7. ENVIRONMENTAL IMPACTS

7. INTRODUCTION

This section presents information on the existing environmental conditions in the vicinity of the Project site and the potential changes that may occur as a result of the Project. The goal of the Project is to better utilize the Project site and complement adjacent uses while minimizing potential adverse environmental impacts to the greatest extent feasible.

As discussed in more detail below, the Project-related impacts, which are to be expected in urban development of this scale, are counterbalanced by the significant public benefits for the adjacent neighborhoods and the City. The following sections identify Project impacts and discuss steps that have been or will be taken through design and management to avoid, minimize and/or mitigate adverse effects.

Where the current state of the design allows, this Concept Plan provides an assessment of the following Project impacts:

- Pedestrian Wind
- Shadow
- Noise

7.1 WIND

7.1.1 INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by the Applicant to complete a pedestrian level wind assessment for the proposed Project. The objective of this assessment is to provide a qualitative evaluation of the potential wind conditions on the Project and the impact of the Project on the surrounding public outdoor areas in terms of pedestrian wind comfort and safety. This qualitative assessment is based on the following:

- A review of the regional long-term meteorological data from Boston Logan International Airport;
- 3D e-model received by RWDI on July 15, 2016;
- Wind-tunnel studies undertaken by RWDI for similar projects in Cambridge and the surrounding cities;
- Our engineering judgment, experience and expert knowledge of wind flows around buildings[1,2,3]; and,
- Use of software developed by RWDI (Windestimator[2]) for estimating the potential wind conditions around generalized building forms.

If necessary, conceptual measures to improve wind conditions will also be provided. This qualitative approach provides a screening-level estimation of potential wind conditions. In order to quantify the wind conditions and to refine wind control solutions, physical scale model tests would be required. Note that other wind issues, such as those related to thermal comfort, door operability, wind loading, etc., are not considered in the scope of the assessment.

RWDI #1603158
August 4, 2016

[1] C.J. Williams, H. Wu, W.F. Waechter and H.A. Baker (1999), "Experience with Remedial Solutions to Control Pedestrian Wind Problems", 10th International Conference on Wind Engineering, Copenhagen, Denmark.

[2] H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", ASCE Structure Congress 2004, Nashville, Tennessee.

[3] H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", Journal of Wind Engineering and Industrial Aerodynamics, vol.104-106, pp.397.407.

7.1.2 SITE AND BUILDING INFORMATION

The Project site is located in Cambridge, MA in the block bound by Broadway to the south, Galileo Galilei Way to the west, Binney Street to the north and the 6th Street Connector to the east. The Project consists of four buildings ranging from 177 ft to 393 ft in height as measured to the top of their mechanical penthouses (Figure 7.2). Phase 1 encompasses Commercial Building A and Phase 2 include both Commercial Building B and Residential Building South. This latter is connected by a large garage podium to Residential Building North, which comprises Phase 3. The existing lots for each phase are occupied by low-rise buildings as shown in Figure 7.1. Publically accessible areas on and around the site include main building entrances, sidewalks and walkways between buildings.

Most public areas at grade level in the vicinity are densely landscaped with large canopy-type trees, which is positive for wind control. The site is located in a densely built up area comprised of several mid-rise buildings (similar in height to the proposed Project) in all directions and low-rise residential development in the distance to the west, north and northwest. Downtown Boston is about 1.5 miles to the southeast.

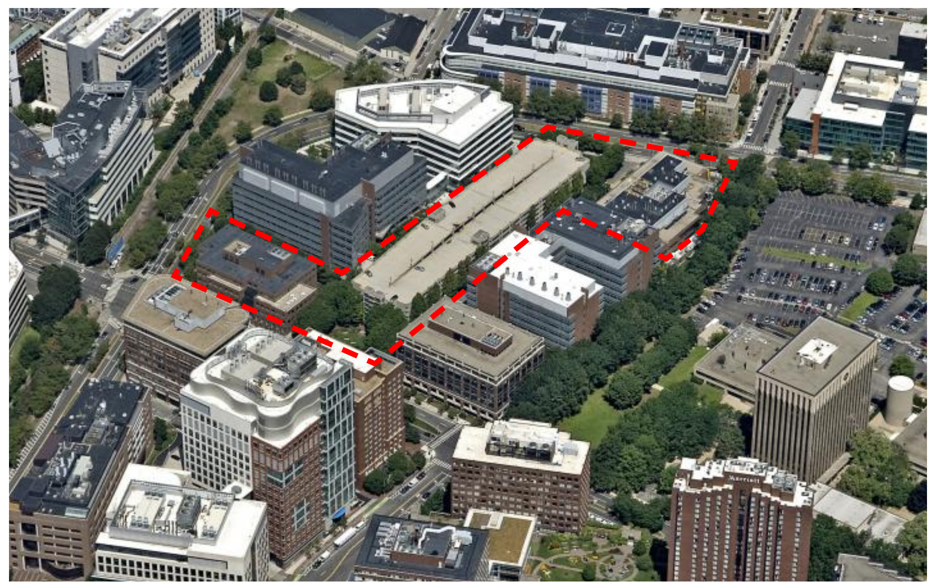


FIGURE 7.1 PROJECT SITE AND EXISTING SURROUNDINGS

7.1.3 METEOROLOGICAL DATA

The analysis was completed for two main periods of the year, namely the summer months (May to October) and winter months (November to April). Meteorological data from Boston Logan International Airport for the period from 1990 to 2015 were used as reference for wind conditions in the region.

The distributions of wind frequency and directionality for summer and winter seasons are shown in the wind roses in Figure 7.3. Winds from the southwest and west-northwest directions are predominant in the summer. In the winter, the predominant of winds are from the west through the northwest.

Strong winds of a mean speed greater than 20 mph measured at the airport (red bands) occur more often in the winter than the summer and are predominantly from the southwest, northwest and northeast quadrants. These strong winds could potentially be the source of uncomfortable or even severe wind conditions, depending upon the site exposure or development design.

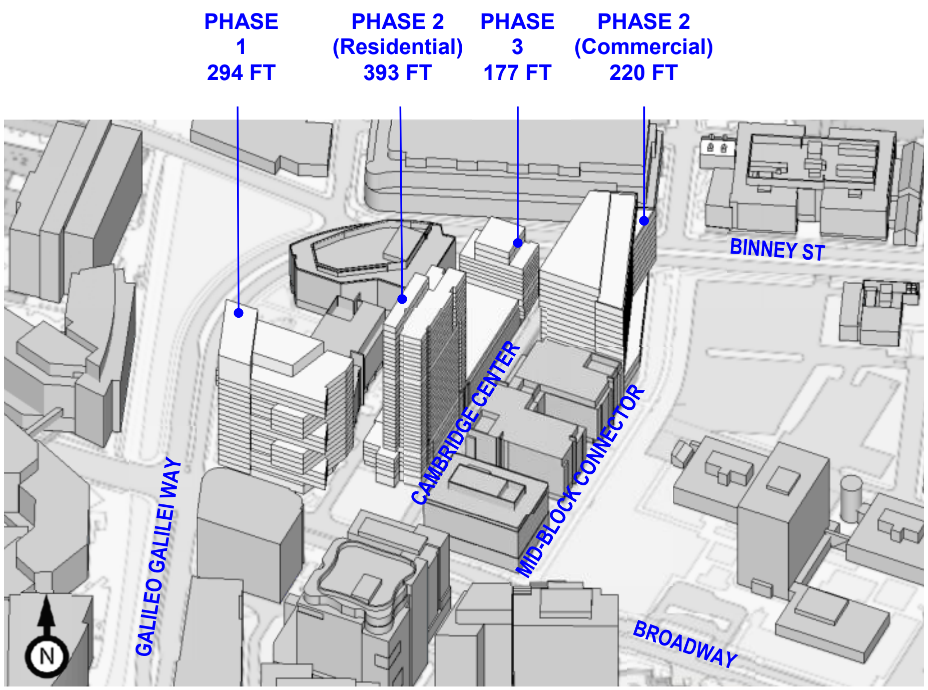
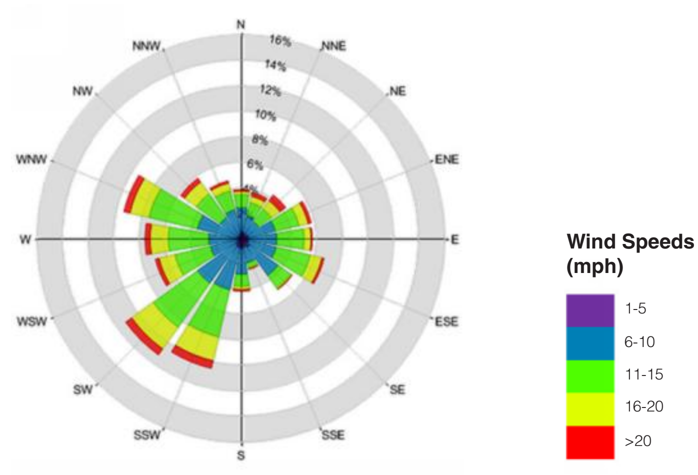
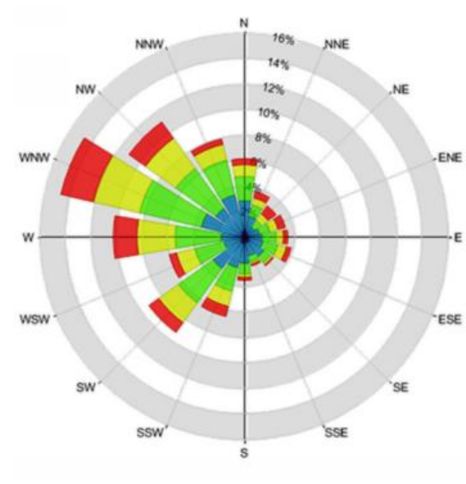


