The buildings were also demolished, but the largest control tower was retained as a landmark.

In 1940, Stapleton Airport was named for mayor Benjamin Stapleton who started its development in 1929. It was known at the time that the mayor was a member of the Ku Klux Klan, and he appointed Klan members to positions in the city. After the airport closed in 1995 and redevelopment started, there was discussion of changing the name. By 2020 Stapleton had an estimated 32,000 residents who presumably had a vested interest in keeping the Stapleton name. Then, on May 25, 2020, George Floyd, a Black man, was killed in Minneapolis, MN by police who held him face down while one officer knelt on Floyd's neck. The incident was filmed and caused controversy and protests throughout the U.S.

Almost immediately, the idea of renaming Stapleton was revived, leading to a vote of the residents who agreed to the change. Shortly thereafter alternative names were proposed, and the residents were polled to determine which one they preferred. The result was the name "Central Park", suggested because the largest park in the development is called Central Park, and because Central Park Bld. is a north/south arterial that runs through the middle of the area. The City Council voted to officially change the name in May 2021 (Denver Post 5/17/2021).

Southern Village in North Carolina is relatively small at 312 acres (0.5 square miles) and is hilly. Central Park is the largest redevelopment project in the U.S. (Urban Land Institute Case #CO34004, 2004) at 4,700 acres (over 7.3 square miles) and the land is flat. Both, however, were products of the New Urbanist movement. D. R. Bryan patterned Southern Village on principles espoused by Andres Duany, while Central Park was conceptually laid out by Peter Calthorpe, a New Urbanist pioneer (Marshall, 2015). Below is the Master Plan for Central Park (Brookfield Properties, 2019).

The Master Plan (Figure 64) shows land use for the 4,700 acres. For marketing and development purposes the area was divided into 12 neighborhoods, each with its own "personality" (Brookfield Properties, 2020). At this point there are some building sites still available, but the development is nearing build-out and has approximately 32,000 residents (Brookfield Properties, 2020).

I have selected three neighborhoods for analysis as far as street and lot layout are concerned. These are Beeler Park at the north end of Central Park (Figure 65), Central Park West (Figure 66), just south of I-70 and the RTD light rail line between downtown Denver and Denver

International Airport, and South End (Figure 67) in the southern portion of the development. These appear to be representative of Central Park as a whole.

Figure 64. Master Land Use Plan for Central Park, Denver, CO, Brookfield Properties, 2019

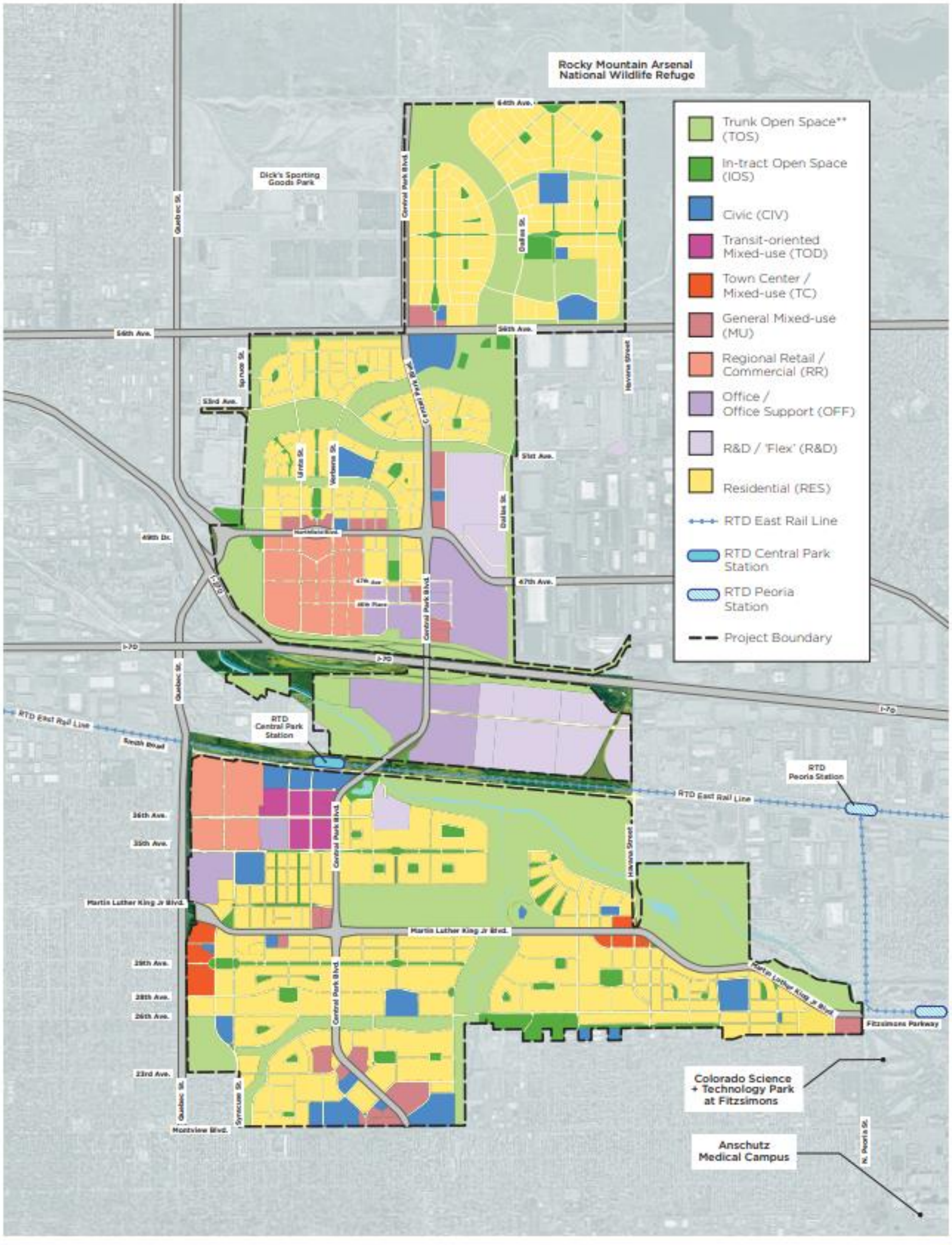
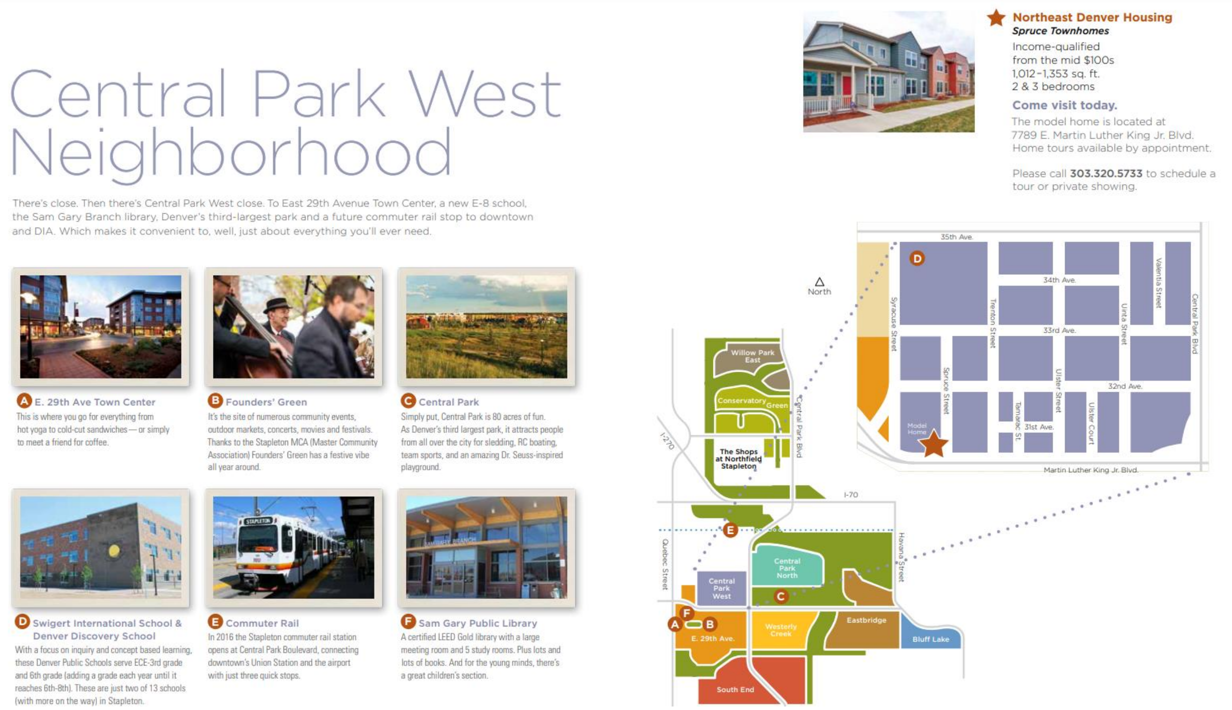


Figure 65. Beeler Park Neighborhood Brochure, Brookfield Properties, 2020

Figure 66. South End Neighborhood Brochure, Brookfield Properties, 2020

Figure 67. Central Park West Neighborhood Brochure, Brookfield Properties, 2020



While the scales of the maps are small, the rectangular north/south orientation of the streets is evident. As I discussed earlier in this paper, Denver was laid out in the 19th century as an orthogonal grid. Marshall (2015) states "According to Stapleton's Green Book (the citizen-driven master plan prepared before redevelopment started), as well as New Urbanist literature on the subject, one of the primary goals of the Stapleton development was to connect to the existing gridded Denver Street network (pg. 153)."

In his article, Marshall sought to highlight the compromises made between the developer and the city regarding the road network and road standards. He states that the City Engineering department's use of the Functional Classification system for roads clashed with the New Urbanist principles of "maximizing connectivity, spacing major streets properly, and keeping all streets safe and walkable (pg. 152)."

In my review of Marshall's article and material supplied by Brookfield Properties, the development succeeds within each neighborhood in providing safe streets for pedestrians and bicycles and easy connections to neighborhood amenities, churches, schools, and services. Where Central Park is bisected by major thoroughfares connecting to the Denver grid, there is a built-in conflict between traffic flow and the comfort of the residents. The thoroughfares are wide and have design speeds (the perceived safe speed by drivers using the road) that are much higher than the posted speeds.

I have not collected pavement widths nor block lengths for any of the collector level streets in Central Park and will confine my analysis to the neighborhood level.

Beeler Park

The map below (Figure 68) shows the street and lot pattern for Beeler Park, the northernmost neighborhood in Central Park. The source is the Denver City Engineer's record of subdivision plats, construction year 2016. I have looked at the area bounded by 58th Drive on the north, 58th Ave. on the south, Central Park Drive on the west and Chester Way on the east. This appears to be a representative portion of the neighborhood.

Details of this area are shown on the next two maps, also from the Denver City Engineer's records, Stapleton Filing 49, sheets 9 (Figure 69) and 10 (Figure 70). The Denver aerial maps are not current, and even Google Earth maps show a neighborhood under construction. Communication with the developer, Brookfield Properties, indicates that they are still selling lots and homes in Beeler Park, but that the street system is complete.

Figure 68. Beeler Park Street and Lot Layout, Denver City Engineer's Office, 2016