FIGURE 7.2 PROPOSED DEVELOPMENT CONTEXT AND BUILDING HEIGHTS



Summer (May to October)



Winter (November to April)

FIGURE 7.3 DIRECTIONAL DISTRIBUTION (%) OF WINDS (BLOWING FROM) BOSTON LOGAN INTERNATIONAL AIRPORT (1990 TO 2015)

7.1.4 PEDESTRIAN WIND CRITERIA

The RWDI wind comfort criteria deal with both pedestrian safety and comfort, as they relate to the force of the wind. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities as well as by the building design and city planning community.

Safety: Pedestrian safety is linked to excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance occur more than 0.1% of the time or 9 hours per year, the wind conditions are considered severe.

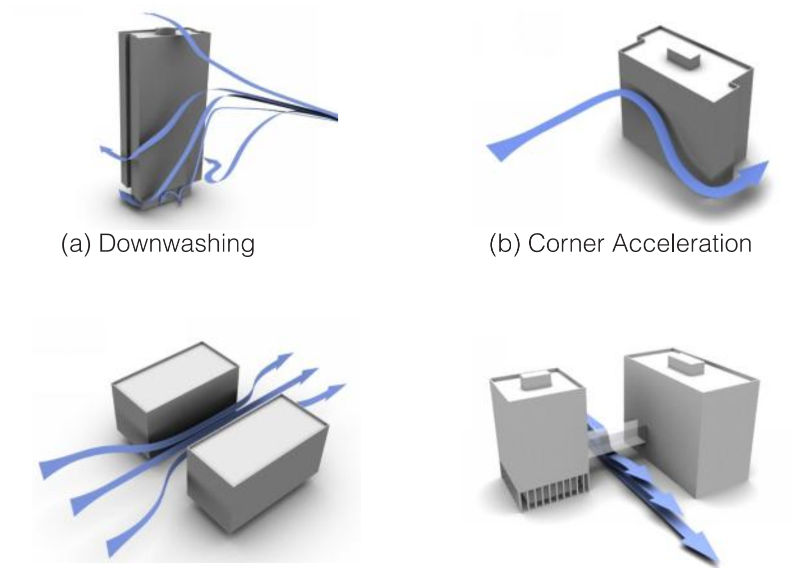
Comfort: Wind conditions are considered suitable for sitting, standing, strolling or walking if the wind speeds corresponding to the respective categories are expected for at least four out of five days (80% of the time).

- Sitting: Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.
- Standing: Gentle breezes suitable for main building entrances and bus stops.
- Strolling: Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.
- Walking: Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.
- Uncomfortable: None of the above comfort categories are satisfied.

Wind control measures are typically required at locations where winds are either rated as uncomfortable or exceed the wind safety criterion.

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

Pedestrians on walkways and parking lots will be active and wind speeds comfortable for walking or strolling are appropriate during the summer and winter. Lower wind speeds comfortable for standing are desired at building entrances where people are apt to linger. On playgrounds, sitting areas and other amenity spaces, low wind speeds comfortable for sitting or standing are desired during the summer. In the winter, wind conditions in these areas may not be of a serious concern due to limited usage and therefore higher wind activity may be acceptable



(a) Downwashing
(b) Corner Acceleration
(c) Channeling
(d) Underpass Acceleration

FIGURE 7.4 - GENERIC WIND FLOW PATTERNS

7.1.5 PEDESTRIAN WIND CONDITIONS

Predicting wind speeds and occurrence frequencies involves the assessment of building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate. Over the years, RWDI has conducted thousands of wind-tunnel model studies on pedestrian wind conditions around buildings, yielding a broad knowledge base. This knowledge has been incorporated into RWDI's proprietary software that allows, in many situations, for a qualitative, screening-level numerical estimation of pedestrian wind conditions without wind tunnel testing. The following sections discuss the predicted impact of the proposed development on wind conditions on and around the development site.

GENERIC WIND FLOW PATTERNS

The following discussion describes the impacts of the proposed Project on wind conditions. In this discussion, references will be made to a few generic wind flow phenomena as shown in Figure 7.4. Tall buildings tend to intercept winds at high elevations and direct them down towards the street in a phenomenon called downwashing (Figure 7.4a). The downwashed winds could subsequently accelerate around building corners (Figure 7.4b), channel along street canyons (Figure 7.4c) and/or accelerate under any bridge connections (Figure 7.4d). If one or more of these wind flow phenomena occurs for the prevailing wind directions, there is the potential for higher than desired or severe wind activity at the ground level.

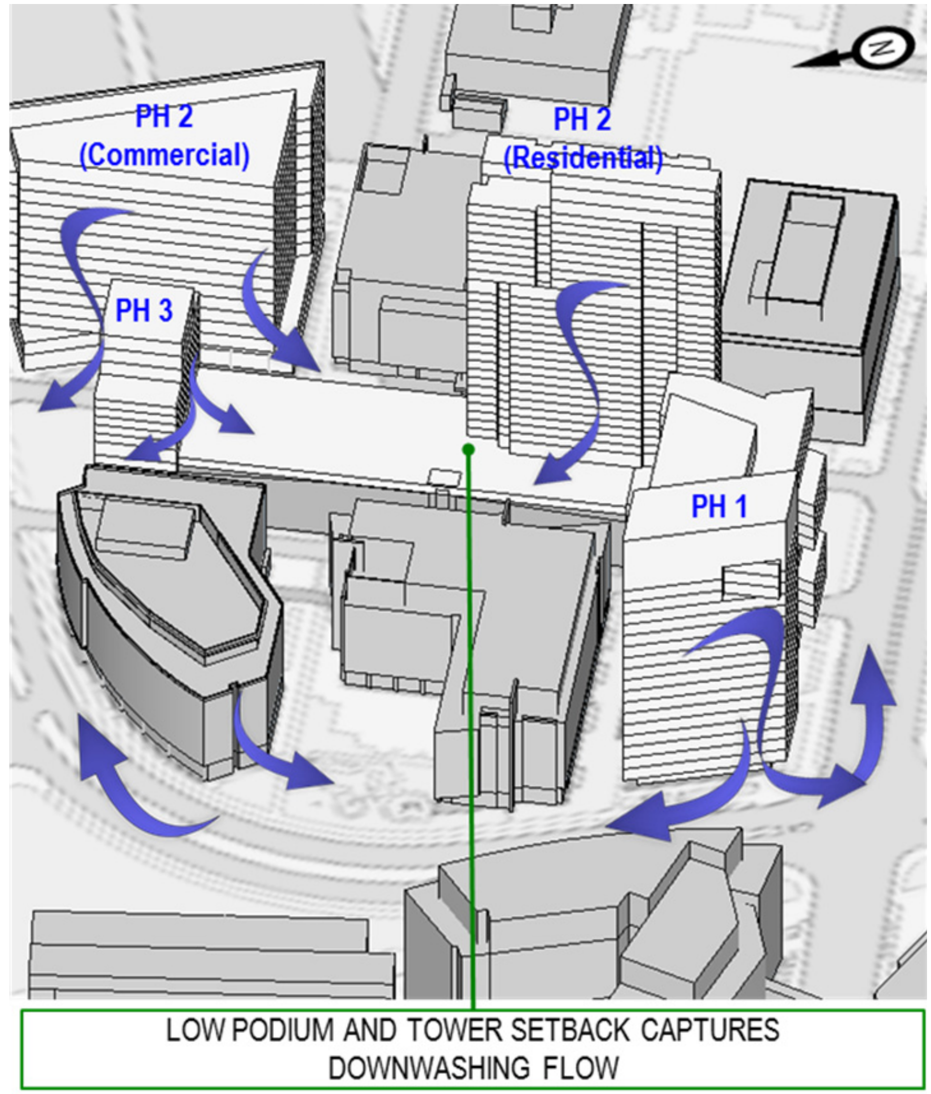
IMPACT OF THE PROPOSED DEVELOPMENT

The proposed Phase 1, 2 (Commercial Building B) and 3 buildings are fairly similar in height to several of the taller buildings in the neighborhood to the south and west. However, they are taller than existing buildings in the immediate vicinity and the surroundings to the west, northwest, north and northeast, which leaves them exposed to prevailing winds from those directions. Therefore, expected results would include downwashing and acceleration of winds on the streets surrounding the Project, as well as the walkways between them. However, the Project Component designs include mitigating measures such as deep setbacks, low podiums and closely spaced buildings which would protect the streets from high wind activity to a large extent (Figure 7.5).

The sidewalks around the Project are currently lined with canopy-type trees which serve to shelter the sidewalks from adverse wind effects in the summer and parts of spring and fall when the trees retain their foliage. During the rest of the year when the trees are bare, they are ineffective against strong winds. The predicted wind flow pattern around the proposed development is illustrated in Figure 7.5.

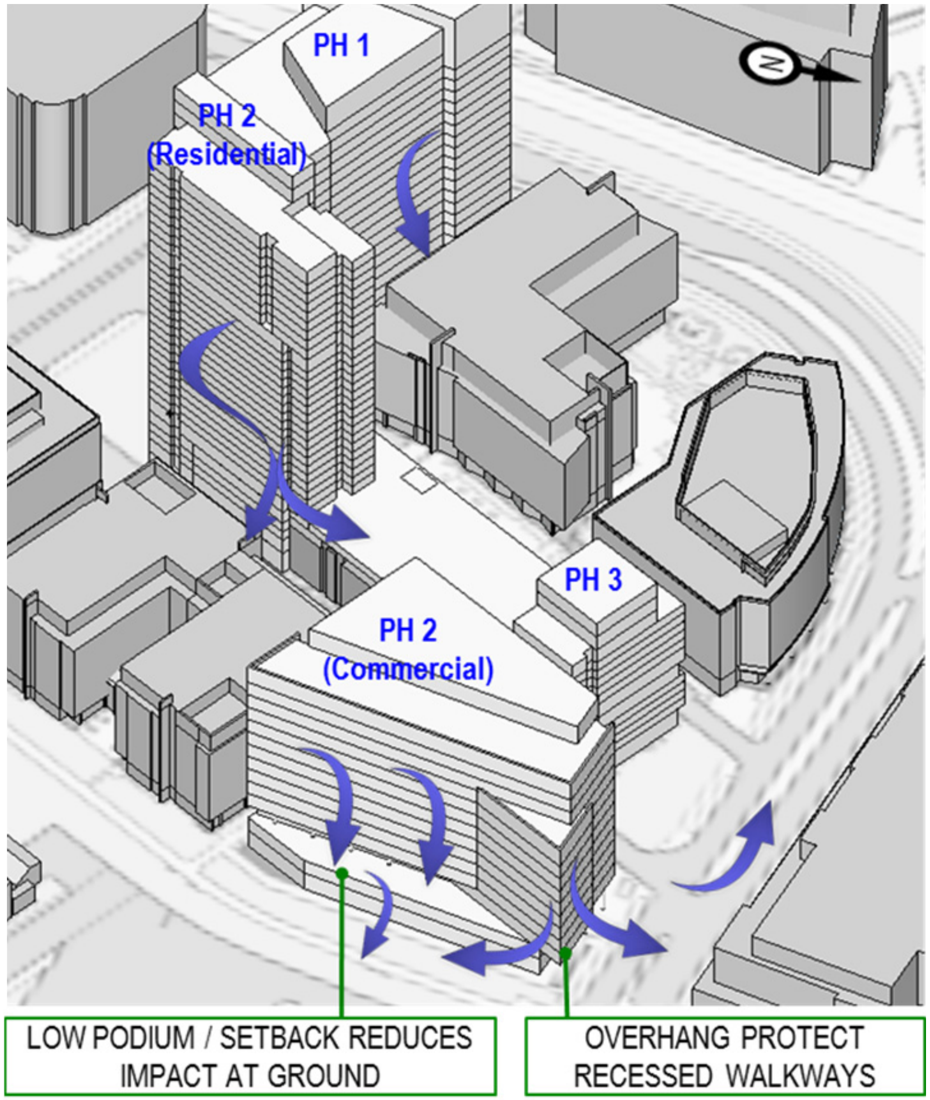
SAFETY

As is expected with any new development of this scale, the proposed buildings would increase wind activity around the Project site. However, as discussed, the densely built up surroundings protect the streets from adverse wind activity. It is expected that wind speeds at ground level on and around the Project site would meet the pedestrian wind safety criterion.



(a)

FIGURE 7.5 - PREDICTED WIND FLOW PATTERNS AROUND THE DEVELOPMENT



(b)

FIGURE 7.5 - PREDICTED WIND FLOW PATTERNS AROUND THE DEVELOPMENT

COMFORT

For the same reasons discussed under the Safety section, wind conditions around the Project are predicted to be appropriate for pedestrian activities. Overall, wind speeds at most areas are anticipated to be comfortable for standing or strolling in the summer (Figure 7.6a). Areas covered by dense street trees would be protected further and wind conditions in those areas would likely be calm and comfortable for sitting.

During the winter, deciduous trees do not retain their foliage and therefore would not be effective for wind control. Additionally, winds are seasonally stronger in the winter. Wind conditions at most areas on and around the development are predicted to be comfortable for strolling or walking (Figure 7.6b).

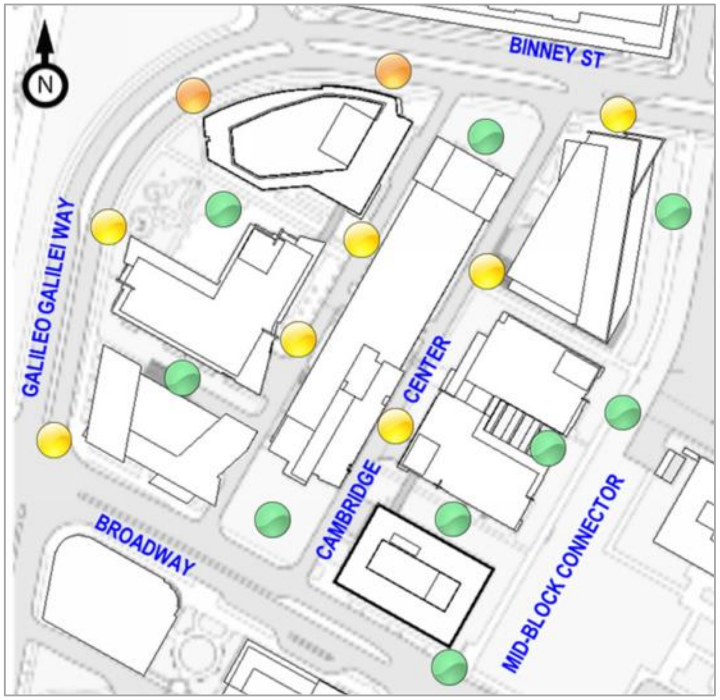
Overall future wind conditions would be fairly similar to that experienced around the existing site. Increased wind activity would be localized around the taller buildings. Although there would be an increase in wind activity at ground level, the conditions would be appropriate for pedestrian use throughout the year. During the winter, the higher wind speeds predicted would not be a concern due to limited outdoor pedestrian activity. If lower wind speeds are desired in areas rated "strolling" or "walking" in Figure 7.6 (to locate an entrance or seating benches for example), dense plants, trees or other landscaping features, or wind screens may be used for wind control. Such features would be approximately 20%-30% porous and 6-8 ft tall to be effective (See examples in Figure 7.7). It would be beneficial for main entrances to be designed with closed vestibules or large lobbies so as to provide occupants with a protected waiting area on windy days and in the winter.

Wind tunnel studies could be performed to quantify conditions and subsequently develop specific wind control measures for each area.