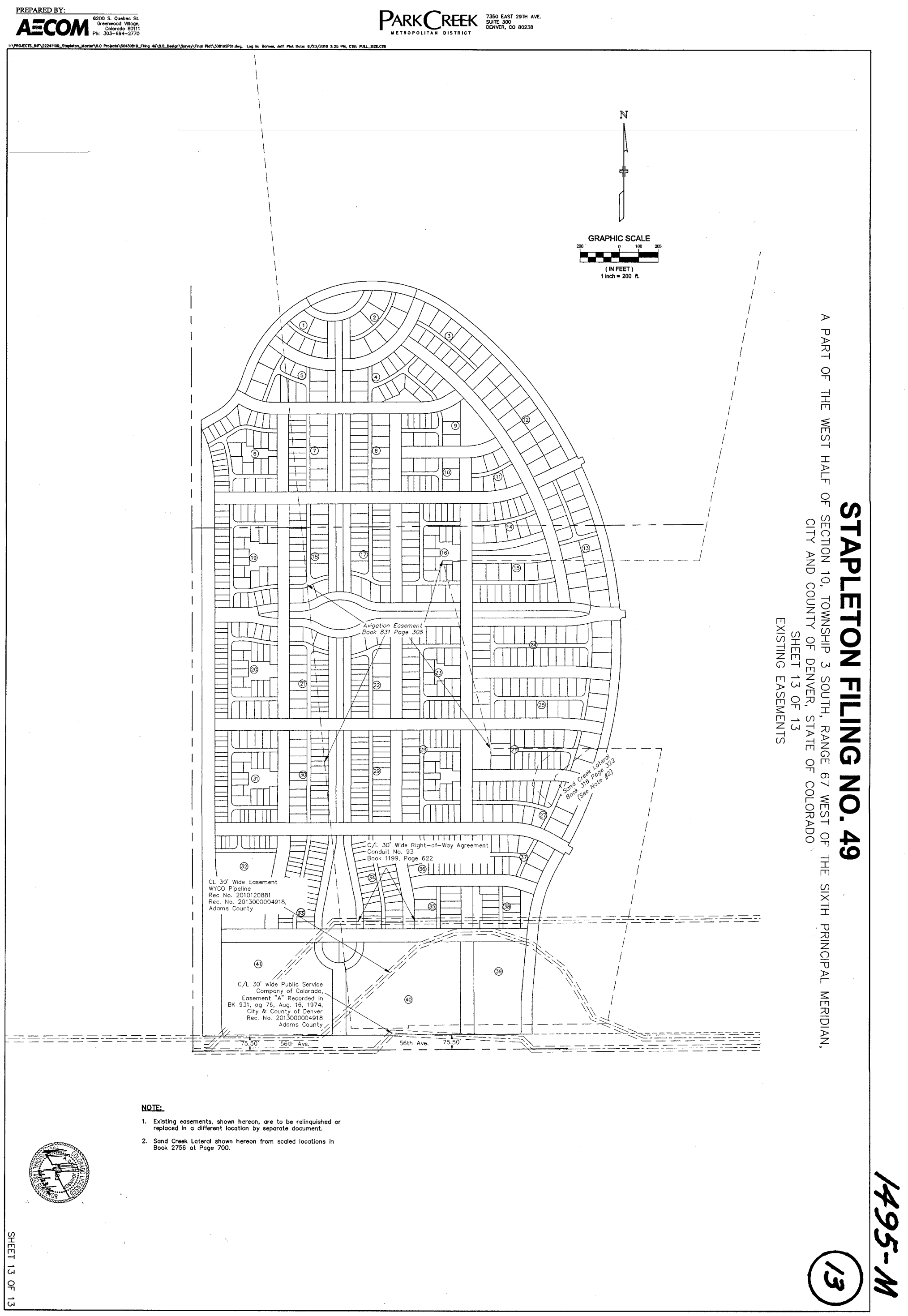


Figure 69. Stapleton Filing 49 Sheet 9, Denver City Engineer's Office, 2016

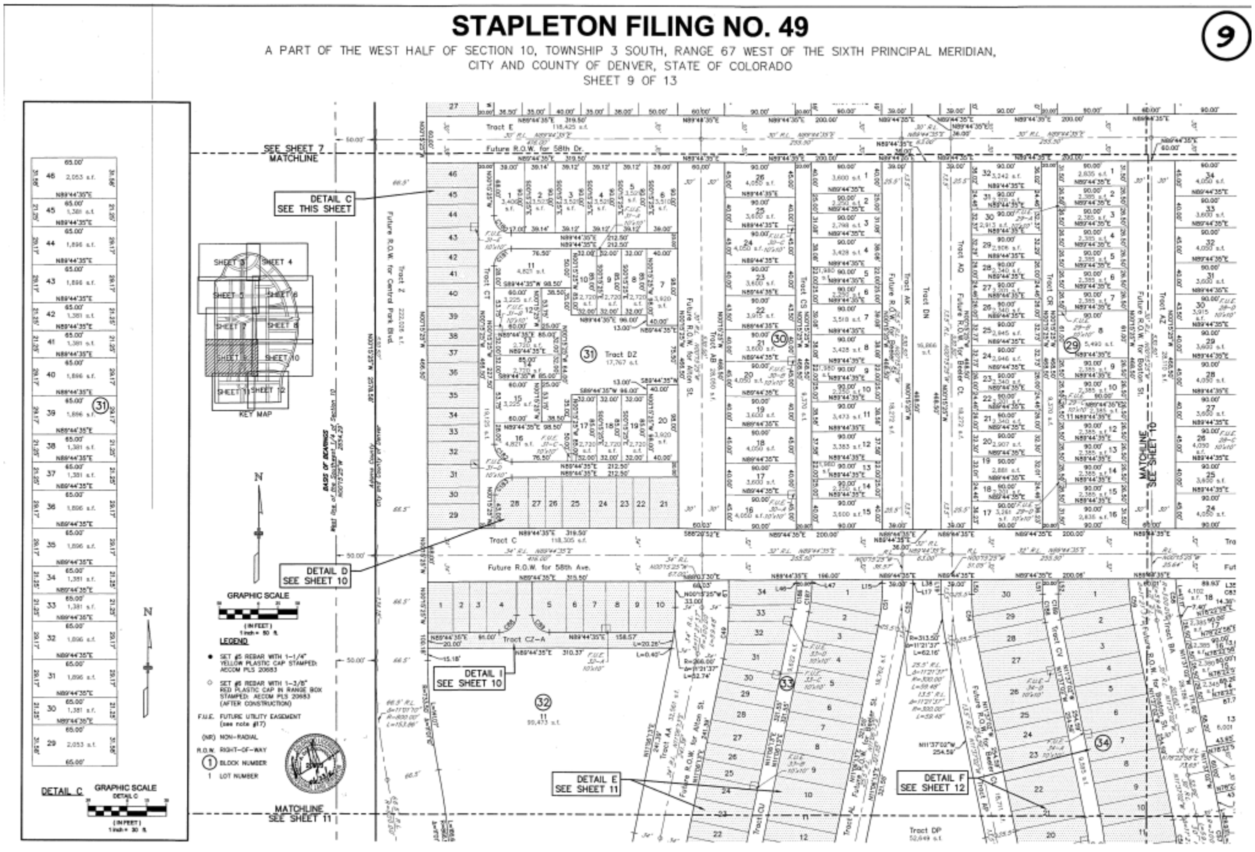


Figure 70. Stapleton Filing 49 Sheet 10, Denver City Engineer's Office, 2016

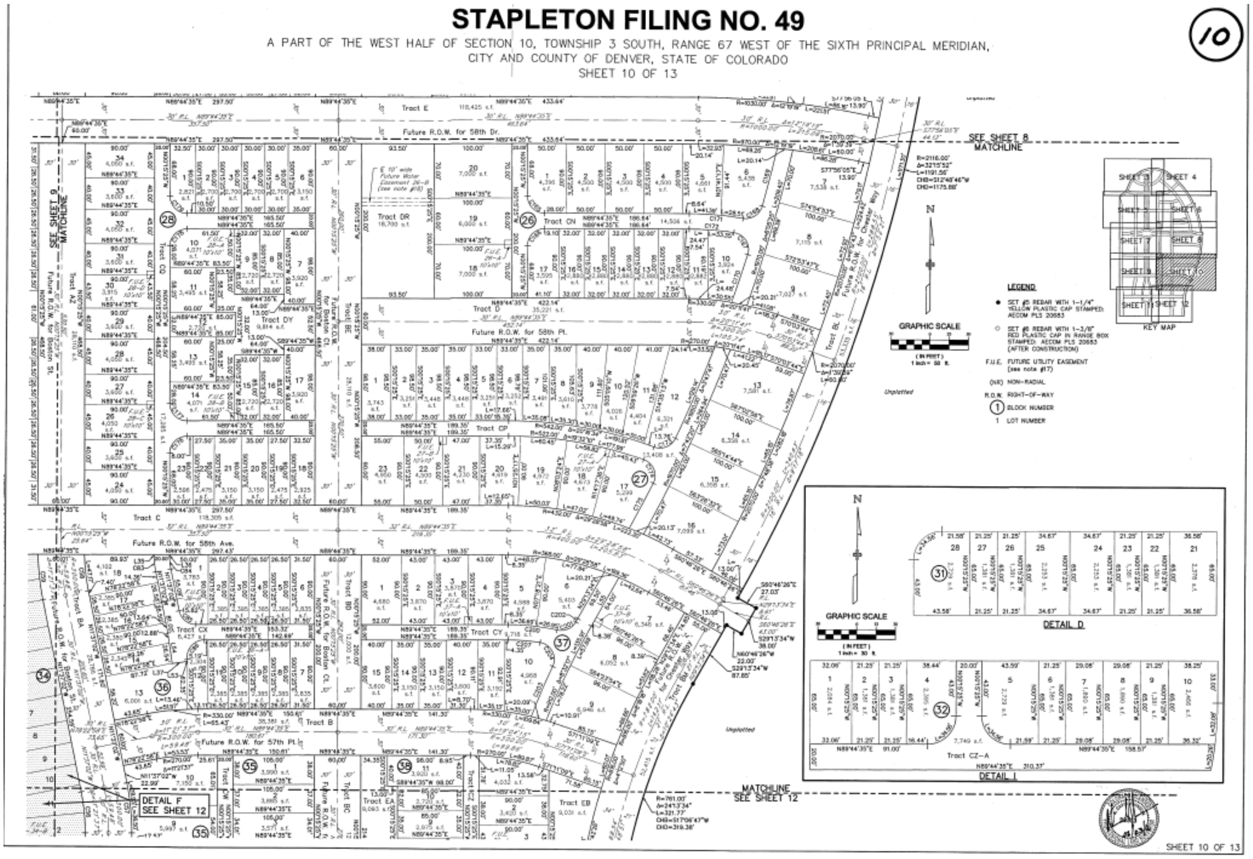


Table 15. Block and Lot Measurements in Beeler Park

North/South Streets:

<u>Central Park Blvd. </u> (I have not included street measurements for this street because it is a major thoroughfare)

Alley:	12' wide within a 20' right-of-way
Setbacks:	Setbacks are 10' from the edge of the sidewalk
Lot Sizes:	Lot width range – 21.25' – 31.58' (n=18)
	31.58' – 2, 29.17' – 8, 21.25' – 8
	Lot length – 65' The width-to-length ratios range from 1:2 to 1:3
Block length:	466.5'

Block width:	319.5’
Ratio:	1:1.46

Alton Street

Street width:	30’
Sidewalk width:	5’, plus 10’ parking strip
Right-of-way:	60’
Alley:	12’ wide within a 20’ right-of-way
Setbacks:	10’
Lot sizes:	Lot width range – 40’- 45’ (n=11)
	45’ – 5, 40’ – 5, 43.5’ – 1
	Lot length – 90’ The width-to-length ratios range from 1:2 to 1:2.25
Block length:	466.5’
Block width:	200’
Ratio:	1: 2.33

Beeler Street

Street width:	25.5’ + 25.5’ (median divided)
Sidewalk width:	5’, plus 10’ parking strip
Right-of-way:	39’ + 39’ + 36’ median
Alley:	12’ wide within a 20’ right-of-way
Setbacks:	10’
Lot sizes:	Lot width range – 22’ – 40’ (n=31)

	22' – 3, 25' – 8, 26' – 4, 31' – 1, 32' – 6, 36' – 2, 37' – 1, 38' – 4, 40' – 2
	Lot length – 90' The width-to-length ratios range from 1:2.25 to 1:4
Block length	468'
Block width	200'
Ratio:	1:2.34

<u>Boston Street</u>

Street width:	30'
Sidewalk width:	5', plus 10' parking strip
Right-of-way:	60'
Alley:	12' wide within a 20' right-of-way
Setbacks:	10'
Lot sizes:	Lot width range – 26' – 45' (n=26)
	26' – 13, 31' – 2, 40' – 5, 43' – 1, 45' – 5
	Lot length – 90' The width-to-length ratios range from1:2 to 1:3.4
Block length:	468.5
Block width:	350'
Ratio:	1:1.34

East/West Streets

<u>58th Drive</u>

Street width:	30'
Sidewalk width:	5', plus 10' parking strip

Right-of-way: 60’

Alley: 12’ wide within a 20’ right-of-way

Setbacks: 10’

Lot sizes: Lot width range for lots facing 58th Drive: 30’ – 50’ (n=18)

30’ – 4, 32.5’ – 1, 35’ – 1, 39’ – 6, 50’ – 6

Lot length: 90’ The width-to-length ratios range from 1:1.8 to 1:3

Block length: 200’

<u>58th Place</u>

Street width: 30’

Sidewalk width: 5’, plus 10’ parking strip

Right-of-way: 60’

Alley: 12’ wide within a 20’ right-of-way

Setbacks: 10’

Lot sizes: Lot width range for lots facing 58th Place: 33’ – 60’ (n=18)

33’ – 3, 35’ – 4, 37’ 1, 38’ – 1, 40’ – 3, 47’ – 1, 50’ – 1, 55’ – 1, 56’ – 1, 60’ – 2

Lot length: 90’ – 8, 98.5’ – 6, 101’ – 131’ – 6 The width-to-length ratios range from 1:1.5 to 1:2.73

Block length: 422’

The lots in Beeler Park are regular in layout where the streets are straight. Where they are curved, such as 58th Place, there is more variation. Lot widths differ for reasons stated in the 1995 Master Plan. “Foremost, the Plan seeks neighborhoods that can encourage and support diversity in age, income, and ethnicity (p. 52)" This quote reflects a New Urbanist principle that neighborhoods should accommodate a variety of families who can live adjacent to each other. Since the developers sold the lots to different builders, the easiest way to achieve a variety of home types was to vary the lot widths. The streets, sidewalks, setbacks, and lot lengths are uniform, leaving lot width as the remaining variable that could be manipulated.

Central Park West

This small neighborhood dates to 2011 and has been fully developed for several years (communication with Brookfield Properties 2020). The site is located just west of Central Park, an 80-acre public park in the center of the Central Park development. It is just south of I-70 and is close to a Rapid Transit District (RTD) train station on a line that links downtown Denver to Denver International Airport.

The neighborhood is bounded by 35th Ave. on the north, Martin Luther King, Jr. Boulevard on the south, Syracuse Street on the west and Central Park Boulevard on the east. The northwest quadrant of the site contains an elementary school.

The following plats from the Denver Engineering Department, 2020 show streets and lot dimensions.

Figure 71. Central Park West Street Layout, Denver City Engineer's Office, 2016

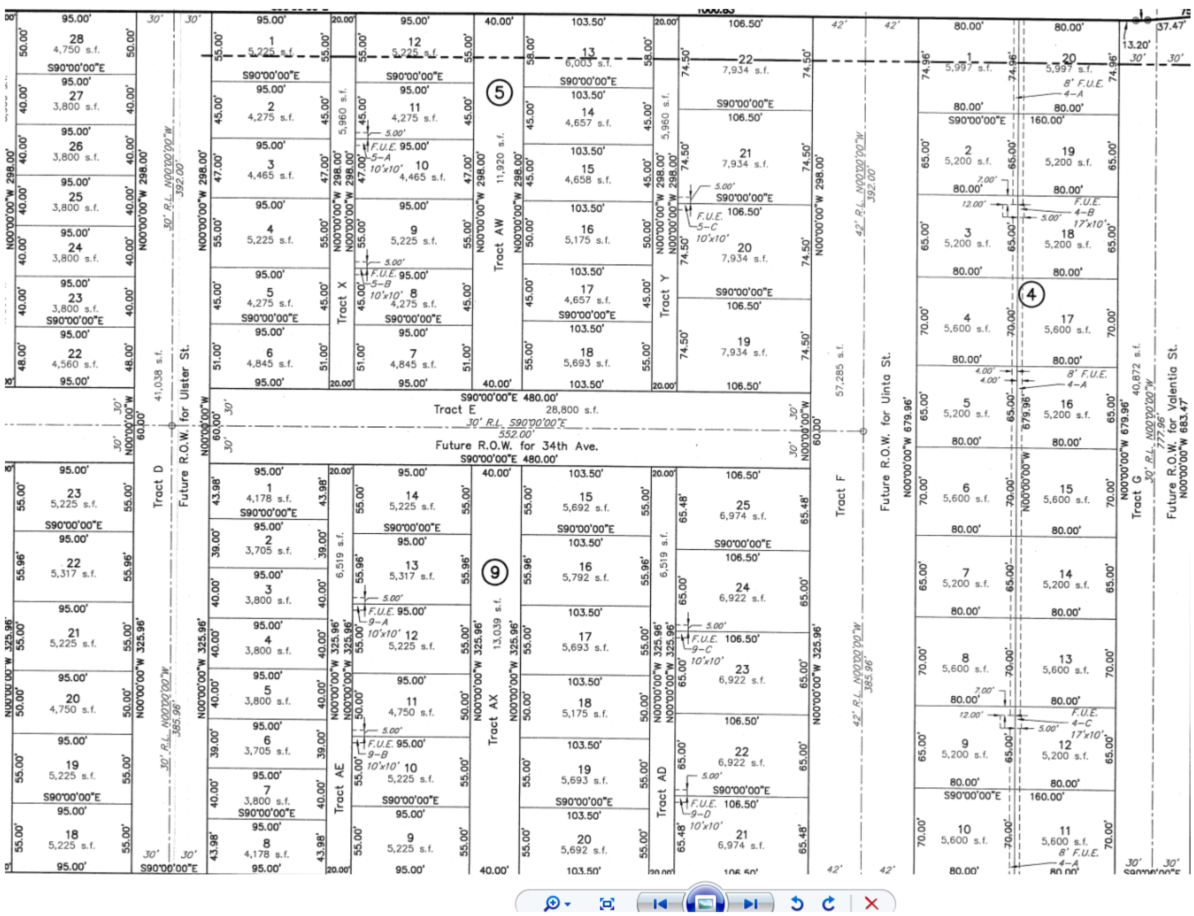


Figure 72. Central Park West Street Layout, Denver City Engineer's Office, 2016

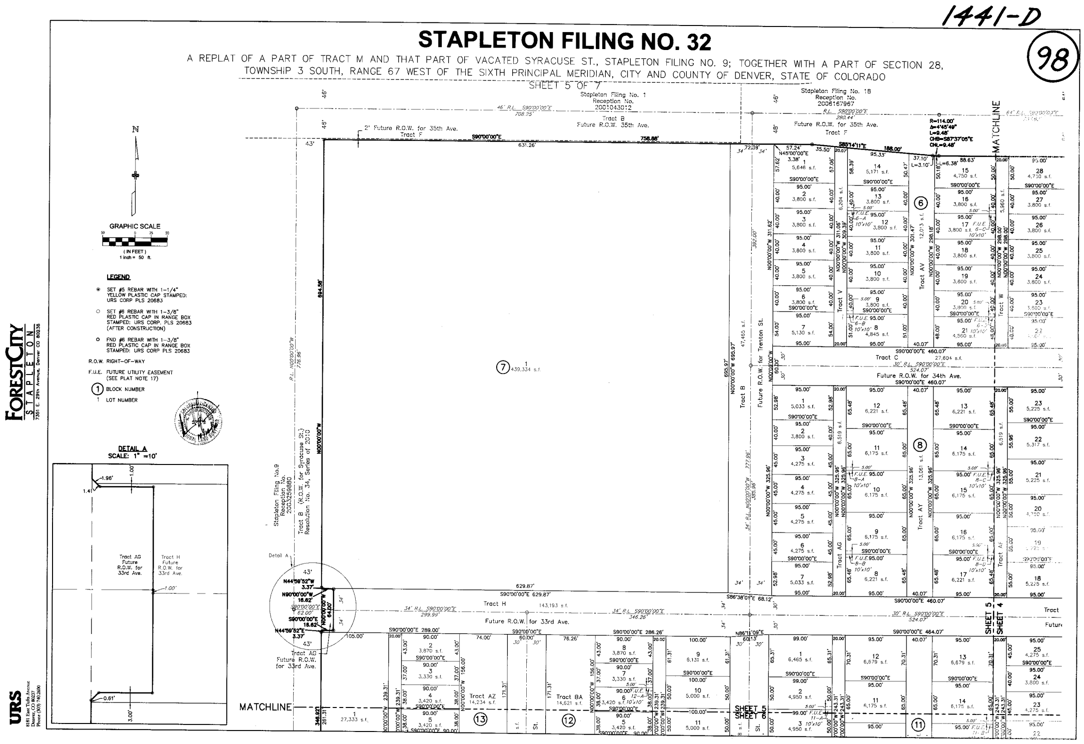


Figure 73. Central Park West Street Layout, Denver City Engineer's Office, 2016

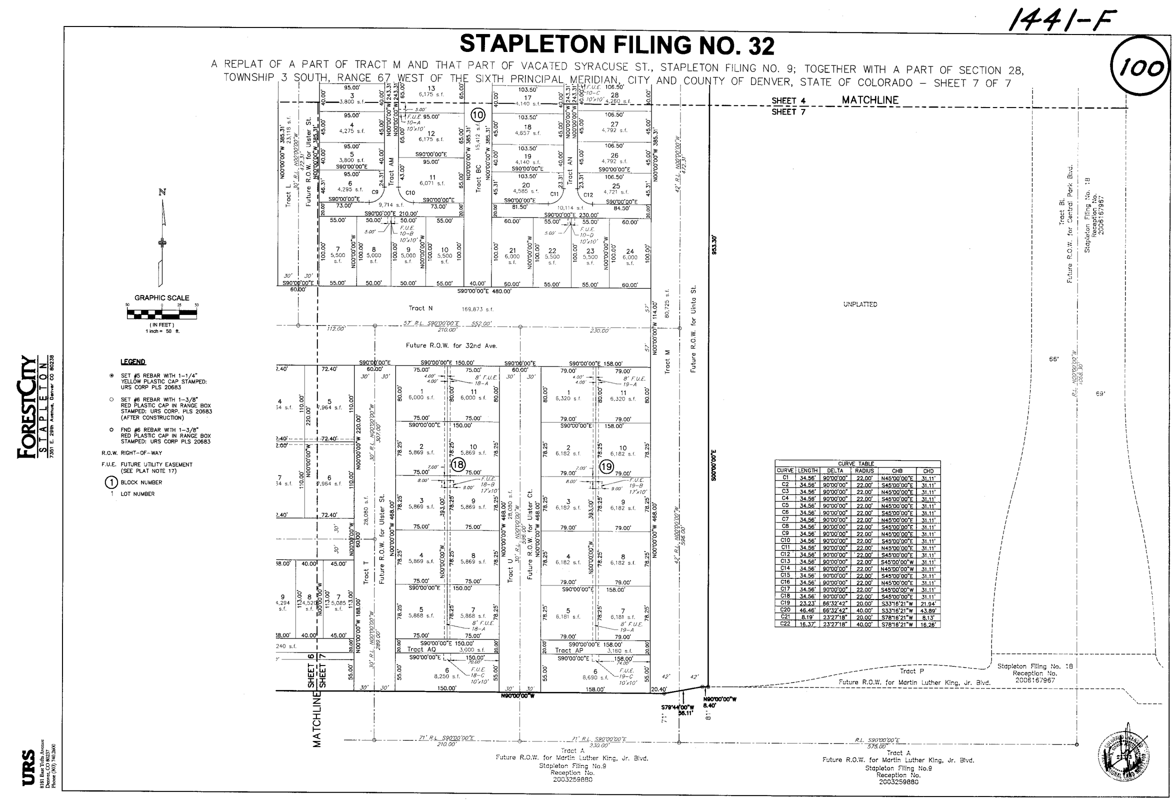
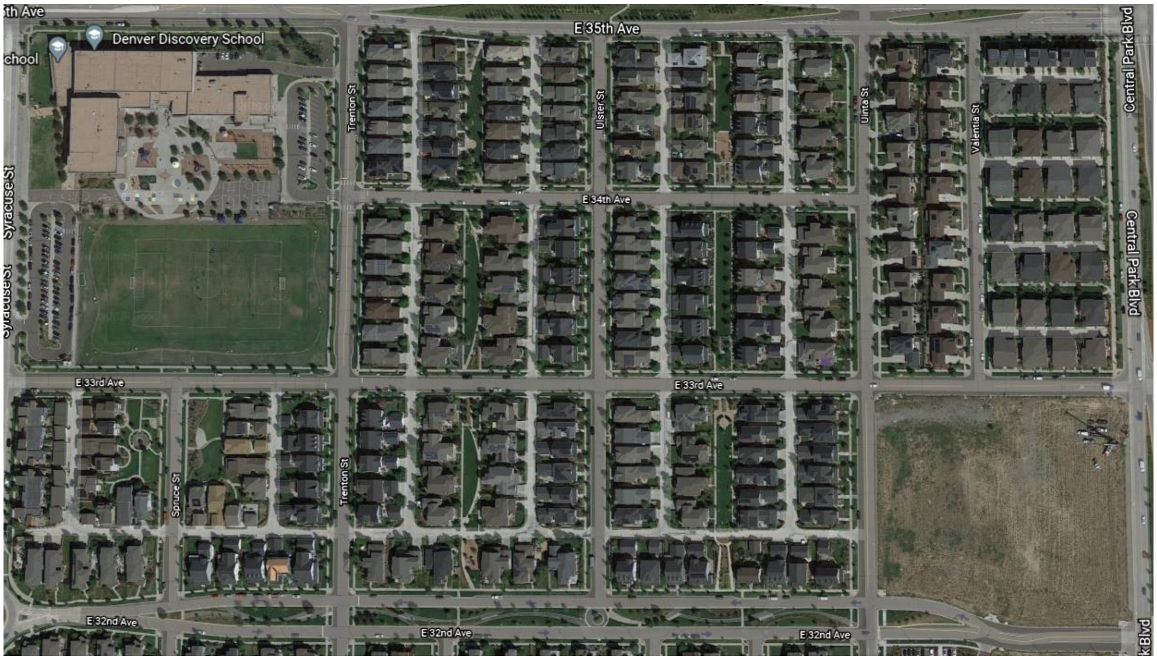


Figure 74. Central Park West Aerial View, Google Earth 2020



This image shows the northern half of the Central Park West neighborhood, including the Denver Discovery School and the regular layout of the streets, lots, and alleys. The lighter colored access ways are alleys, while the darker colored access ways are streets. On the next image I have highlighted a portion of the neighborhood to show its unusual configuration.

Figure 75. Aerial Blow-Up of Block in Central Park West, Google Earth 2020

As you can see, some of the homes face “mews” rather than streets and have vehicular access via alleys to the rear of the buildings. The east/west streets, such as E. 34th Ave. and E. 33rd Ave. serve the alleys and not the homes. The north/south streets, Uinta St. and Ulster St. serve the homes that front them, but the two rows of homes in the interior of the blocks do not have direct street access. This is an unusual layout but reflects New Urbanist ideas for making neighborhoods pedestrian and child friendly.

The following are the dimensions for the lots and streets above:

Table 16. Block and Lot Measurements in Central Park West

North/South Streets	
Ulster	
Street width:	30’
Sidewalk/parking strip width:	15’
Right-of-way width:	60’
Alley:	20’
Setbacks:	vary from 8’ – 15’
Lot width: range – 39’ – 55’	(n=27) 39-40’ – 11, 43’ – 2, 45’ – 2, 47’ – 1, 48’ – 1 50’ – 2, 51’ – 1, 55’ – 7
Lot depth:	95’
Ratio:	1:2.4 to 1:1.7
Uinta	
Street width:	30’
Sidewalk/parking strip width:	15’
Right-of-way width:	84’

Alley:	20’
Setbacks:	vary from 8’ – 15’
Lot width: range – 65’ – 74’	(n=19) 65’ – 10, 70’ – 4, 74’ – 5
Lot depth:	80’ (east side of street), 106.5’ (west side of street
Ratio:	1:1.4 – 1:1.23 (east side), 1:1.43 – 1:1.64 (west side)

Lots facing 40’ “Mews”

Mews 1 (backs up to lots on Ulster)

Green width:	30’
Sidewalk width:	5’
Setbacks:	10’
Right-of-way width:	40’
Lot width: range 45’ – 55’	(n=12) 45’ – 2, 47’ – 1, 50’ – 1, 51’ – 1, 55’ – 7
Lot depth:	95’
Ratio:	1:2.1 to 1:1.7

Mews 2 (backs up to lots on Uinta)

Green width:	30’
Sidewalk width:	5’
Setbacks:	10’
Lot width: range 45’ – 58’	(n=12) 45’ – 3, 50’ – 2, 55’ – 6, 58’ – 1
Lot depth:	103.6’
Ratio:	1:2.3 to 1:1.8

In the table above it can be seen that Ulster has a right-of-way width of 60’ while Uinta has a right-of-way width of 84’. Nevertheless, the street and sidewalk widths are identical, meaning that there is extra right-of-way width on Uinta that has been reserved for future purposes. I did not discover the reasoning behind the extra space, but it is a fairly common practice, being based on the thought that it is much easier to acquire right-of-way before development starts than after buildings have been built.

Central Park West is like Beeler Park in that lot widths vary considerably, while lot depths and other dimensions are consistent. This seems to be the variable used to ensure that there is variety in the size of homes built, and therefore in purchase price. The 1995 Master Plan identified a goal of providing for families with differing ages, incomes, and ethnicities (p 52).

Central Park West offers homes that face 30’ “mews” bordered by a 5’ sidewalk, a pattern not seen in Beeler Park. The objective appears to be to create a quiet, auto-free front space in which neighbors can easily interact with each other without worrying about traffic. This ideal is borne out by the sales literature for Central Park.

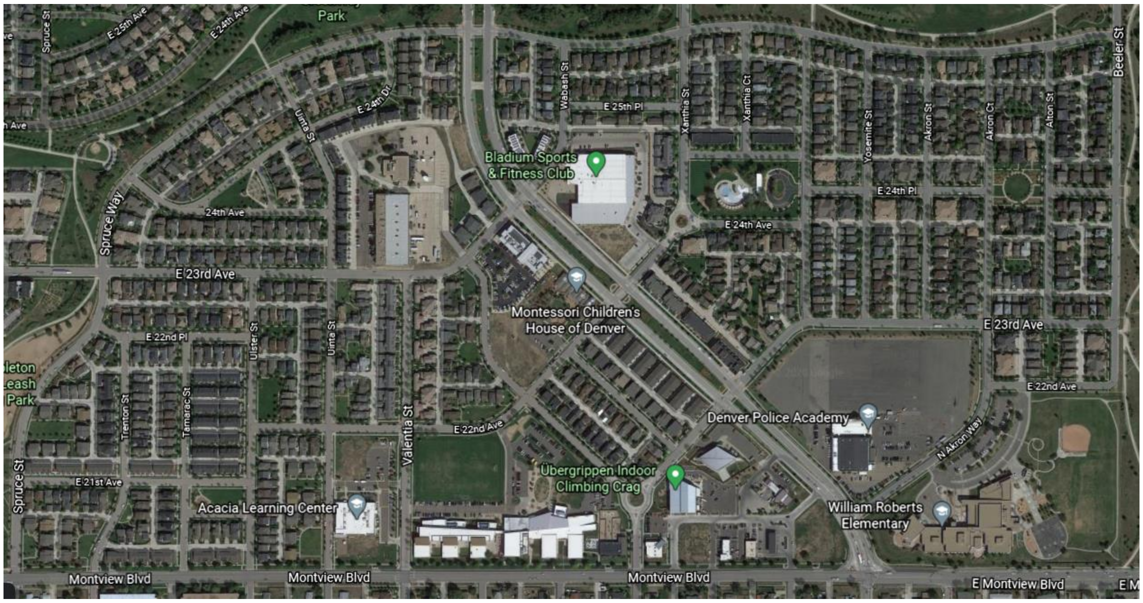
“Central Park West features two linear parks – or mews – where homes face each other across a greenway with meandering paths, gardens, trees, and community tables. They’re an open invitation to the neighbors to get together and be . . . neighborly.”

A Google Earth search of Central Park did not reveal any more linear mews, but it did reveal rectangular “pocket” parks in which homes faced a small park instead of having direct street frontage. There are, for instance, six such parks in Beeler Park. These green spaces are public, but primarily benefit the fronting homes.

South End

The last neighborhood we will examine is South End. It is bounded by Spruce Way on the west and north, Montview Blvd. on the south and Beeler Street on the east.