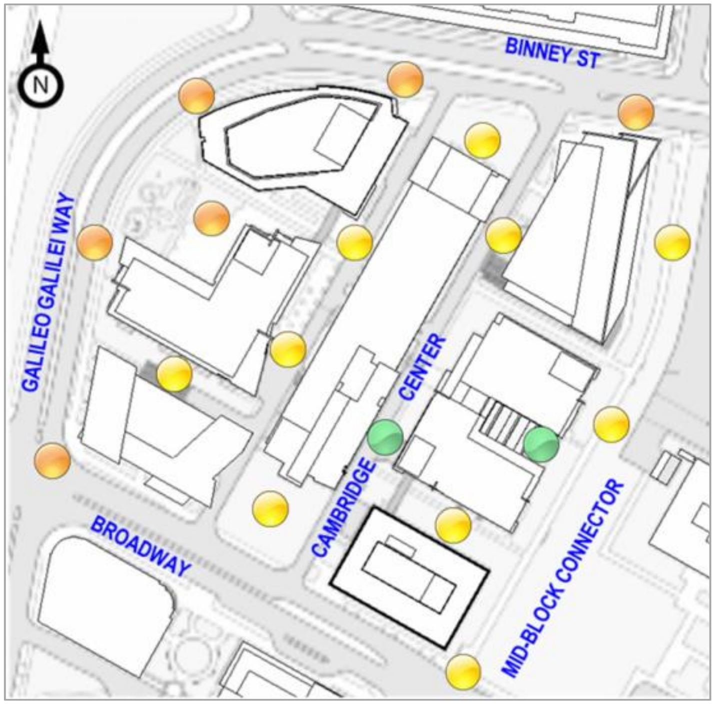
Description of Wind Conditions:

Low wind speeds comfortable for passive activities — sitting or standing

Moderate wind speeds comfortable for active pedestrians — strolling or walking



(A) SUMMER
ASSUMING DENSE STREET LANDSCAPING



(B) WINTER
ASSUMING NO STREET LANDSCAPING

FIGURE 7.6 - PREDICTED WIND CONDITIONS AROUND THE DEVELOPMENT

FIGURE 7.7 - EXAMPLES OF WIND CONTROL MEASURES

(a) Canopies Above Entrance

(b) Wind Screens

7.2 SHADOW STUDIES

The illustrations in the following section present the estimated net new shadow as a result of the Project (shown in blue) for the times of 9:00AM, 12:00PM, and 3:00PM during the Summer and Winter Solstices, and Spring/Fall Equinox. The net new shadow depicted falls both on the ground plane and on rooftops. Based on the shadow studies, the Project creates a modest amount of new shadow commensurate with urban development of this scale and is not expected to result in significant new shadow on surrounding public open space.

EQUINOX (MARCH 21 & SEPTEMBER 21)

March 21 and September 21 are the Spring and Fall Equinoxes, respectively, on which Cambridge experiences roughly equal length of day and night. The net new shadow for these conditions are depicted at the right. At 9:00AM, some net new shadow will fall along the southern portion of Binney Street Park and across Binney Street. At 12:00 PM, the majority of Project shadow falls within the Project site, with some new shadow cast across Binney Street. At 3:00 PM, the Project is expected to cast some net new shadow across Binney Street, along the northern end of the 6th Street Connector, and onto the adjacent Volpe parcel.

New Shadow
Existing Shadow
Proposed New Building

MARCH 21, 9:00 AM

MARCH 21, 12:00 PM

MARCH 21, 3:00 PM

7.2 SHADOW STUDIES

SUMMER SOLSTICE (JUNE 21)

June 21 is the summer solstice and the longest day of the year where the sun is highest in the sky. On this day, the Project casts the least amount of net new shadow, the majority of which is cast within the Project site. At 9:00AM, some net new shadow is cast on the southernmost tip of Binney Street Park and along the southern sidewalk of Binney Street. At 12:00 PM, the majority of Project shadow falls within the Project site, with some new shadow cast across Binney Street. At 3:00 PM, the Project is expected to cast net new shadow onto Binney Street and over the northern end of the 6th Street Connector, similar to the shadow cast by existing buildings located immediately to the south.

New Shadow
Existing Shadow
Proposed New Building

JUNE 21, 9:00 AM

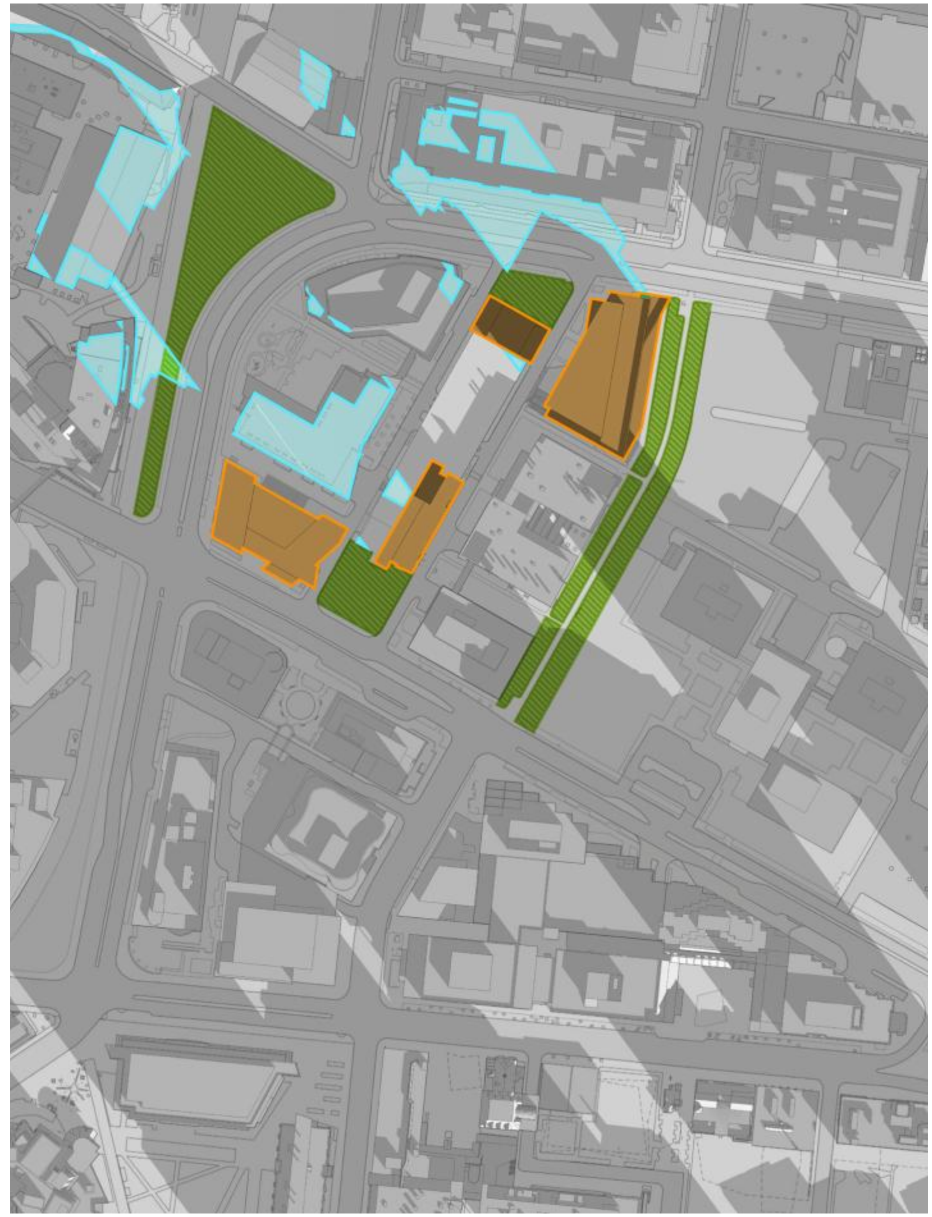
JUNE 21, 12:00 PM

JUNE 21, 3:00 PM

7.2 SHADOW STUDIES

WINTER SOLSTICE (DECEMBER 21)

December 21 is the winter solstice and the shortest day of the year, where the sun is low in the sky. Therefore, Cambridge experiences the longest shadows of the year on this day and many of the adjacent sidewalks and public spaces are already subsumed in shadow. At 9:00 AM, the sun is low in the southeast sky resulting in long shadows to the northwest. Net new shadows cast by the Project fall primarily over surrounding building rooftops. At 12:00 PM, the Project will create new shadow primarily over building rooftops and does cast some net new shadow onto the northern side of Binney Street Park. At 3:00 PM, the sun is low in the southwest sky and shadows are cast toward the northeast. The Project casts net new shadow within the Project site and across building rooftops to the northeast.



New Shadow
Existing Shadow
Proposed New Building

DECEMBER 21, 9:00 AM

DECEMBER 21, 12:00 PM

DECEMBER 21, 3:00 PM

7.3 NOISE

The noise impact assessment evaluated the potential noise impacts associated with the Project's activities, including mechanical equipment and loading activities. This section discusses the fundamentals of noise, noise impact criteria, noise analysis methodology, and potential noise impacts. Noise monitoring was conducted to determine existing ambient sound levels. The analysis demonstrates that the Project will comply with City of Cambridge's noise control ordinance (Municipal Code, Chapter 8.16).

7.3.1 FUNDAMENTALS OF NOISE

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, communication, work, or recreation. How people perceive sound depends on several measurable physical characteristics, which include the following:

- Intensity - Sound intensity is often equated to loudness.
- Frequency - Sounds are comprised of acoustic energy distributed over a variety of frequencies. Acoustic frequencies, commonly referred to as tone or pitch, are typically measured in Hertz. Pure tones have all their energy concentrated in a narrow frequency range.