Figure 76. South End Aerial View, **Google Earth, 2020**



While it is difficult to see at this scale, there are 16 single-family residential clusters that face green space rather than streets. There is also a set of townhomes that face green space and have parking off an alley just to the north.

I have selected two areas within the neighborhood in which I look at the lot and street measurements. The first area is on the west side (Figure 77). There are two rows of lots that are served by north/south streets. Then there are two areas in which the lots face green space rather than streets.

Figure 77. South End Street and Lot Layout, Denver City Engineer's Office, 2016

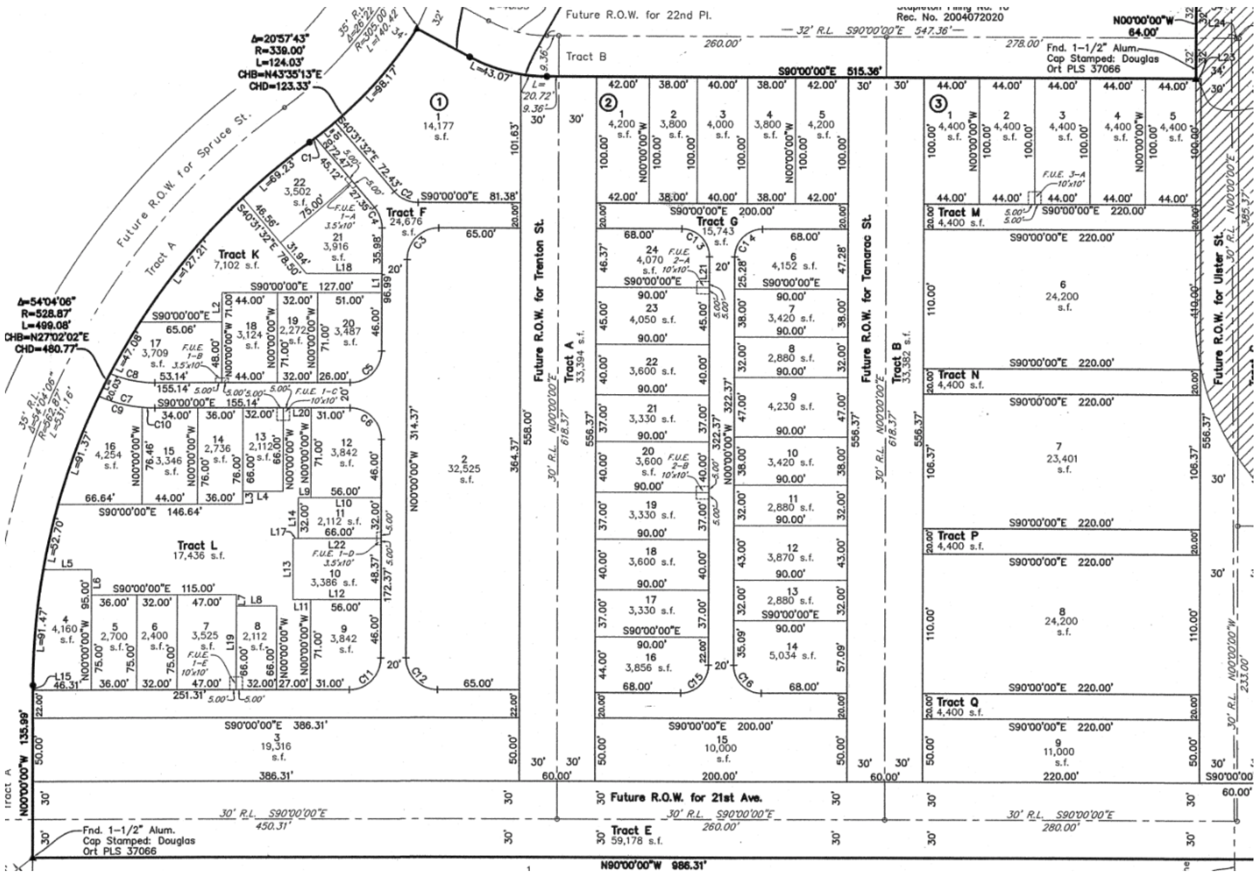


Table 17. Street, Sidewalk, Right-of-Way, and Lot Dimensions in South End, Area 1

<u>Trenton/Tamarac Streets</u>

Street width:	30'
Sidewalk width:	5'
Right-of-way width:	60'
Alley:	20'
Setbacks:	7'

Lot width range: 32' – 57' (n=18) 32' – 3, 37' – 3, 38' – 2, 40' – 3, 43' – 1, 44' – 1, 46', 45' – 1, 47' – 2, 57' – 1.

Lot depth:	90'

Ratio range: 1:2.8 – 1:1.6

Block length: 556’

Block width: 200’

Ratio: 1:2.78

Green Area 1 (Tract K)

Lot width range: 32’ – 51’ (n=5) 32’ – 2, 44’ – 1, 46’ – 1, 51’ – 1

Lot depth: 71’ – 3, 75’ – 2

Ratio range: 1:2.2 – 1:1.4

Green Area 2 (Tract L)

Lot width range: 32’ – 66’ (n=13) 32’ – 4, 36’ – 2, 44’ – 1, 47’ – 1, 46’ – 1, 48’ – 1, 56 – 2, 66’ – 1

Lot depth range: 66’ – 95’

Ratio range: 1:1.375 – 1:2.3

All the lots facing Trenton/Tamarac streets are 90’ in depth, but the widths range from 32’ to 57’. As we saw in Beeler Park and Central Park West, the New Urbanist designers were trying to achieve two Master Plan-driven outcomes. First was to create a neighborhood that was easy to navigate on foot or by bike with a pattern of regular blocks and frequent intersections.

Second was to force a variety of house sizes, and therefore prices, on the same street by varying the lot widths. The developers also created rows of townhomes along Trenton and Tamarac streets that face the single-family homes. This mixed-size, mixed-cost pattern presumably has fostered the mix of ages and incomes envisioned by the 1995 Master Plan.

A third outcome was to create clusters of homes that face green space rather than streets. There are 16 such areas in South End and I have shown two here for illustration purposes. There is a variety of lot width and depth generated by the need to give each home in the cluster reasonable access to the green space. The Brookfield property brochures make it clear that the green space allows safe spaces for neighbors to interact without worrying about vehicular traffic.

The next focus area is Willow Court/21st Avenue, a set of homes on two streets that are not oriented north/south (Figure 78).

Figure 78. South End Street and Lot Layout Area 2, Denver City Engineer's Office, 2016

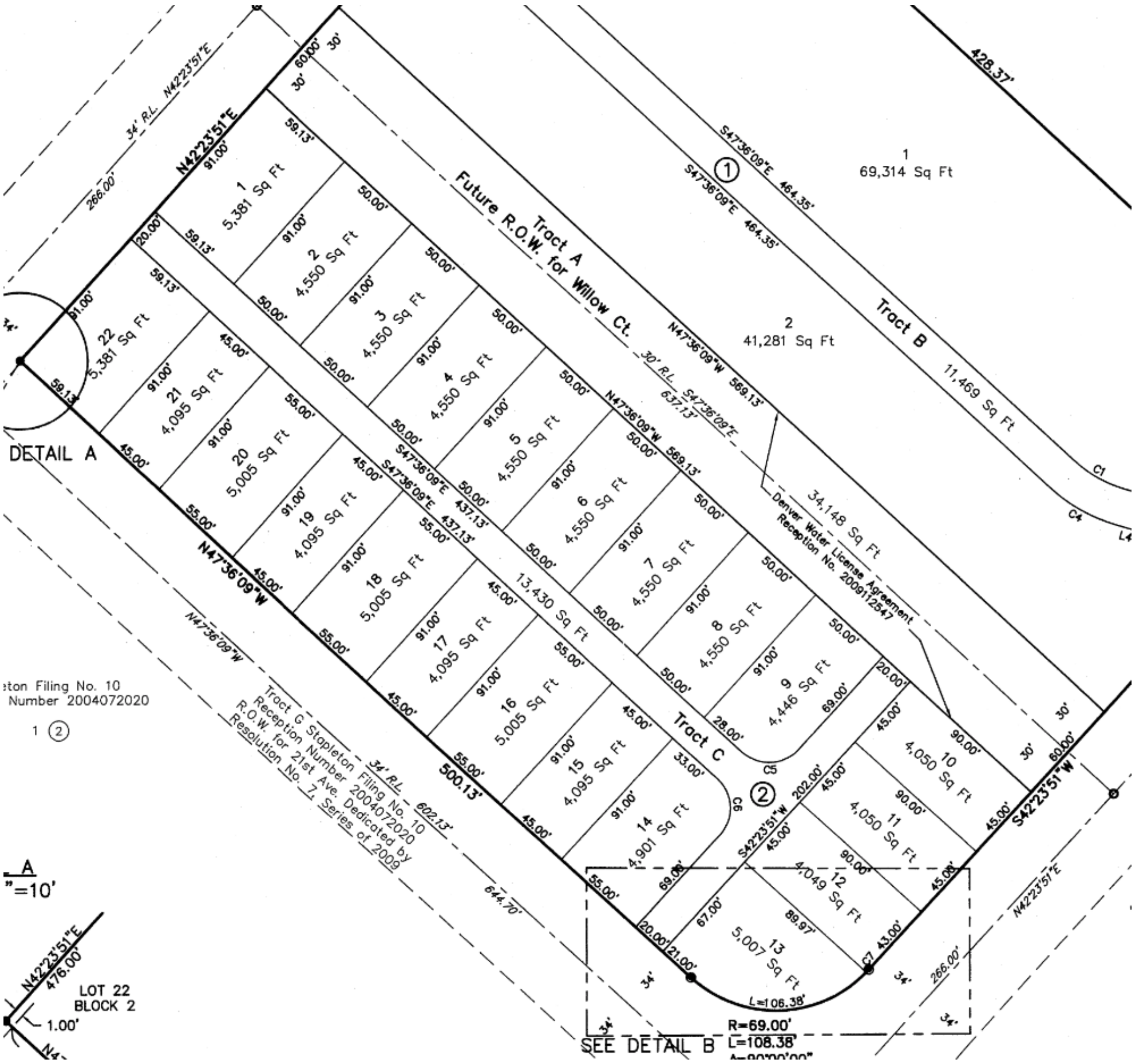


Table 18. Street, Sidewalk, Right-of-Way, and Lot Dimensions in South End, Area 2

Street width:	30'
Sidewalk width:	5'
Right-of-way:	60'
Alley:	20'
Setbacks:	13'
Lot width range:	45' – 59' (n=18), 45'- 4, 50' – 8, 55' – 4, 59' – 2

Lot depth:	91
Ratio range:	1:2.0 – 1:1.54
Block length:	569’
Block width:	202
Ratio:	1:2.8

This small area has a narrow range of lot widths, and from Google Earth it does appear that the homes are similar in size. It should be noted, however, that the homes across Willow Ct. are duplexes, which in turn back up to townhouses, so that the larger area has a mixture of house sizes and costs.

Conclusion

Central Park, at 4,700 acres, is the largest (by area) redevelopment project in the U.S (ULI Case # C034004, 2004).

For me, the interesting aspect of Central Park is that it was built according to principles outlined in the 1995 Master Plan. Marshall (2015) contends that the overall transportation system in Central Park failed to live up the ideals of the plan. He blames the clash of the Functional Classification System used by the Denver Engineering Department to design roads versus the New Urbanist contextual system for the problems. Within each neighborhood the streets are bikeable and there are complete sidewalk systems so pedestrians can easily get around.

When the major streets were laid out to connect Central Park to the Denver grid (also a Master Plan goal) they were built to accommodate large numbers of vehicles. Likewise, turning radii at the intersections were made large so that vehicles could make the turns without having to slow down very much. The result, according to Marshall, is that residents are intimidated when they must cross major streets by bike or on foot. The major streets are also wide, flat, and straight, which encourages speeding.

The purpose of this paper, however, is not to enter the debate between traffic engineers and New Urbanists. My intention is to determine if development patterns exhibit consistencies through time and space. In the case of Central Park, we can define a narrow range of lot sizes, street sizes, setbacks, and other variables. And we can read about the ideals that the citizens of Denver hoped to see in the 1995 Master Plan for the redevelopment. Because of the documentation we can state that the pattern is intentional and expresses the ideals.

This is clearly demonstrated in an article by Michael Leccese (2005) who states, "School populations will be economically diverse because Stapleton homes sell from $120,000 to over $1 million, with apartment rents from $600 to $2,000 a month." He goes on to explain how the developer carefully prevented builders from constructing similar-sized and priced homes in clusters.

> In 2000, Wolff-Lyon Architects and EDAW, Inc., directed by Forest City Stapleton, produced the 130-page *Stapleton Design Book.* The team studied historic Denver neighborhoods to create many patterns of building forms, colors, and styles, and then tested the guidelines with homebuilders to ensure their practicality.
>
> Forest City Stapleton used the *Design Book* to attract competitive proposals from 100 interested homebuilders. The developer eventually chose 20 building companies that are now building 15 housing types, generally on small urban lots with density as high as 25 homes to the acre. Significantly for social diversity, homes for drastically different household incomes often exist on the same block or across the street from each other.

> Production builders buy finished lots a block at a time, which gives them enough room for efficient staging and production. But to ensure visual variety, no builder is sold contiguous blocks. As a result, different companies build different homes on facing sides of the street. (2005, p. 2)

Leccese wrote his article in 2005, but in my Google Earth review of Central Park in 2020, it appears that the principles guiding the initial layout were adhered to in the ensuing 15 years.

Before we leave Central Park, it would be instructive to compare its lot and street measurements to those of 19th Century Denver since Central Park is part of the City of Denver, and the Master Plan expressed a goal to integrate the redevelopment area into the city development pattern.

Table 19. Comparison of Denver and Central Park Street, Sidewalk and Lot Dimensions

Denver	Central Park
Street widths (typical)	
48’/36’	30’
Sidewalk/parking strip widths	
16’ along 48’ streets and 22’ along 36’ streets	15’
Alley width	
16’	12’
Right-of-way width	
80’	60’
Lot dimensions (typical)	
25’ x 125’	22’ – 55’ x 90’ – 106’
Block length/width (typical)	

375’ x 266’ (1:1.41)	500’ – 600’ x 201’ (1:2.49 – 1:3)

These dimensions are comparable, although not identical. In 19th Century Denver the street rights-of-way are wider and the blocks more square than rectangular. The lot widths platted in the 19th Century are very consistently 25’, whereas the lots in Central Park vary considerably. According to the literature, development in Denver was intended to sell property, and uniform lots were easy to market. Buyers could purchase one, two or even three units to accommodate what they wanted to do. If we look at the original plats versus current property lines, we see that there have been many combinations made to facilitate today’s development pattern.

In Central Park, the lot widths were purposely varied in order to create different sized (and priced) homes adjacent to each other. Two different approaches that resulted in similarly diverse building plots.