Sound levels are most often measured on a logarithmic scale of decibels (dB). The decibel scale compresses the audible acoustic pressure levels which can vary from the threshold of hearing (zero dB) to the threshold of pain (120 dB). Because sound levels are measured in dB, the addition of two sound levels is not linear. Adding two equal sound levels creates a 3 dB increase in the overall level. Research indicates the following general relationships between sound level and human perception:

- A 3 dB increase is a doubling of acoustic energy and is the threshold of perceptibility to the average person.
- A 10 dB increase is a tenfold increase in acoustic energy but is perceived as a doubling in loudness to the average person.

The human ear does not perceive sound levels from each frequency as equally loud. To compensate for this phenomenon in perception, a frequency filter known as A weighted [dB(A)] is used to evaluate environmental noise levels. Table 7-1 presents a list of common outdoor and indoor sound levels.

A variety of sound level indicators can be used for environmental noise analysis. These indicators describe the variations in intensity and temporal pattern of the sound levels. The following is a list of common sound level descriptors used for environmental noise analyses:

- L90 is the sound level which is exceeded for 90 percent of the time during the time period. The L90 is generally considered to be the ambient or background sound level.
- Leq is the A-weighted sound level, which averages the background sound levels with short-term transient sound levels and provides a uniform method for comparing sound levels that vary over time.

TABLE 7-1 COMMON OUTDOOR AND INDOOR SOUND LEVELS

Outdoor Sound Levels	Sound Pressure (µPa)*		Sound Level dB(A)**	Indoor Sound Levels
	6,324,555	-	110	Rock Band at 5 m
Jet Over Flight at 300 m		-	105	
	2,000,000	-	100	Inside New York Subway Train
Gas Lawn Mower at 1 m		-	95	
	632,456	-	90	Food Blender at 1 m
Diesel Truck at 15 m		-	85	
Noisy Urban Area—Daytime	200,000	-	80	Garbage Disposal at 1 m
		-	75	Shouting at 1 m
Gas Lawn Mower at 30 m	63,246	-	70	Vacuum Cleaner at 3 m
Suburban Commercial Area		-	65	Normal Speech at 1 m
	20,000	-	60	
Quiet Urban Area—Daytime		-	55	Quiet Conversation at 1 m
	6,325	-	50	Dishwasher Next Room
Quiet Urban Area—Nighttime		-	45	
	2,000	-	40	Empty Theater or Library
Quiet Suburb—Nighttime		-	35	
	632	-	30	Quiet Bedroom at Night
Quiet Rural Area—Nighttime		-	25	Empty Concert Hall
Rustling Leaves	200	-	20	
		-	15	Broadcast and Recording Studios
	63	-	10	
		-	5	
Reference Pressure Level	20	-	0	Threshold of Hearing

7.3.2 METHODOLOGY

The noise analysis evaluated the potential noise impacts associated with the Project's mechanical equipment and loading/service activities. The noise analysis included measurements of existing ambient background sound levels and a qualitative evaluation of potential noise impacts associated with the proposed mechanical equipment (e.g., energy recovery units, cooling towers, etc.) and loading activities. The study area was evaluated and sensitive receptor locations in the vicinity of the Project were identified and examined. The site layout and building design, as it relates to the loading area and management of deliveries at the Project site were also considered. The analysis considered sound level reductions due to distance, proposed building design, and obstructions from surrounding structures.

RECEPTOR LOCATIONS

The noise analysis included an evaluation of the study area to identify nearby sensitive receptor locations, which typically include areas of sleep and areas of outdoor activities that may be sensitive to noise. The noise analysis identified six nearby sensitive receptor locations in the vicinity of the Project. As shown on Figure 7.8, the receptor locations include the following:

- R1 – Residence Inn Hotel;
- R2 – Marriott Hotel;
- R3 – Eastgate Apartments;
- R4 – Lofts at Kendall Square Apartments;
- R5 – Pedestrian Walkway (connecting Broadway and Binney St); and
- R6 – Public greenspace south of Cambridge Center garage.

These receptor locations, selected based on land use considerations, represent the most sensitive locations in the vicinity of the Project site.

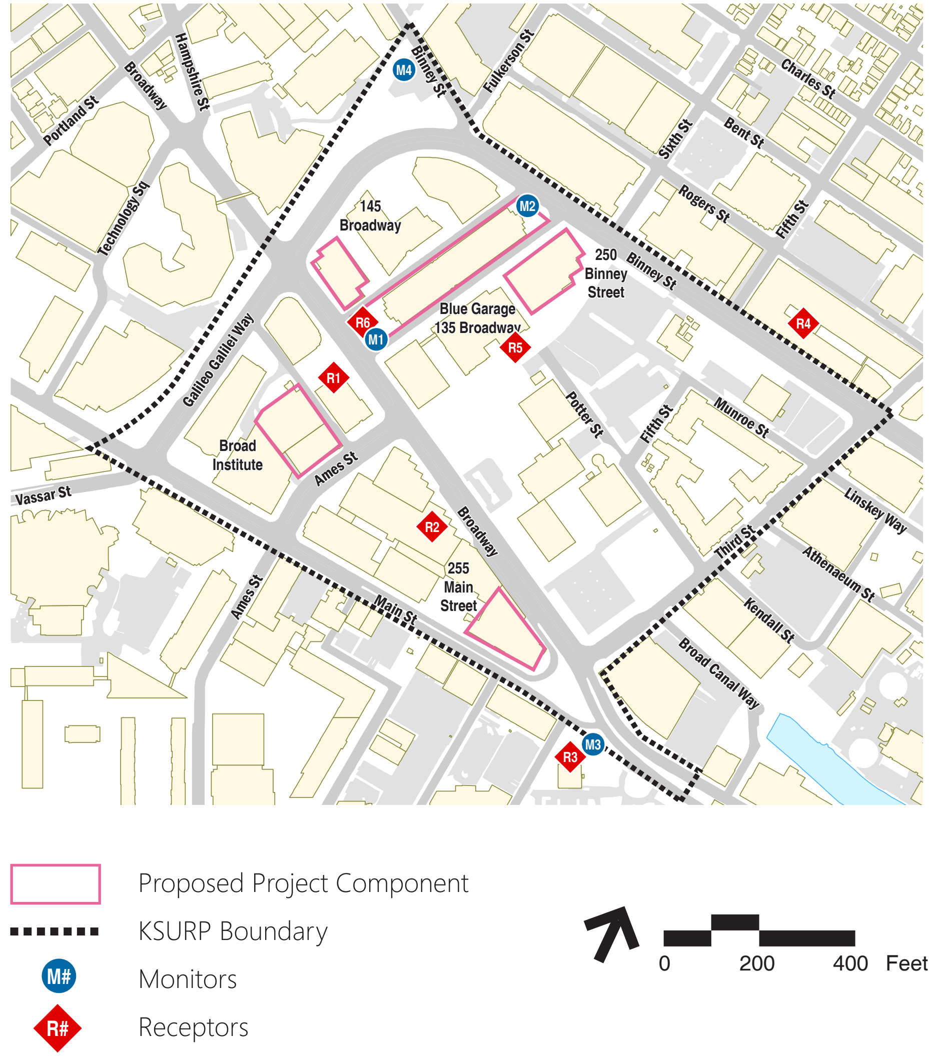


FIGURE 7.8 - RECEPTOR LOCATIONS

7.3.3 CITY OF CAMBRIDGE NOISE IMPACT STANDARDS

The City has developed noise standards that establish noise thresholds deemed to result in adverse impacts. The noise analysis for the Project used these standards to evaluate whether the proposed development will generate sound levels that result in potential adverse impacts.

The noise standards are provided under Chapter 8.16 of the City of Cambridge Municipal Code (Noise Ordinance). These standards establish maximum allowable sound levels based upon the land use affected by the proposed development. Table 7.2 summarizes the maximum allowable sound levels that should not be exceeded.

For a residential zoning district, the maximum noise level affecting residential uses shall not exceed the Residential Noise Standard. The single number equivalent noise standard for a residential use is 60 dB(A) for daytime periods (7:00 AM to 6:00 PM) and 50 dB(A) during other times of the day.

The City of Cambridge noise control regulation considers construction sound levels to be an impact to residential land uses if the L10 sound level is in excess of 75 dB(A) or the Lmax sound level is in excess of 86 dB(A) measured at the lot of the affected property.

TABLE 7.2 CITY OF CAMBRIDGE NOISE STANDARDS BY ZONING DISTRICT

Octave Band Center Frequency (Hz)	**Residential Area**		**Residential in Industrial**		**Commercial Area**	**Industry Area**
	Daytime	**Other Times**	**Daytime**	**Other Times**	**Anytime**	**Anytime**
31.5	76	68	79	72	79	83
63	75	67	78	71	78	82
125	69	69	69	69	69	69
250	62	52	68	57	68	73
500	56	46	62	51	62	67
1,000	50	40	56	45	56	61
2,000	45	33	51	39	51	57
4,000	40	28	47	34	47	53
8,000	38	26	44	32	44	50
Single Number Equivalent, dB(A)	60	50	65	55	65	70

Source: City of Cambridge Municipal Code, Chapter 8.16, Table 8.16.060E.

7.3.4 EXISTING NOISE CONDITIONS

A noise monitoring program was developed to establish existing ambient sound levels. The existing sound levels were measured using Type 1 sound analyzers (Larson Davis 831 and SoundExpert LxT). Measurements were conducted during the weekday daytime period (approximately 9:00 AM to 11:00 AM) and late night period (1:00 AM to 3:00 AM) in the vicinity of the Project Site on July 21, 2016. The monitoring program consists of three short-term monitoring locations, as shown in Figure 7.3. In addition, a 24-hr measurement was conducted in an open lot located at the corner of Binney Street and Fulkerson Street. During the daytime period, the measured sound levels data under existing conditions were composed of noise from construction activities and vehicles on local roadways, such as Binney Street and Broadway. The nighttime period sound levels were generally associated with mechanical equipment from nearby buildings. The existing measured sound level data are presented in Table 7.3.

The measured L90 sound levels range from approximately 58 dB(A) to 62 dB(A) during the daytime period and from 55 dB(A) to 59 dB(A) during the nighttime period. The result of the noise monitoring program indicates that the daytime sound levels within the study area are currently exceeding the City of Cambridge's daytime standard of 60 dB(A) along Broadway. The existing sound levels during the nighttime period exceed the City's nighttime standard of 50 dB(A) for residential use at all evaluated locations.

TABLE 7.3 EXISTING AMBIENT SOUND LEVELS, DB(A)

	City of Cambridge Residential District Noise Standard*		Measured L90 Sound Levels	
Monitoring Location	**Daytime**	**Nighttime**	**Daytime**	**Nighttime**
M1 –Broadway	60	50	**62**	**59**
M2 – Binney Street	60	50	60	**59**
M3 – Main Street	60	50	58	**55**
M4 – Lot at Binney St/Fulkerson St	60	50	60	**58**

7.3.5 FUTURE NOISE CONDITIONS

The noise analysis evaluated the potential noise impacts associated with the Project's proposed mechanical equipment and loading activities. The analysis determined the potential sound level impacts at the nearby sensitive receptor locations.

MECHANICAL EQUIPMENT

Since the Project is in the early stages of the design process, the specific details related to the final selection of mechanical equipment are unknown at the time of this noise assessment. Based on preliminary design plans, the anticipated mechanical equipment associated with the Project are expected to include the following:

- Energy recovery units
- Cooling towers
- Emergency generators
- Co-generation units

The mechanical equipment will be located within screening walls on the rooftop or in mechanical rooms of the proposed buildings. During the design and selection process, the appropriate low-noise mechanical equipment will be selected, including potential noise mitigation measures, such as acoustical enclosures and/or acoustical silencers. The Project will incorporate noise attenuation measures necessary to comply with City of Cambridge's noise criteria at the sensitive receptor locations.

In addition to being located within acoustical screening walls, the mechanical systems would be strategically located on the rooftop, utilizing the height of the buildings in providing noise attenuation. Noise attenuation could be achieved by the Project's building design as the heights of the Project's buildings are similar or greater than the height of nearby sensitive receptors. The rooftops of the Project's buildings will serve as a barrier and break the direct line of exposure between the noise sources and receptors. As such, the sound levels associated with the Project's mechanical equipment are expected to be negligible at the surrounding sensitive receptor locations. With greater distances and impeding building structures, receptors located further away from the Project are expected to experience lower sound levels associated with the Project's noise sources.

The Project may require an emergency generator for life safety purposes, such as emergency exit lighting. The determination of specific generator parameters, such as the sizes and locations will be made during the building design process. The Project will be required to adhere to Massachusetts Department of Environmental Protection's (MassDEP's) regulations that require such equipment to be certified and registered. As part of the air permitting process, the Project will be required to meet additional noise requirements described in MassDEP regulations under the Codes of Massachusetts Regulations (310 CMR 7.00). When the details of the emergency generator are developed, the Applicant will submit the appropriate permit application to MassDEP, which would include noise mitigation measures (such as acoustic enclosures and exhaust silencers) that are necessary to meet MassDEP's noise criteria.

SERVICE AND LOADING ACTIVITIES

Off-street designated loading area will be provided for loading and service activities associated with the Project. The loading areas will be located within the ground level of the proposed buildings. The loading dock activities will be managed so that service and loading operations do not impact traffic circulation on the adjacent local roadways. Since loading and service activities will be enclosed within the proposed buildings and operations will be managed, noise impacts to nearby sensitive receptor locations are expected to be negligible.

IMPACT ON PROPOSED RESIDENTIAL USE

The results of the noise monitoring program indicate existing exterior sound levels exceed the City's noise standards. Noise attenuation measures are limited since the Project consists of multi-level residential buildings and noise walls are not a feasible measure for receptors at high heights. The Project will consider measures to minimize the impacts to interior sound levels even though the City's noise ordinance does not provide interior noise standards.

The proposed buildings will be designed to incorporate building materials with the appropriate sound transmission class to minimize the impacts to the interior sound levels of the proposed residential units. Substantial sound level reductions are considered achievable since general construction material typically provides 20 decibels of attenuation. The building design would consider restricting exposure to exterior noise environment, such as limiting operable windows or balconies and providing central climate control systems.

CONSTRUCTION ACTIVITY

The construction activity associated with the Project may temporarily increase nearby sound levels due to the use of heavy machinery. Heavy machinery is expected to be used intermittently throughout the Project's construction phases, typically during daytime periods. The construction activities that will generate the highest sound levels may include demolition, site excavation and grading, and construction of the foundation for the proposed building. A construction management program will be developed with the City to ensure that the applicable noise regulation is met.

The Project will implement mitigation measures to reduce or minimize noise from construction activities. Construction vehicles and equipment would be required to maintain their original engine noise control equipment. Specific mitigation measures may include the following:

- Construction equipment would be required to have installed and properly operating appropriate noise muffler systems.
- Appropriate traffic management techniques would be implemented during the construction period would mitigate roadway traffic noise impact.
- Proper operation and maintenance, and prohibition of excessive idling of construction equipment engines, would be required.

Therefore, construction noise levels are proposed to be mitigated to the greatest extent possible.

CONCLUSION OF NOISE IMPACT ASSESSMENT

The noise analysis evaluated the sound levels associated with the Project. This analysis determined that the sensitive receptor locations in the vicinity of the Project site currently experience sound levels exceeding the City's daytime and nighttime noise standards. Due to the anticipated location of the proposed equipment within screening walls on the rooftop, the sound levels associated with the Project's mechanical equipment are expected to have no adverse noise impacts at nearby sensitive receptor locations. While impacts of the emergency generator are also expected to be negligible, a separate MassDEP permitting process will allow for further review of this equipment at a later date. The Project is designed such that the loading areas will be enclosed, which will attenuate sound levels associated with the loading activities. As a result of the preliminary design, the Project's operations will have no adverse noise impacts at nearby sensitive receptor locations.

The noise evaluation demonstrates that the existing ambient sound levels exceed the City's noise standards. As a result, the design of the residential buildings will incorporate sufficient acoustical material with the appropriate sound transmission class rating to minimize impacts to interior sound levels.

7.4 EXHAUST RE-ENTRAINTMENT REVIEW

Because the proposed buildings are adjacent to several existing laboratory buildings with exhaust stacks, the Applicant engaged RWDI to evaluate the potential air quality impacts that these neighboring buildings might have on the Project (refer to Figure 1 of Appendix C).

The results of the modeling, presented more fully in Appendix C, predict minimum dilution levels, or unacceptable impact at all buildings facing the exhaust stacks. Boiler stacks on any of the new roofs are not expected to be a significant concern. To mitigate predicted air impacts on the proposed buildings from existing exhaust stacks, air intakes will be limited to the locations shown in Figure 4 of Appendix C. These areas are protected from the surrounding sources by the building forms.

A representative kitchen exhaust was modeled on the roof of Commercial Building A (referred to as 11CC in the report) to determine its impact on Residential Building South. The results found predicted emissions to be well below the dilution required to eliminate odor impacts. Therefore, kitchen exhausts of Commercial Building A will be equipped with odor reduction equipment.