Seaside, Florida

Seaside, Florida is one of the oldest New Urbanist communities in the U.S. It is also one of the smallest (Figure 79). According to Patton (1991) the development is 80 acres in size and contains 300 homes. Unlike Central Park, which featured significant public involvement, Seaside is essentially the product of three people: Robert Davis, the property owner and developer, Andres Duany, and Elizabeth Plater-Zyberk, architects who helped develop New Urbanist principles.

Patton states that Robert Davis inherited 80 acres of land on the Florida coast from his grandfather and wanted to create an authentic beach town that would be traditional in its layout and characteristics. He contacted Andres Duany after hearing him speak about New Urbanist ideas. According to Mohney (1991)

> Andres Duany and Elizabeth Plater-Zyberk's powers of observation are such that they not only found the appropriate prototypes but understood how to codify the elements of the types in a manner that would allow for creativity in composing new structures. Best of all, they saw and understood, clearly, the value of a sense of place shared (or reinterpreted, and thus reinforced) by many different points of view. (p. 37)

Figure 79. Map of the Original Seaside Development, Pinterest, 2020

Seaside is in Walton County on the Florida panhandle between Panama City Beach and Destin. Because the property was in an unincorporated part of the county there were no existing municipal zoning or subdivision codes to work around. The three people involved visited beach towns in Florida and Alabama and ended up writing their own codes, one for the town layout and one that controls architectural design.

Duany and Plater-Zyberk, who are an architectural team (now DPZ CoDesign, DPZ website) decided to refrain from designing any homes in Seaside. Their stated purpose, according to an interview with Elizabeth Plater-Zyberk recorded in their book (Mohney and Easterling 1991), was to help ensure that the architecture of the homes would be varied. Individual lots were sold to buyers who in turn hired architects. As in Central Park, blocks of lots were not sold to developers who might replicate the same design in homes sited next to each other.

As I will show below, the lots in different sections of town are identical to each other, although DPZ purposely lined the major roads with larger lots to encourage stately homes that would create an entrance statement. Elsewhere, the lots are small, with the houses close to the street. To the rear are footpath alleys. All yards are required to be surrounded with white picket fences, and no adjoining houses may use the same picket design.

The result was that the town looks exactly like what Davis and DPZ wanted. A small town with a compact commercial square and streets that encourage walking and biking. Seaside was used as the set for “The Truman Show”, a 1998 movie starring Jim Carrey, simply because it seemed so “perfect” and believable as a reality TV location. In the movie, Jim Carrey (Truman Burbank) has lived his entire life inside a bubble that covers Seaside. 5,000 cameras record everything he does – the other people in the town, including his wife, are actors who play their roles as if they are small town residents. As an adult, Truman begins to suspect that he is at the center of an elaborate reality play and eventually escapes the bubble. Truman’s house in the movie is located on Natchez Street in Seaside 6.

I have picked three areas in and near Seaside for analysis of the lots, streets, and blocks. Below are a plat (Figure 80) and aerial photo (Figure 81) of the first area, Seaside 6. Seaside 6 is part of the original development and is shown on the west side of the map (Figure 79) above.

Figure 80. Seaside 6, Walton County Clerk of Court, 2020

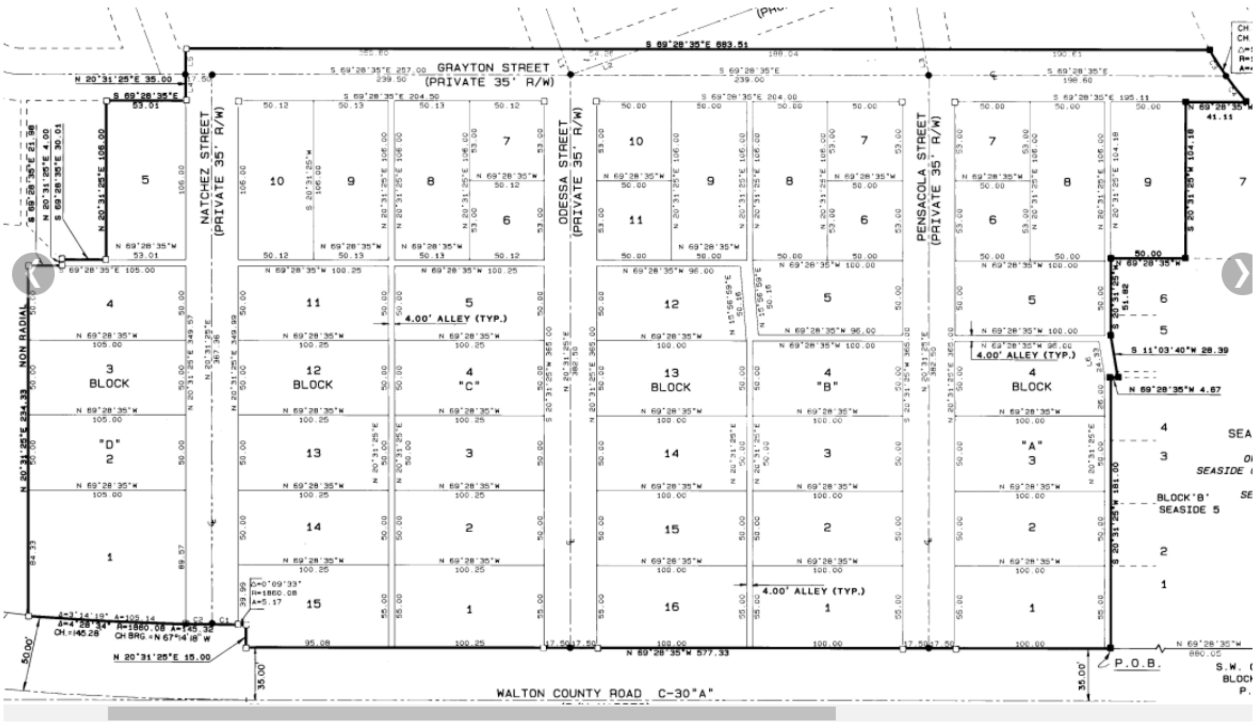


Table 20. Street, Sidewalk, Right-of-Way, and Lot Dimensions in Seaside 6

<u>Natchez Street</u> (north/south)

Right-of-way: 35’

Alley: 4’

Lot Widths (n=9): 50’ – 7, 55’ – 1, 90’ – 1

Lot lengths: 100’ – 5, 105’ – 4

Ratios: 1:2 to 1:2.1

I have excluded the 90’ wide outlier from the ratio calculation as there are no other lots of similar size in Seaside 6.

Street width: 18’

Parking strip: 8.5’

Block length: 367’

Block width: 204’

Ratio: 1:1.8

<u>Odessa Street</u> (north/south)

Right-of-way: 35’

Alley: 4’

Lot Widths (n=14): 50’ – 8, 55’ – 2, 53’ – 4

Lot lengths: 100’ – 10, 50’ – 4

Ratios: 1:1, 1:1.8, 1:2

The four lots that face Odessa near its intersection with Grayton are square, being 50’ on all sides. This is not typical for Seaside but may have been an attempt to introduce variety into this section.

Street width: 18’

Parking strip: 8.5’

Block length: 382’

Block width: 204’

Ratio: 1:1.9

<u>Pensacola Street</u> (north/south)

Right-of-way: 35’

Alley: 4’

Lot Widths (n=14): 50’ – 8, 55’ – 2, 53’ – 4

Lot lengths: 50’ – 4, 100’ – 10

Ratios: 1:1, 1:1.8, 1:1.9

As on Odessa, there are four square lots facing Pensacola, 50’ on all sides.

Street width:	18’
Parking strip:	8.5’
Block length:	382’
Block width:	204’

Ratio: 1:1.9

Grayton Street (east/west)

Right-of-way:	35’
Lot Width (n=8):	50’ – 8
Lot lengths	106’ – 8
Ratio:	1:2.1
Street width:	18’
Parking strip:	8.5’
Block length:	365’
Block width:	204’
Ratio:	1:1.8

This is the block bounded by Grayton, Natchez, Odessa, and Walton County Road. In addition to being easily navigated on foot, it is bisected in both directions by 4’ pedestrian alleys, giving people on foot an option to not compete with vehicles at all when leaving home.

There are several things to note in Seaside 6. First is that all the rights-of-way are private, meaning that the streets are owned and maintained by the Homeowners Association. Since Seaside was developed in unincorporated Walton County there were no municipal codes to follow. The street rights-of-way are the minimum needed to accommodate a narrow street and parking strips. There are no sidewalks in this section, which was developed early in the project.

The four-foot alleys shown are to serve foot traffic only. The Google Earth Street view shows cars parked in the parking strips and pedestrians strolling down the middle of the streets.

When Seaside was first developed the streets were surfaced in crushed shells (Patton 1991). Complaints about dust pushed the developer to replace the shells with brick. In the aerial below the red brick of the streets is clearly visible.

The vegetation in Seaside has matured since the village was founded, making it difficult to use GIS to measure building setbacks. The houses appear to vary in their setbacks from the right-of-way line from 8' to 12', but the number of points was limited, and I cannot state that the range covers all the homes in Seaside 6. Given that Robert Davis and DPZ were trying to create an authentic Florida beach town, variation would be expected. Historic beach towns were developed lot-by-lot over time with different owners having different tastes and expectations.

Figure 81. Seaside 6 Aerial View, Source Walton County GIS, 2020

The second area I looked at consists of portions of four plats that together form a rectangle (Figure 82). This area is not part of the original Seaside development but was done in much the same style.

Figure 82. Cinnamon Fern at Watercolor, Walton County Clerk of Courts, 2020

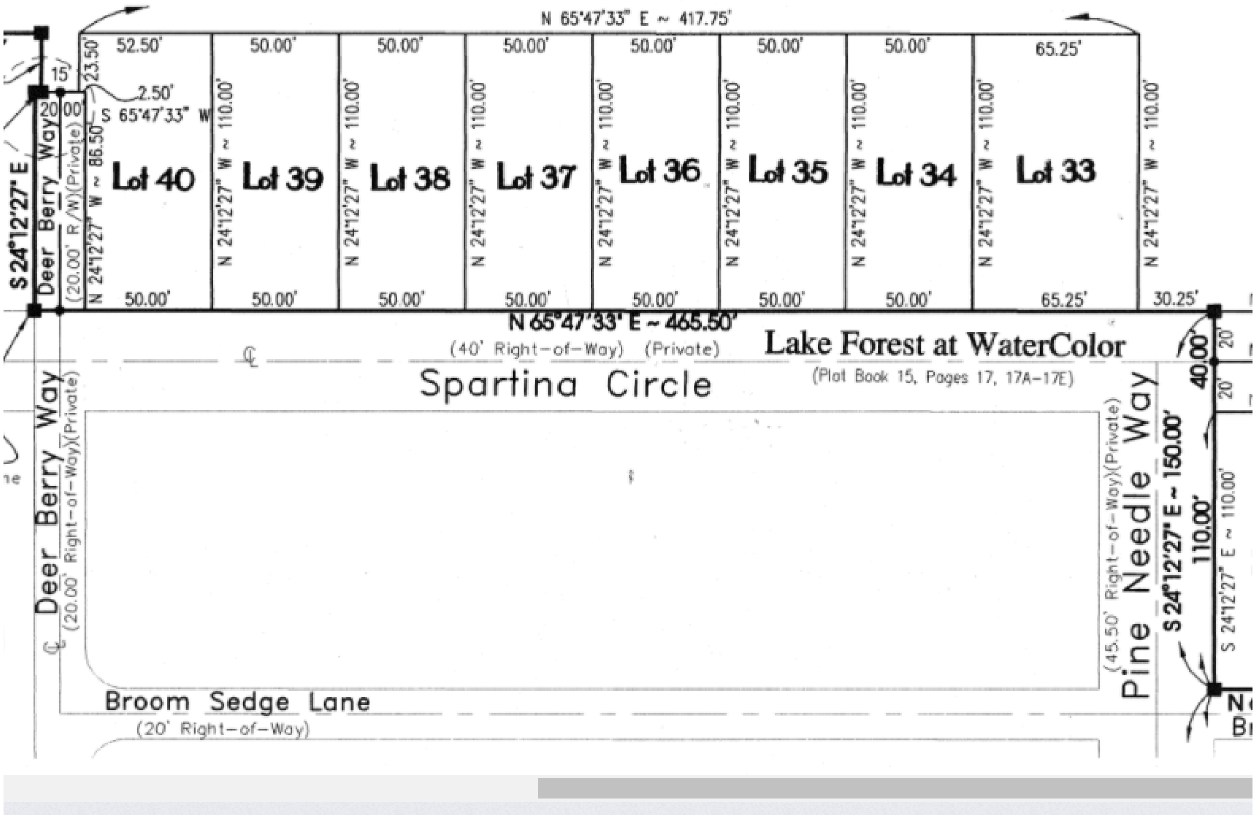


Table 21. Street, Sidewalk, Right-of-Way and Lots Dimensions in Cinnamon Fern

<u>Spartina Circle</u>

Right-of-way:	40’
Lot widths (n=8):	50’ – 7, 65.25’ – 1
Lot length:	110’
Ratios:	1:2.2 – 7, 1:1.69 – 1
Pavement width:	20’
Sidewalk width:	5’
Parking/landscaping strip:	8’

Figure 83. Lake Forest at Watercolor, Walton County Clerk of Courts, 2020

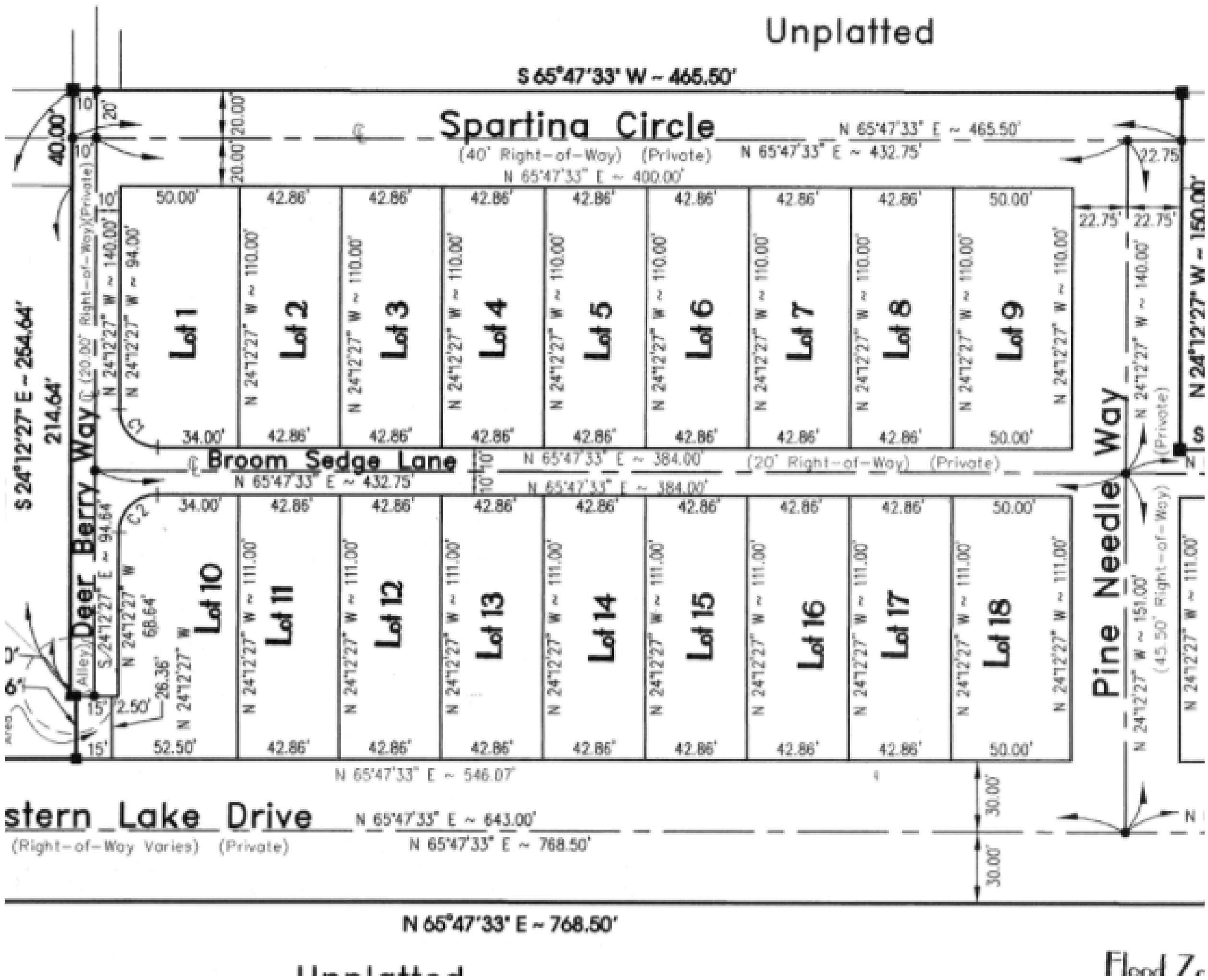


Table 22. Street, Sidewalk, Right-of-Way, and Lot Dimensions in Lake Forest

<u>Spartina Circle</u>

Right-of-way:	40’
Alley (Broom Sedge Lane):	20’
Lot widths (n=9):	50’ – 2, 43’ – 7
Lot length:	110’
Ratios:	1:2.2 – 2, 1:2.56 – 7

Pavement width:	20’
Sidewalk width:	5’
Parking/landscaping strip:	8’
Block length:	520’
Block width:	241’
Ratio:	1:2.16

The Spartina Circle/Pine Needle Way block is bisected by 20’ alleys in both directions, meaning that pedestrians can navigate through the block rather than having to go entirely around it to get to a particular destination.

Western Lake Drive

Right-of-way:	60’
Lot width (n=9):	52.5 – 1, 50’ – 1, 43’ – 7
Lot length:	110’
Ratios:	1:2.1 – 1, 1:2.2 – 1, 1:2.56 – 7
Pavement width:	24’
Sidewalk width:	5’
Parking/landscaping strip:	8’

Western Lake Drive is, for this area, a major street running through the community. It has a wider right-of-way than most of the other streets (60’ vs. 40-45’) and a wider pavement profile (24’ vs. 18-20’). The 24’ width accommodates two full travel lanes.

Figure 84. Eastern Cove at Watercolor, Walton County Clerk of Courts, 2020

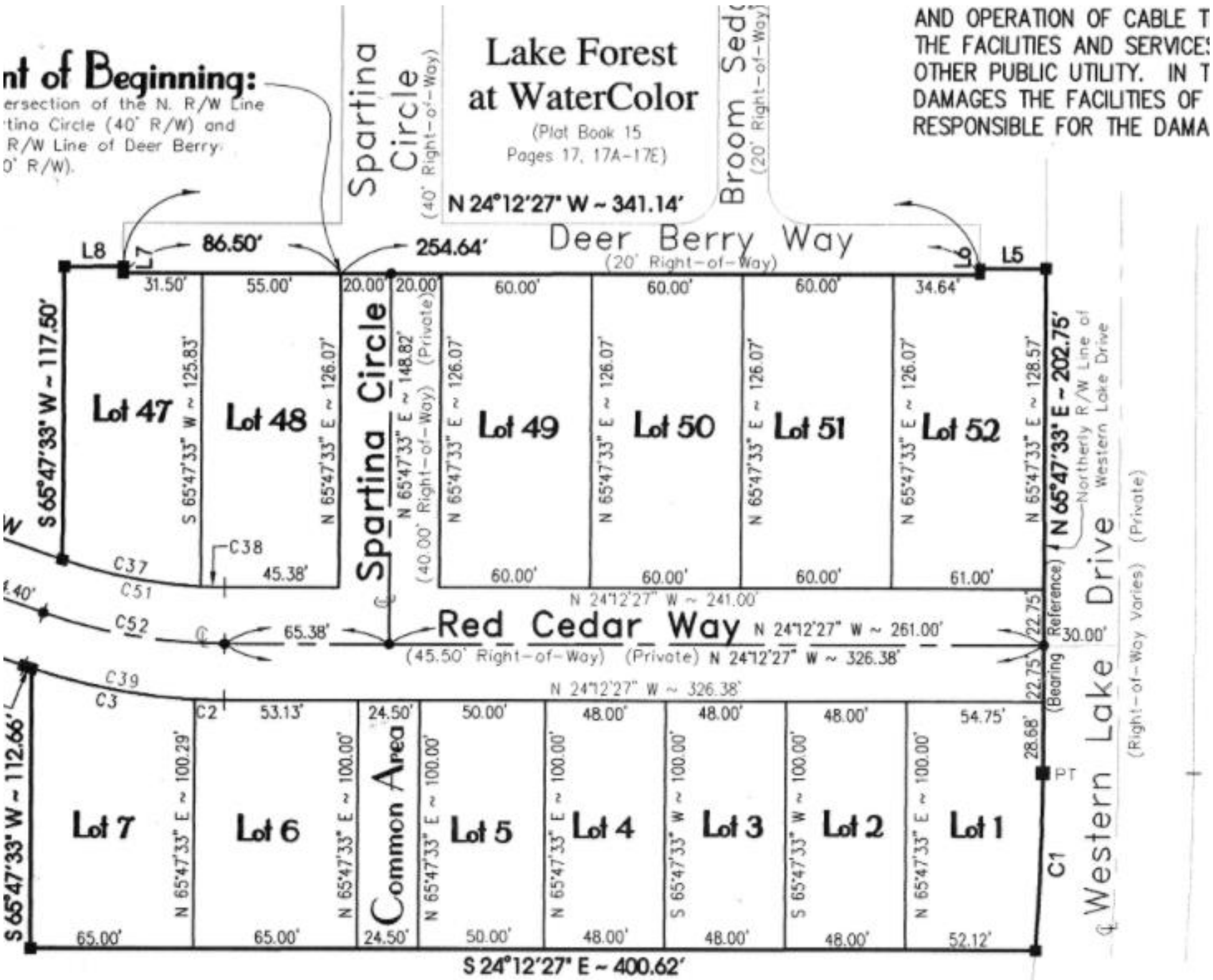


Table 23. Street, Sidewalk, Right-of-Way, and Lot Dimensions in Watercolor

<u>Red Cedar Way</u>

Right-of-way:	45.5'
Alley (Deer Berry Way):	20'
Lot widths (n=13):	65' – 2, 61' – 1, 60' – 3, 55' – 2, 52' – 1, 50' – 1, 48' – 3
Lot lengths:	126' – 6, 100' – 7
Ratios:	1:2.08, 1:2.10, 1:2.29, 1:1.54
Pavement width:	20'

Sidewalk width: 5’

Parking/Landscaping strip: 8’

Figure 85. Pine Ridge at Watercolor, Walton County Clerk of Courts, 2020

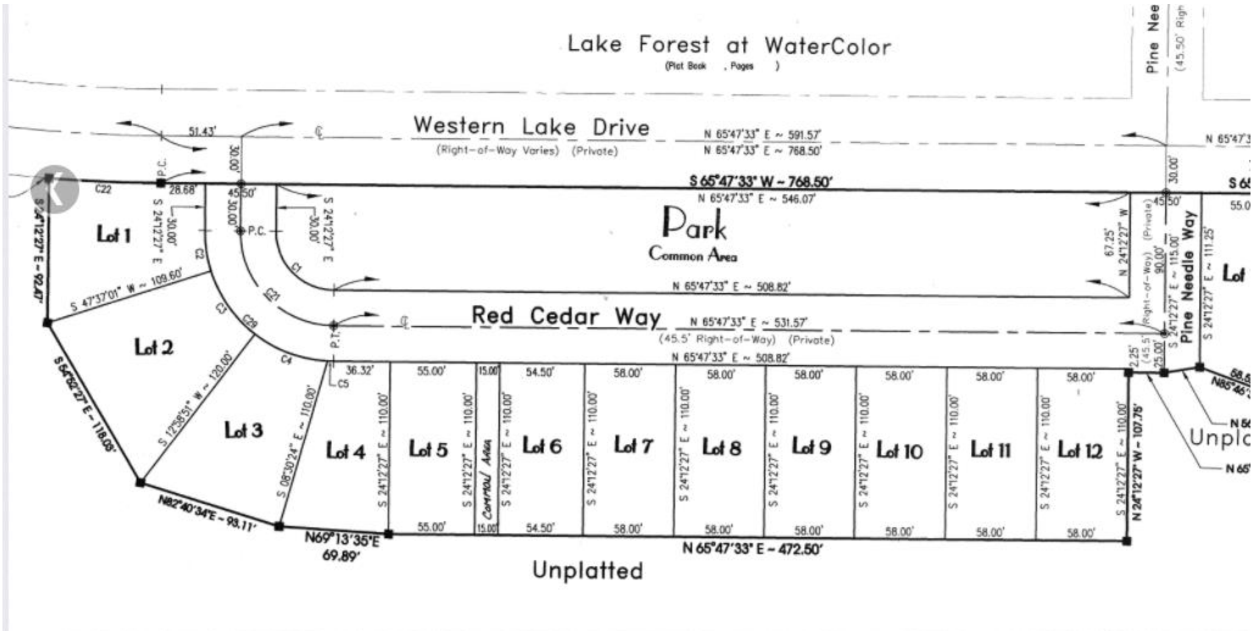


Table 24. Street, Sidewalk, Right-of-Way and Lot Dimensions in Pine Ridge

<u>Red Cedar Way</u> (Pine Ridge)

Right-of-way: 45.5’

Lot widths (n=9): 53’ – 1, 54.5 – 1, 55’ – 1, 58’ – 6

Lot length: 110’

Ratios: 1:2.07, 1:2.0, 1:1.7

Pavement width: 20’

Sidewalk width: 5’

Parking/Landscaping strip: 8’

Block length: 768’

Block width: 115’

Ratio: 1:6.68

This block is formed by Red Cedar Way, Western Lake Drive and Pine Needle Way. It is unusually long for a New Urbanist community, but since the homes front a park, pedestrian access through the block is not limited by the street system. Someone living on Red Cedar Way who wants to visit someone on Western Lake Drive can simply walk through the park to get there, rather than having to travel around the block.

Figure 86. Cinnamon Fern, Lake Forest, Eastern Cove and Pine Ridge at Watercolor, Source: Walton County GIS 2020

Conclusion

The stated intent of Robert Davis and DPZ was to produce an authentic Florida beach town and it appears to have been successful. Property values have increased, and most homes are owned by non-residents who rent them out to tourists. While that has been a source of criticism by some who feel the village concept has been violated, others have pointed out almost all beach towns are primarily rentals. A benefit of this is many people can experience a New Urbanist community and perhaps appreciate the bikeable and walkable nature of the design.

CHAPTER V: DATA ANALYSIS

In Chapters 2-4 I presented numeric data on lots, streets and, where feasible, sidewalks. The data was from different centuries and different societies. Most of the communities in my sample were developed on vacant or nearly vacant land in which the people could plan how the cities would look when they were done. My premise is that when these conditions exist, a grid is the preferred pattern.

Furthermore, I will show that the range exhibited for several variables is small, indicating that people have similar ideal patterns in mind. The greatest range shown is in street width which I intend to show is driven by different forces from block layout.

The following is presented in graph form that is a cross-tabulation of the form with the sample communities. The measurements are shown in the system used locally at the time, as well as in meters. As discussed in the Introduction, measurements often make sense if they are conveyed in the units used by the original surveyors.

Table 25. Lot Size Comparisons

	Length	Width	Ratio
Piraeus, Greece (1) (townhouses)			
	62’	36’	1:1.7
	20.34 m	11.81 m	
Olynthos, Greece (2) (townhouses)			
	58’	57.5’	1:1
	17.23 m	17.08 m	

Priene, Turkey (1) (townhouses)

	80	30	1:2.67
	26.24 m	9.84 m	

Rhodes, Greece (1) (townhouses)

	46'	25.67'	1:1.8
	15.09 m	8.42 m	

1) Doric foot (327 mm)
2) Greek Common foot (297 mm)

	Length	Width	Ratio
Pompeii, Italy (1) (townhouses)			
Half block	15.4 – 17.3 m	8.45 – 14.2 m	
Full block	32.6 – 34.5 m		

(1) Measurements shown in meters. Blocks on the West side and part of the East side were laid out in Oscan feet (275 mm) while a portion of the blocks on the East side were laid out in the Roman common foot (296 mm).

Leptis Magna, Libya (townhouses)

The scaled map prepared by J.B. Ward-Perkins shows regular blocks in the grid that are 100 x 25 meters (337 x 84 Roman feet). It is likely that each block was divided into four lots that are about 25 x 25 meters each. Aerial views of the residential areas show wall stubs that support this conclusion.

Manhattan, NYC (measurements in English/U.S. feet (304.8 mm) and meters)

Chelsea (townhouses)	Length	Width	Ratio
	98.75'	25'	1:3.75

	30.1 m	7.62 m	

Upper East Side (townhouses)

(Facing 91st street)	100.71’	15’	1:6.71
	30.67 m	4.57 m	
(Facing 92nd street)	100.71’	25’	1:4.03
	30.67 m	7.62 m	

Manhattan gives us an opportunity to see the changes in lots lines over (1896-2020) a period of 124 years. In Chelsea there is little of the original pattern remaining while in the Upper East Side many lot lines are unchanged.

Denver, Colorado (measurements in English/U.S. feet (304.8 mm) and meters)

Area 1 (single-family detached homes)

	Length	Width	Ratio
	125’	25’	1:5
	38.1 m	7.62 m	

Area 2 (single-family detached homes)

	125’	25’	1:5
	38.1 m	7.62 m	

In Denver, most of the 25’ wide lots were combined into 50’ lots or larger between 1904 and 2020. This may be a result of a desire on the part of the buyers to build single-family detached homes that have at least some side yards.