8. SUSTAINABILITY PLAN

8. INTRODUCTION

This section presents the Project's overall approach to sustainability and addresses the specific areas of the topic, per Article 14.74. Additionally, in accordance with Article 22.20 of the Ordinance, this section demonstrates how the Project Components of the Concept Plan are being designed to achieve a Leadership in Energy and Environmental Design (LEED®) Gold level or better.

8.1 APPROACH TO SUSTAINABILITY

Sustainable principles are integral to the Project's design. Viewed through a land use planning lens, the sustainability approach includes repurposing previously developed land rather than building on untouched land, as well as locating new development within a high density urban area with excellent access to public transportation, pedestrian circulation systems and a robust bicycle network. New commercial and residential space will be located on previously developed sites, a portion of which will be constructed above an existing garage. By reusing existing sites, the Project will achieve energy savings associated with lower embodied energy and reduced Greenhouse Gas (GHG) emissions through the construction process.

As a Transit Oriented Development (TOD), the Project will integrate into the existing public transportation and mode share infrastructure to further reduce traffic and indirect air emissions, including mobile source GHG emissions. TOD is environmentally, economically, and socially sustainable; it promotes greater mobility, walking and biking, healthy lifestyles; value for property owners, businesses, local governments, transit authorities and residents. A recent study by the Center for Transit-Oriented Development shows that TOD produces approximately 43 percent less emissions than conventional suburban development.

The Project will promote the design and construction of high-performance, green buildings through an integrated design approach where all project disciplines are engaged early and throughout the design process in order to meet sustainability goals. The Project's design will prioritize sustainability as a core strategic imperative and will implement state-of-the-art high performance green building technologies, construction, and operating procedures. Sustainability planning with an integrated design team during conceptual design will establish a pathway to Gold-level certification under the Leadership in Energy and Environmental Design (LEED®) Green Building Rating System. The project design teams will use iterative energy modeling and life cycle analysis to consider the long-term value of sustainable property investment decisions.

The integrated design approach will address best practices in energy and emissions, water management, reduced urban heat island effect (cool roofs), energy use monitoring and rooftop mechanical equipment noise mitigation, as set forth in Article 14.74. The Applicant is looking beyond these zoning requirements by addressing climate change preparedness, implementing sustainable tenant guidelines, and considering the health and wellness of its future occupants and users through the potential use of the WELL Building Standard® (WELL) design and operation principles.

In addition, the Applicant is studying the feasibility of connecting one or more of the Project Components to an existing co-generation facility located within Parcel 2. As the facility is not controlled by the Applicant, any connection to it will require an agreement with a third party. If feasible, incorporating this measure could further contribute to additional energy savings and reduce CO_2 emissions.

Furthermore, the Applicant will work with its design teams to evaluate and incorporate, where feasible and reasonable, strategies that support the Cambridge Net Zero Action Plan.

8.2 ENERGY CONSERVATION APPROACH

Buildings are significant consumers of energy, and building mechanical and electrical systems are the chief consumers within any building. The Project Components will be designed to be energy-efficient, green buildings, and renewable energy strategies will continue to be evaluated as the design evolves and will be included in each Project Component's design review submission. As previously referenced, the Applicant proposes that for each square foot of solar-ready rooftop provided, a square foot of occupiable green roof be permitted as exempt GFA (a 1:1 ratio).Renewable energy credits can also be purchased on a building-by-building basis to support off-site renewable energy production and offset non-renewable electricity use on site.

8.2.1 REGULATORY CONTEXT

All Project Components will meet the current Stretch Energy Code requirement to achieve at least a 20 percent overall reduction in annual energy use compared to a baseline. The current Stretch Energy Code requires that the Project show at least 20 percent overall reduction in energy used as compared to the IECC2009/ASHRAE 90.1-2007 code compliant baseline model. Since the IECC 2012 and ASHRAE 90.1-2010 is more stringent than the current Code, the proposed HVAC and lighting systems and the Energy Conservation Measures (ECMs) were selected so that the overall energy savings fall within 25 and 30 percent better than 90.1-2007 and, therefore, also meet the future Stretch Energy Code requirements.

In accordance with Article 22.20, all new project buildings will also meet the LEED minimum building performance requirement of a 10% improvement in energy use by cost when compared to a baseline building performance as calculated using the rating method in Appendix G of ANSI/ASHREA/IESNA Standard 90.1-2007.

8.2.2 DESIGN STAGE - REDUCE ENERGY DEMAND

Success in reducing energy demand from these systems follows a four-step approach. This basic approach will be followed for each Project Component.

- Step 1 - Reduce Demand: Challenge assumptions to right size equipment, reduce plug and lighting loads, and improve the building shell.
- Step 2 - Harvest Site Energy: Orient the building to maximize passive solar and daylighting opportunities. Harvest waste energy on site through heat recovery and other means.
- Step 3 - Maximize Efficiency: Beyond simply reducing loads, use efficient equipment to maximize benefit.
- Step 4 - Efficient Operations and Maintenance: Building commissioning, training of staff, and ongoing preventative maintenance, combined with monitoring of on-going performance will be implemented to ensure energy efficiency gains are realized.

8.2.3 DESIGN STAGE – SET ENERGY TARGETS

These energy conservation targets are met by the selection of efficient building systems, equipment, and a lighting power density that is below code. Additionally, an improved building envelope design is required. The design teams will develop whole building energy models to demonstrate the expected energy performance of each designed building.

A variety of ECMs will continue to be evaluated as design progresses. ECM's to be considered include, but are not limited to, the following:

- High-performance mechanical systems, including chilled beams in office and laboratory spaces.
- High-performance building envelope
- Reduced window-to-wall ratio
- Reduced lighting power density
- Building orientation and window locations shall be suited for improved energy efficiency
- Cogeneration
- Rooftop Solar PV
- Energy Star appliances and equipment
- Occupancy and daylight sensors and controls
- Demand Response / Peak Load Reduction / Smart Grid Compatibility

A preliminary energy analysis and GHG study was completed for each Project Component. The summary of findings is represented in the Preliminary Energy Analysis and Greenhouse Gas Study shown on the opposite page.

COMMERCIAL BUILDING A - 145 BROADWAY

Based on preliminary design strategies being considered, the estimated energy use reduction for the building is approximately 28.1 percent, which equates to a 23.4 percent reduction (446.8 tons per year) in stationary source CO_2 emissions when compared to the Base Case. Key energy savings features include improved glazing properties, improved roof and wall insulation, improved lighting power densities, variable volume condensing water pump, a high efficiency DW heater, and a high efficiency gas boiler.

RESIDENTIAL BUILDINGS NORTH AND SOUTH (BLUE GARAGE)

Based on preliminary design strategies being considered, the estimated energy use reduction for Residential buildings is 24.1 percent, which equates to a 15.5 percent reduction (319.1 tons per year) in stationary source CO_2 emissions when compared to the Base Case. Key energy savings features include improved glazing properties, improved roof and wall insulation, improved lighting power densities, high efficiency heat pumps, high efficiency ventilation systems, and a high efficiency gas boiler.

COMMERCIAL BUILDING B - 250 BINNEY STREET

Based on preliminary design strategies being considered, the estimated energy use reduction for the new commercial building is approximately 27.0 percent, which equates to a 21.0 percent (417.5 tons per year) reduction in stationary source CO_2 emissions when compared to the Base Case. Key energy savings features include improved glazing properties, improved roof and wall insulation, improved lighting power densities, variable volume condensing water pump, a high efficiency DW heater, and a high efficiency gas boiler.

Project Component	Energy Consumption (MBtu/yr) Base Case	Design Case	Percent Savings	CO_2 Emissions (tons/yr) Base Case	Design Case	Percent Reduction
Commercial Building A - 145 Broadway	21,977	15,812	28.1%	1,909.4	1,462.6	23.4%
Residential Buildings (North and South) – 135 Broadway Street	25,883	19,643	24.1%	2,053.6	1,734.5	15.5%
Commercial Building B - 250 Binney Street	22,140	16,167	27.0%	1,984.4	1,566.9	21.0%

tons/yr = short tons per year

8.2.4 OPERATIONS STAGE BUILDING COMMISSIONING

In addition, building commissioning will be conducted prior to and during occupancy to ensure the building systems are operating efficiently and as designed. Tenant green building guidelines will engage and educate building users and influence occupant behavior toward more energy (water and material) efficient practices.

8.2.5 OPERATIONS STAGE ENERGY TRACKING AND MONITORING

The Applicant has a robust internal program for tracking building energy use over time, using Energy Star Portfolio Manager and other tools. In addtion, the Applicant has committed to reducing average building EUI by 15%, and is currently a strong supporter of the City's Building Energy Use Disclosure Ordinance.

The Applicant will implement a Measurement and Verification (M&V) plan that will utilize the base building energy management system to monitor operation of equipment or systems that are not already directly metered for electric or gas use. Core and shell projects will include a centrally monitored electronic metering network in the base building design that is capable of being expanded to accommodate and document the future tenant sub-metering.