San Francisco, California (measurements in English / U.S. feet (304.8 mm) and meters)

Nob Hill (townhouses)

4 lots	77’	23’	1:3.35

	23.47 m	7.01 m	
4 lots	100’	25’	1:4
	30.48 m	7.62 m	
3 lots	87.5’ or 137.5’	25’	1:3.5/1:5.5
	26.67 m or 41.91 m	7.62 m	
2 lots	137.5’	37.5	1:3.67
	41.91 m	11.43 m	

Richmond (townhouses)

Long side lots	120’	25’	1:4.8
	36.58 m	7.62 m	
Corner lots	75’	29’	1:2.6
	22.86	8.84	

As I discussed in Chapter 3, the blocks in Nob Hill and Richmond remained the same size after the 1906 earthquake and fire, but the lot dimensions changed dramatically because of extensive redevelopment. Nob Hill was burned and totally cleared, while Richmond was not. Nevertheless, Richmond experienced extensive changes in buildings and lot lines shortly after 1906.

Southern Village, Chapel Hill NC (measurements in English / U.S. feet (304.8 mm) and meters)

Area 1 (single-family detached homes)

	Length	Width	Ratio
Hillspring Lane	117.5’	55’	1:2.14
	35.81 m	16.76 m	

Highgrove Drive	133’–139’	45’–65’	1:2.96/1:2.14
	40.54–42.37 m	13.72–19.81 m	
Area 2 (townhouses)			
Glade St., Nolen			
Lane, Westside Dr.	105.3’	22-28’	1:4
	32.13 m	6.71–8.53 m	
Highgrove Drive	102’	22’	1:4.6
	31.09 m	6.71 m	
Area 3 (single-family detached homes)			
Parkside Circle	100’	36–45’	1:2.6/1:2.8
	30.48 m	10.97–13.72 m	
Central Park, Denver, CO (measurements in English / U.S. feet (304.8 mm) and meters)			
Beeler Park (single-family detached homes)			
Central Park Blvd.	65’	21.25–31.58’	1:2/1:3
	19.81 m	6.48–9.63 m	
Alton Street	90’	40-45’	1:2/1:2.25
	27.43	12.2–13.72 m	
Beeler Street	90’	22-40’	1:2.25/1:4
	27.43 m	6.71–12.2 m	
Boston Street	90’	26–45’	1:2/1:3.4
	27.43 m	7.92–13.72 m	
58th Drive	90’	30-50’	1:1.8/1:3
	27.43 m	9.14–15.24 m	

58th Place	90–131’	33–60’	1:1.5/1:2.73
	27.43–39.92 m	10.06–18.29 m	
Central Park West (single-family detached homes)			
	Length	Width	Ratio
Ulster Street	95’	39–55’	1:1.7/1:2.4
	28.96 m	11.89–16.76 m	
Uinta Street	80–106.5’	65–74’	1:1.23/1:1.64
	24.38–32.46 m	19.81–22.56 m	
Mews 1	95’	45–55’	1:1.7/1:2.1
	28.96 m	13.72–16.75 m	
Mews 2	103.6’	45–58’	1:1.8/1:2.3
	31.58 m	13.72–17.68 m	
South End (single-family detached homes)			
Trenton/Tamarac St.	90’	32-57’	1:1.6/1:2.8
	27.43 m	9.75-17.37 m	
Green Area 1	71-75’	32-46’	1:1.6/1:2.8
	21.64-22.86 m	9.75-14.02 m	
Green Area 2	66–95’	32–66’	1:2.3/1:1.38
	20.12–28.96 m	9.75–20.12 m	

Seaside, Florida, single-family detached houses (measurements in English / U.S. feet (304.8 mm) and meters)

Natchez Street	100–105’	50–55’	1:2/1:2.1
	30.48–32.00 m	15.24 m	

Odessa Street	100'	50–55'	1:1.8/1:2.0
	30.48 m	15.42–16.76 m	
Pensacola Street	100'	50–55'	1:1.8/1:1.9
	30.48 m	15.42–16.76 m	
Grayton Street	106'	50'	1:2.1
	32.31 m	15.42 m	

The lot is a space usually devoted to a dwelling and its associated "yard". In the Mediterranean Basin, the yard was often internal (atrium), with building walls enclosing the entire lot. With townhouse designs, the lot is also enclosed with walls, except that there is usually an open yard behind the rear wall. Single-family detached homes may have some open yard space around the dwelling in which the property lines are defined with fences, walls, or plantings.

The lot is *private* space for the use of the household and guests. So, what sizes of space seem comfortable and are typically provided for the end users. In the ancient Mediterranean Basin, lots are 15-25 meters long (mean: 20.79 m, median: 20.34 m) by 9-17 meters wide (mean: 14.43 m, median 11.81 m), with the yard internal to the building. Length to width ratios range from 1:1 to 1:2.7, with most being less than 1:2. The presence of an open space internal to the house, with rooms arranged around the outside, lent itself to a square or short rectangular shape.

In New York, San Francisco, and Southern Village the townhouse lots are generally 30–32 meters long (mean: 30.6 m, median: 30.67 m, mode: 30.67 m) by six to eight meters wide (mean: 8.20 m, median: 7.62 m, mode: 7.62 m). The length to width ratios are close to 1:4.

Lots used for single-family detached housing also contain assumptions about the size and shape of the homes that will be built. In Denver, the standard lots were 38 meters long by 7.62 meters wide. To fit a typical house on a lot, buyers purchased two lots so that the finished size was 38 by 15 meters, for a ratio of 1:2.5. In Southern Village lots were 30–42 meters long by 10–14 meters wide with ratios ranging from 1:2.14 to 1:2.8. In Central Park lot lengths ranged from 20 to 39 meters long, with the most common being 27 meters. Widths range from 10–20 meters, with ratios from 1:1.6 to 1:2.73. In Seaside the lots are 30–34 meters long by 12–15 meters wide, with ratios from 1:1.8 to 1:3.0.

We know from literature published about the New Urbanist communities that the developers consciously varied lot widths to encourage variety in house sizes and costs. In some of the Mediterranean cities, and in the 19th Century cities, uniformity was common, possibly because it was efficient and easy to develop.

Block Size

As I stated in the Introduction, blocks are areas of land bounded by streets. In a grid-pattern city the streets run perpendicular to each other, producing rectangles. In some Mediterranean Basin cities such as Piraeus, Olynthos, and Priene it appears that the lot size was determined before development started so that the street, block, and lot patterns are uniform. In Manhattan and San Francisco, we know that the streets were planned first, leading to blocks that are uniform but have a variety of lot sizes and shapes within them. In the New Urbanist communities blocks are not rigidly uniform, but do have a pattern that is recognizable.

<u>Piraeus, Greece</u>

Block length, 145 Doric feet / 47.56 meters. Block width, 124 Doric feet / 40.67 meters. Width to length ratio, 1:1.17

Olynthos, Greece

Block length, 300 Greek common feet / 89.1 meters. Block width, 120 Greek common feet / 35.64 meters. Width to length ratio, 1:2.5

Priene, Turkey

Block length, 160 Greek common feet / 47.36 meters. Block width, 120 Greek common feet / 35.52 meters. Width to length ratio, 1:1.33

Rhodes, Greece

Block length, 138 Doric feet / 45.00 meters. Block width, 77 Doric feet / 25.10 meters. Width to length ratio, 1:1.79

Pompeii, Italy - I have shown dimensions in meters only since portions of Pompeii were laid out in Oscan feet and others may have been laid out in Roman common feet.

Northern Blocks, West Side.

Block length, 140.64 meters. Block width, 33.76 meters. Width to length ratio, 1:4.17

Southern Blocks, West Side.

Block length, 90.1 meters. Block width, 33.16 meters. Width to length ratio, 1:2.72

East Side Blocks

Block length, 86.36 meters. Block width, 33.43 meters. Width to length ratio, 1:2.58

Leptis Magna, Libya

Block length, 337 Roman common feet / 100 meters. Block width, 84 Roman common feet / 25 meters. Width to length ratio, 1:4

Manhattan, New York City

Chelsea

Block length, 800 English feet / 243.84 meters. Block width, 197.5 English feet / 60.2 meters. Width to length ratio, 1:4.05

Upper East Side

Block length, 405 English feet / 128.02 meters. Block width, 201.42 English feet / 61.39 meters. Width to length ratio, 1:2.09.

Denver, Colorado

Area 1

Block length, 375 English feet / 114.3 meters. Block width, 266 English feet / 81.08 meters. Width to length ratio, 1:1.41.

Area 2

Block length, 375 English feet / 114.3 meters. Block width, 266 English feet / 81.08 meters. Width to length ratio, 1:1.41.

San Francisco, California

Nob Hill

Block length, 412.5 English feet / 125.73 meters. Block width, 275 English feet / 83.82 meters. Width to length ratio, 1:1.5.

Richmond

Block length, 600 English feet / 182.88 meters. Block width, 275 English feet / 73.15. Width to length ratio, 1:2.5

Southern Village, Chapel Hill, NC

Area 1

Block length, 914 English feet / 278.59 meters. Block width, 241 English feet / 73.46 meters. Width to length ratio, 1:3.8.

Area 2

Block length, 480 English feet / 146.30 meters. Block width, 240 English feet / 73.15 meters. Width to length ratio, 1:2.0.

Area 3

Block length, 480 English feet / 146.30 meters. Block width, 240 English feet / 73.15 meters. Width to length ratio, 1:2.0.

<u>Central Park, Denver, Colorado</u>

Beeler Park,

Central Park Blvd. - Block length, 466.5 English feet / 142.19 meters. Block width, 319.5 English feet / 97.38 meters. Width to length ratio, 1:1.46

Alton Street – Block length, 466.5 English feet / 142.19 meters. Block width, 200 English feet / 60.96 meters. Width to length ratio, 1:2.33.

Beeler Street – Block length, 468 English feet / 142.65 meters. Block width, 200 English feet / 60.96 meters. Width to length ratio, 1:2.34.

Boston Street – Block length, 468.5 English feet / 142.80 meters. Block width, 350 English feet / 106.68 meters. Width to length ratio, 1:1.34.

Central Park West

The blocks in this neighborhood are rectangular, generally measuring 498.69 English feet / 152 meters long by 360.09 English feet /110 meters wide, with a ratio of 1:1.38.

South End

Trenton/Tamarac Street – Block length, 556 English feet/ 169.47 meters. Block width, 200 English feet / 60.96 meters. Width to length ratio, 1: 2.78.

Willow Court/21st Ave. – Block length, 569 English feet / 173.43 meters. Block width, 202 English feet / 61.57 meters. Width to length ratio, 1:2.8.

Xenia, Yosemite, Akron, Alton and Beeler – Block length, 500 English feet /152.40 meters. Block width, 201 English feet / 61.26 meters. Width to length ratio, 1:2.49.

Seaside, Florida

Natchez Street – Block length, 367 English feet / 111.86 meters. Block width, 204 English feet / 62.18 meters. Width to length ratio, 1:1.8.

Odessa Street – Block length, 382 English feet / 116.43 meters. Block width, 204 English feet / 62.18 meters. Width to length ratio, 1:1.9.

Pensacola Street – Block length, 382 English feet / 116.43 meters. Block width, 204 English feet / 62.18 meters. Width to length ratio, 1:1.9.

Grayton Street – Block length, 365 English feet / 111.25 meters. Block width, 204 English feet / 62.18 meters. Width to length ratio, 1:1.8.

Spartina Circle – Block length, 520 English feet / 158.50 meters. Block width, 241 English feet / 73.46 meters. Width to length ratio, 1:2.16.

Red Cedar Way – Block length, 768 English feet / 234.09 meters. Block width, 115 English feet / 35.05 meters. Width to length ratio, 1:6.68. This anomaly is explained by the lots on Red Cedar Way facing a park that provides direct access to nearby streets such that pedestrians do not have to go around the block to get to neighborhood destinations.

Buttercup Street – Block length, 271 English feet / 82.60 meters. Block width 260 English feet / 79.25 meters. Width to length ratio, 1:1.04.

In a grid system, blocks are the central component. They create the pattern upon which the system is based. Intuitively, residents and visitors may view streets as more important than blocks since that is how they navigate the community. The block, however, contains the homes, businesses, common spaces, churches, and civic buildings that form the city.

In looking at the width to length ratios above, we can see that a block can be anywhere from nearly square (1:1) to rectangular (1:4). The mean ratio is 1:2.2. The median is 1:2.0 and the mode is 1:1.9. It is possible that a larger sample size would yield slightly different results, but I feel certain that the range of 1:1 – 1:1.4 and the median of 1:2.0 are representative of most grid form cities.

Streets and Roads

Streets have several functions, including transportation and land access. I am using the term "street" for vehicle and pedestrian ways that define the blocks in the grid and give the property in the blocks value. I will use "road" for transportation facilities primarily intended to get people and goods from one point to another. In many cities the larger roads such as the Roman cardo and decamanus or New York's 5th Avenue were also used for processions on certain occasions.

In the U.S. today we are accustomed to streets and roads that were designed for motor vehicles. We also have heavy equipment and materials available to us that enable construction to take place quickly and without great amounts of hand labor. This was not the case in the ancient Mediterranean Basin or in the 19th Century U.S. Street and road construction consumed enough labor and materials that it was not undertaken lightly, nor were the facilities larger than they needed to be.

I collected data on sidewalks as well as streets and roads because pedestrian safety and comfort seem to have been a concern across time and culture. Sidewalks are part of the street system that is used to convey all types of traffic.

Piraeus, Greece

Street width: 15 Doric feet (327 mm) / 4.92 meters.

Olynthos, Greece

Street width: 17 Greek common feet (297 mm) / 5.05 meters.

Major north/south road: 30 Greek common feet (297 mm) / 8.91 meters.

Priene, Turkey

Street width: 12 or 16 Greek common feet (297 mm) / 3.56 meters or 4.75 meters.

Major east/west road: 24 Greek common feet / 7.13 meters.

Major north/south roads around the Agora: 20 Greek common feet / 5.94 meters.

Rhodes, Greece

Street width: 24.46 – 27.52 Doric feet (327 mm) / 8-9 meters.

Major east/west roads: 37 Doric feet / 12.10 meters.

Pompeii, Italy

West side:

Street width: 9.9 – 16.8 Roman common feet (296 mm) / 2.93 – 4.97 meters.

Major roads: 24.7 – 25.5 Roman common feet / 7.31 – 7.56 meters.

East side:

Street width: 10.0 – 18.6 Roman common feet / 2.96 – 5.52 meters.

Major road: 24 Roman common feet / 7.10 meters.

Gerasa, Jordan

Cardo width: 42 Roman common feet / 12.5 meters.

Decamanus width: 28 Roman common feet / 8.33 meters.

Leptis Magna

Major north-south roads: 33.7 Roman common feet / 10 meters.

Major east-west road width: 42 Roman common feet / 12.5 meters.

Manhattan, NY

Chelsea

Streets: 60 English feet (304.8 mm) / 18.28 meters.

Major roads: 100 and 140 English feet / 30.48 and 42.68 meters.

Upper East Side

Streets: 60 English feet (304.8 mm) / 18.28 meters.

Major roads: 100 English feet / 30.48 meters.

Note that street and road widths include sidewalks, and Park Avenue in Chelsea includes a wide median.

Denver, CO

Area 1

Streets: 80 English feet / 24.38 meters.

Area 2

Streets: 80 English feet / 24.38 meters.

Note that the street widths include sidewalks and wide parking strips between the edge of the street pavement and the sidewalk.

San Francisco, CA

Nob Hill

Streets: 59 – 84 English feet / 17.98 – 25.60 meters.

Major road (California): 96.67 English feet / 29.47 meters.

Richmond

Streets: 70 – 80 English feet / 21.34 – 24.38 meters.

Major road (Geary): 125 English feet / 38.1 meters.

Major road (Arguello): 100 English feet / 30.48 meters

Note that the street widths include sidewalks.

Southern Village, Chapel Hill, NC

Area 1

Streets: 52 English feet / 15.85 meters.

Area 2

Streets: 52 English feet / 15.85 meters.

Area 3

Streets: 52 English feet / 15.85 meters.

Note that the street widths include sidewalks and parking strips.

Central Park, Denver, CO

Beeler Park

Streets: 60 English feet / 18.29 meters

Major road (Beeler Street): 114 English feet / 34.75 meters.

Note that the Beeler Street includes sidewalks and a median.

Central Park West

Streets: 60 English feet / 18.29 meters.

South End

Streets: 60 English feet / 18.29 meters.

Seaside

Seaside 6

Streets: 35 English feet / 10.67 meters.

Note that the streets are narrow with no sidewalks. Pedestrians may walk in the road or use paths to the rear of the homes.

Cinnamon Fern

Streets: 40 English feet / 12.19 meters.

Major Road (Western Lake Drive): 60 English feet / 18.29 meters.

Note that the streets have sidewalks on both sides.

Lake Forest

Streets: 40 English feet / 12.19 meters.

Major Road (Western Lake Drive): 60 English feet / 18.29 meters.

Note that the streets and the road have sidewalks on both sides.

Sunset Ridge

Streets: 45 English feet / 13.72 meters.

Note that the streets have sidewalks on both sides.

Street widths have certainly changed over time, with the Mediterranean Basin streets being narrower than those in the U.S. cities, both in the 19th and 20th centuries. As mentioned above, before heavy equipment was available, city builders did not make ordinary streets wider than necessary to access adjoining property. If the residents normally travelled by foot, a narrow street would be adequate, and supplies could be transported by horse or donkey. A cart or freight wagon could traverse a three-meter street if the driver did not need to pass another cart. For two carts to pass would require approximately six meters of space. Interestingly, that is the same width needed today for two cars to pass each other.

In my selected Mediterranean cities, most streets could accommodate one-way cart traffic, while the major roads would serve two-way traffic. In my 19th century cities, the rights-of-way easily accommodated sidewalks and carriageway that separated vehicles from pedestrians and allowed two-way vehicle movement. In the New Urbanist communities, an attempt was made to narrow the streets to slow speeds and promote pedestrian safety, but even the smallest streets (18 feet of pavement) allow two-way traffic.

In spring 2022 I visited the seaside town of Whitby in northern Yorkshire, England (U.K.) Whitby was not laid out in a grid pattern and its streets wind and intersect at odd angles. I decided to assess the widths of some of the typical streets in the center of town. I was able to determine that the street widths were original to the 18th and 19th centuries based on the ages of the structures that abutted them. Building walls and retaining walls defined the edges of the roads, which sometimes, but not always, contained small sidewalks on one or both sides.

I found that the smaller, one lane streets were 12 feet (3.7 meters) wide, while the two-lane streets were 18 feet (5.5 meters) wide. The mid-block alleys were 4-5 feet (1.5 meters) wide. In walking several of them I determined that they were original to the town layout and were intended to, and still serve as, pedestrian transportation routes. My anecdotal conclusion was that street layout, in Whitby at least, had been done according to a set of rules that defined construction even if the block layout was irregular. I was struck by the fact that the street widths were like those of the cities in the ancient Mediterranean.

In conclusion, streets and roads are built to handle the traffic that is anticipated by the developers. When circumstances change, such as in New York, the result is congestion, mitigated by construction of elevated or underground travel ways. In Pompeii, Poehler (2008) says it was “a small city gone big” and that the streets were crowded. From his analysis of ruts in the pavement stones, most streets were one-way through cooperation of the wagon drivers. Pompeii had a 500-year history before its destruction and had outgrown its street system.

Sidewalks

As I stated above, sidewalks are part of the street system in which a portion of the public space is allocated to pedestrian traffic while the space in between is allocated to vehicles, pack animals, horseback riders, marching troops or other users that are incompatible with individual humans on foot. In the ancient Mediterranean basin, Pompeii is the best example of how sidewalks may have looked in other Greek and Roman cities. There are sidewalks on major streets where heavy traffic of all types might be anticipated, and no sidewalks on minor streets.

In 19th century U.S. cities, sidewalks seem to have been considered essential, and in Manhattan and San Francisco the widths indicate that heavy pedestrian traffic was anticipated. Both cities became much more densely populated than was anticipated when they were laid out, and the sidewalk system is often crowded.

In 19th century Denver and in the New Urbanist communities I looked at the typical sidewalk is five feet (1.524 meters) wide. While not universal, five feet is the most common standard in the U.S. today outside of downtown areas.

CHAPTER VI: CONCLUSIONS

When I began my research, I was intrigued by the notion, discussed at times since the early 20th century, that some cities are planned and that others are "organic". Planned cities, presumably, were laid out by people working according to accepted norms about what a city should look like, while organic cities grew based on individual decisions. I realized that a city looked "planned" when it conformed to a pattern that the researcher recognized, and that the most common pattern was a grid. Other cities may have, in fact, been planned but without records to review the plan may not be obvious.

Cities are large artifacts; they are conceived of and made by human beings, just as pots, houses and vehicles are the result of mental images that people have of what a particular object should look like. When a group of people is organized in a way that allows them to share an image of a city, then it can be created according to a plan. At one end of the spectrum is the Roman castrum. This military camp could be transient or permanent, but it was always constructed according to a plan. Since the residents were trained soldiers, they would work together to rapidly build the camp, and then improve it according to circumstances.

At the other end were groups of migrants looking for better circumstances or moving away from hostile forces. They might find a suitable area and then simply spread out, with each family building its own shelter.

In the preceding chapters I have looked at cities that were designed for relatively large populations, were built on open sites, and were under some pressure to produce a habitable city in a short period of time. For the analysis I broke down the components and variables that go into city-building and looked for commonalities across time and culture. Along the way I discovered several unexpected things as well as developing a better understanding of what most people think of as the components of a city.

Measurements

It was interesting to realize that to build a city you need to measure things, and that there are standard ways to do so. The Minoan foot from 1,500 BCE, the Roman common foot from 100 AD and the English foot from today are only a few millimeters apart in length. While the foot was not the only measure used, it appears frequently, and is the basis for larger measures such as the yard and the mile. It was also apparent that reporting measurements for streets, blocks, or other components of a city are best done in the original measures since they are often even and regular numbers. Greaves pointed that out in his 17th century article on the “Romane foot”. While intriguing and worthy of the future study, I was not able to pursue this avenue any further.

City Components

During the Introduction I enumerated the city components I would be studying across time and culture. For the most part they work together to produce a harmonious development pattern because the people laying out the city are hoping to satisfy/please the future residents.

Lots

The smallest component is the lot; the space occupied by a single household or business. Whether in Olynthos, Priene or Manhattan, the lot was clearly a product of a mental image, a rectangle with a length/width ratio ranging from 1:1 to 1:4, depending on the expected configuration of the structure and its associated yard or atrium. Lot lines may be altered as the needs of the residents change. In some cases, the lines change very little over time, and in others, such as San Francisco they are completely redrawn. In Pompeii, which had a 500-year history, only a few of the original lines, as defined by interior walls, appeared to remain.

Blocks

While it may seem counterintuitive, the block is *the* most important component of a city. In a grid layout it is any four-sided rectangle bounded by roads or other hard feature such as a wall. Within the block most of the activities associated with a city take place. People live, work, conduct business and recreate there. It can be relatively easy to move a lot line within a block. It requires only the agreement between two or three parties. In the case of the block, everyone needs to agree to a change, or have it forced on them. That is why, in the case studies shown earlier, the block is a durable component. Even in San Francisco, where large areas were burned and cleared in 1906, the blocks generally remained the same.

Blocks have a length and a width, and I have recorded the ratios between the two in the cases studies. They range from 1:1.1 to 1:4 with the mean, median and mode all being close to 1:2. There is typically a dominant, public-facing side and a secondary side with fewer or no buildings facing them. In the case studies I examined, most of the blocks are double loaded; that is, there are two rows of buildings that face streets but back up to each other. This is certainly an easy and efficient way to create usable blocks, but I was intrigued by how common it was. In Central Park, CO, where some blocks faced green space rather than roads it felt like a marketing strategy rather than a legitimate alternative to traditional development.

On a closing note to the discussion of blocks, New Urbanists have long favored the grid pattern and short blocks because they are convenient to pedestrians since no one has to walk very far in one direction before being able to turn, and doubling back get to a location on the other side of the block is minimized.

Streets

When people think of a grid pattern city, they generally think of streets intersecting each other at right angles and having fairly even spacing between them. Streets are often durable artifacts, particularly those in Roman cities where deep base courses and basalt pavers were used. Once established, the pattern persists since it is easier to overlay the streets than to dig them up and move them. In Nafplio, Greece, I observed street work being done to narrow the pavement and widen the sidewalk on a downtown commercial street. That work included drainage, so portions of the existing street had been dug up. The original Roman-style street was clearly visible, one meter down. The new curb line and sidewalk were being built directly above the originals.

I believe that most people view streets and blocks as part of the same urban fabric since they help define each other. In my research it became clear that streets and blocks can operate independently of each other. Streets provide access to property and transportation between origins and destinations. Blocks contain the activities that the street system serves. In most of my sample cities the two are balanced. By balanced I mean that the land use (blocks) does not generate more traffic than the street system can handle. In Piraeus, Priene and Olynthos it appeared that the city plan anticipated a particular number of residents and that the lots, blocks, and roads were laid out to accommodate them. In Manhattan, on the other hand, the streets were laid out to serve townhouse development, but the city outgrew its street system by building vertically. Likewise, Pompeii appears to have streets that are too narrow for the population and development that existed in 79 A.D.

I devoted significant research to street widths. I found that widths were likely related to the traffic that the city designers expected. If two-way wagon traffic was anticipated, then the street would be 17+ feet (5.2 meters) wide. If only the occasional wagon, or pack train was anticipated the road could be 12 feet (3.7 meters) wide, like the streets I encountered in Whitby, England. If the terrain was too steep for wagons, like in Priene, then the streets might be 6 feet (2 meters) wide. I discovered a corollary: Times change, and the assumptions of the original designers could be rendered obsolete. The seemingly generous streets and sidewalks in Manhattan are now overcrowded and many have been converted to one-way traffic. It might be noted that the famous Brooklyn Bridge was originally designed for pedestrians and horse-drawn cabs. Today the bridge deck is crowded with motor vehicles and the pedestrians are relegated to a walkway suspended above the road.

Sidewalks

Sidewalks are a city component that gained much interest and attention during the New Urbanist movement. One aim of the movement has been to increase densities and put people and their destinations within walking distance. To encourage walking, people need sidewalks. This concept was never a question in the ancient world, nor in 19th century America where everyone walked. Once people started to drive, however, the need for sidewalks was less clear. In Greensboro, NC construction of new sidewalks was abandoned after World War II and not resumed until the 1990s.

I looked at the relationship between the area devoted to sidewalks and the area devoted to carriageways to judge the "value" given to each. While it makes sense in my 20th century sample cities where automobile speeds are great, it makes less sense in the ancient Mediterranean and 19th century U.S. cities where pedestrians and vehicles often mingled. The sidewalks there were a convenience and a way to keep your feet clean. I was interested to see that in the 19th century U.S. the amount of space devoted to sidewalks was generous. Ten to fifteen feet in urban Manhattan and San Francisco, and five feet plus a wide parking strip in Denver. Today, in suburban areas, the standard sidewalk width is five feet while sidewalks in downtown areas may be wider. It should be noted, however, that many downtown areas were laid out in the 19th century when pedestrians were a major design consideration.

Conclusion

To recap, time and again through different eras and cultures, when a society has chosen or been forced to lay out a city that will accommodate many people in a short time, they have chosen the grid. The lots are regular in size, the blocks have a width to length ratio of about 1:2, the streets intersect at right angles and the carriage ways and sidewalks are built to handle the expected traffic. These cities are artifacts that reflect the societies that created them. The fact that circumstances change and some features of the city do not work as well as originally intended, should not be seen in a negative light.

New Urbanists recognized that in order to return to building places where people can walk, the community layout needs to be walkable. The term “walkable” in this context means being able to walk along and between relatively small blocks to access a variety of destinations (the grid). They also recognized that the motor vehicle had negatively affected this dynamic by eliminating the time penalty involved in traveling to a distant destination. The average person can walk three miles in an hour while the same person in a vehicle can travel 60 miles in an hour.

The perception in today’s urban areas is that vehicles can cause congestion and that they can be dangerous to pedestrians and cyclists. While these perceptions are accurate, the biggest effect that vehicles have on urban areas is in the time/distance dynamic. We assume that we can go about our lives without having to worry about traveling 10–50 miles a day. That means our urban areas do not need to be efficient for pedestrian movement. The corollary is that the efficiency inherent in the grid layout is not critical today to providing housing and commercial areas. Residential areas can be remote from the city center and may consist of long streets with frequent cul-de-sacs. Commercial development may be spread out for miles along major roads. In these environments walking as a means of transportation does not work.

Understanding the long history of the grid and why its components are arranged the way they are can inform urban design. Knowing that the components of the grid have been consistent over time means that we can understand the “map in the mind” that city designers have had and know they work for people who use walking as their primary means of transportation.

I think that new development or redevelopment areas should first be organized in ways, such as the grid, that are designed primarily for the pedestrian. This is a different view of the term “walkable” that is frequently used today. “Walkable” to most people means that there are sidewalks available for people to use. The walkable design inherent in the grid means that walking as a means of transportation is convenient and functional.

If a walkable grid environment is overlaid with a collector/arterial network designed to allow pedestrian access between neighborhoods, then vehicles can be accommodated without negatively affecting what is primarily a walking environment. Central Park in Denver, for the most part, illustrates this concept where all of the 12 neighborhoods are walkable.

I believe that further research is needed to quantify and explain how the grid functions and how it can be used to design urban development today. This is in keeping with the principles of the CNU touched on in the Introduction.

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