In compliance with the Cambridge Building Energy Use Disclosure Ordinance, Chapter 8.67 of the Municipal Code, the Applicant will report energy use.

8.2.6 ON-SITE CLEAN/RENEWABLE ENERGY GENERATION

The Project Components will be constructed to be solar-ready, including designing the roof structure to support the weight and wind loads associated with solar energy collectors as well as providing space to accommodate associated infrastructure, including conduit to the roof and space in the electrical room for an inverter. Each building will be individually analyzed for solar opportunities as the design develops. In addition, innovative strategies such as solar roadways will be considered.

Small-scale co-generation systems will also be considered to provide domestic hot water and a portion of the electricity for the residential buildings.

8.2.7 DISTRICT-WIDE ENERGY CONSERVATION

The City secured major grant funding to support the development of a Kendall Square EcoDistrict and to initiate a study of district energy opportunities. This Project as part of the KSURP is deeply involved in both of these initiatives. The EcoDistrict will provide a framework for the utilities, the City, and the developers to work together to right size projects and infrastructure, with a goal of minimizing energy usage, water usage, and GHG generation.

The Kendall Square EcoDistrict would provide opportunities for combined heat and power and shared generation, provided projects are co-located that can utilize the heat and power generated. The Kendall Square EcoDistrict is intended to incorporate renewable energy generation, and should promote combined/cooperative development with shared information about project needs and contributions.

8.3 WATER CONSERVATION

The Project will reduce overall potable water use and reduce wastewater generation compared to a conventional development through installation of low-flow plumbing fixtures and high-efficiency irrigation systems. All Project Components are currently targeting a minimum 30% water use reduction compared to conventional plumbing fixtures (per Energy Policy Act of 1992 fixture performance requirements).

The landscape design will incorporate native and adaptive vegetation and the design of the irrigation system will target, at minimum, a 50% reduction in potable water use when compared to a mid-summer baseline through the use of high-efficiency irrigation systems with controllers and moisture sensors. Non-potable water use strategies, such as rainwater reuse will be considered for irrigation. In addition, the landscape design will consist mostly of local, drought resistant species to minimize or eliminate the need for irrigation over the lifetime of the Project. Landscape areas will be designed to hold as much rainwater as practicable. The Applicant is also considering the use of rainwater capture for irrigation and the incorporation of green roofs and rainwater harvesting tanks for each individual building design.

Each Project Component will largely maintain the existing site drainage, replacing existing impervious rooftop and hardscape in kind on-site. The Project will be required to mitigate stormwater runoff to comply with City and MassDEP standards. Stormwater infrastructure will be designed and installed for each Project Component to reduce the runoff discharge rate and improve the quality of the runoff to the City's stormwater system and the Charles River basin.

8.4 RECYCLING AND SOLID WASTE MANAGEMENT

Recycling and reuse programs will be developed and implemented by all construction contractors to reduce the amount of waste that is sent to landfill throughout construction. Prior to the start of construction, the construction management team will prepare and submit a Construction Waste Management plan which will be implemented on site. By keeping the Blue Garage overwhelmingly intact, a significant amount of construction waste associated with demolition and new construction to rebuild a garage structure is eliminated by the Project. A minimum of 75% of C&D waste will be diverted, as required by Massachusetts' law.

Storage of collected recyclables will be accommodated on the ground floor of the new buildings in a designated recycling area. A contracted waste management company will collect the recyclables on a regular basis. It is anticipated that approximately 100% of paper, corrugated cardboard, glass, plastic and metal would be recycled during operations. The Tenant Design and Construction Guidelines (discussed further below in Section 8.8) will include strategies to reduce waste through recycling and reuse programs.

8.5 REDUCE HEAT ISLAND EFFECT

Over the design life of the Project, climate change is expected to significantly increase the duration and frequency of heat waves. The anticipated change in average temperatures is exacerbated by the development density of Cambridge, which results in urban heat island effect. In an effort to mitigate urban heat island effect, the Applicant is considering a number of site and building design strategies, including light colored roof materials, light colored hardscape materials, landscaped areas, and green roofs.

8.5.1 SITE DESIGN

Site landscaping will be designed with tree canopy cover, low-level plantings, discontinuous impervious covers, reflective materials and permeable pavements in an effort to reduce the capture of energy from sunlight while promoting evaporation and plant transpiration. This design approach will not only reduce the increased heat associated with heat island effect, but will provide for a more comfortable pedestrian environment.

8.5.2 BUILDING DESIGN

To further reduce the heat island effect and mitigate stormwater runoff, the Applicant is exploring the use of green roof cover, where feasible. Vegetation and shading structures will also be employed to shade buildings and outdoor spaces, where possible. The roof membrane on all Project Components will be a high albedo roof product with a minimum Solar Reflectance Index (SRI) value of 78, covering a minimum of 75% of the total roof area, excluding any green roof areas. All Project Components include covered parking in garage structures, greatly reducing the uncovered and impervious surface area needed for the Project's required parking. In conjuction with the development of the Residential Project Components, the uncovered area on the top level of the Blue Garage will be upgraded to include light-colored materials and landscaping, where feasible.

8.6 RESILIENCY IN BUILDING DESIGN

The Applicant has studied the vulnerability of the infill development sites for the potential of precipitation-based inland flooding events. Potential building design resiliency measures being considered include limiting basement areas, and other improvements that may mitigate potential flooding. Additionally, ground floor finish elevations for all Project Components will be raised to the greatest extent possible to reduce the risk of internal flooding. Flood-resilient materials will be specified for first floor uses, where practicable.

Since the Residential Buildings are proposed to be constructed primarily over the existing Blue Garage structure, ground floor exposure to the effects of extreme weather events, such as flooding is greatly minimized. Other flood prevention techniques could include: sealed wall penetrations for cable and electrical lines; watertight door barriers; septic line backflow prevention valves, sump pumps, and discharge pumps—all of which could be connected to auxiliary external generator connections or resilient backup power. In addition, the Project is anticipated to include green roofs/roof gardens and roofing membranes with high SRI to reduce the volume of stormwater runoff and reduce solar heat gain/minimize air conditioning loads, respectively. Additionally, high-performance curtain wall is being considered to maximize views and daylighting of interior spaces, thus reducing overall lighting loads and associated internal heat gains, which has a direct impact on the space cooling load. As the climate change analysis shows, the rising temperature increases the space cooling demand in the Cambridge climate; therefore, any strategy that can reduce the space cooling demand is considered an adaptive strategy for climate change.

The Project's climate change mitigation includes the incorporation of several ECMs to reduce GHG emissions associated with energy use beyond what is required by Code. (Refer to Appendix D for further details on such measures.) Some of these measures can also be considered adaptive design approaches to mitigate the potential impacts of climate change on the Project. These GHG emissions mitigation and climate change adaptation measures are considered mutually re-enforcing and, therefore, cannot be considered in isolation. As an example, the window area in the Residential Project Components will be designed at an appropriate ratio to reduce energy use while still providing enough daylight and opening area for natural ventilation. This is an adaptive strategy in response to potential future increases in mean temperature. Other climate change adaptive strategies considered will include improved envelope insulation and high performance glazing in response to increasing temperatures. The design team will continue to investigate the feasibility of renewable energy sources and highly energy-efficient technologies, such as solar PV, wind, and co-generation. As climate change is not limited only to temperature increase, but may also include flooding, intensified downpours, and/or hail events, the design team will continue to consider ways in which the architectural elements selected for the Project can reduce the vulnerability to these extreme events.

OTHER POTENTIAL RESILIENCY MEASURES

On-site renewable energy, a district energy network, and combined heat and power (CHP) systems also provide opportunities for added resiliency during periods of power loss during storms. While the KSURP area is served by underground utility power lines and gas mains, and as such, is not normally effected by storms that disrupt power or gas transmissions, according to DOER, the Kendall Square CHP district plant has been registered by the ISO-NE as a black start generation asset that can operate in island mode to provide both electricity to the Cambridge grid and thermal energy to the KSURP area in the event of a grid outage.

On-site CHP, or solar PV, generally will operate in phase with the incoming utility power, and needs incoming power to synchronize phase delivery. In “island mode”, generators and CHP systems can be made to operate independently of the grid and self-synchronize power phasing with on-site solar. However, this approach is normally used in large-scale shelter locations only, when long-term operation may be needed to protect a group of people.

In most cases, the proposed commercial buildings will shut down and send occupants home in storm-related power failure scenarios. Any generators provided will most likely be optional standby generators that are sized to maintain server room or process operations only. In the case of the residential components, the generators provided will be for life-safety uses only (stairway pressurization, egress elevators, fire pump, etc.) and cannot by Code be used for ordinary ongoing operations in a building. The capacity provided by solar PV, even if the available space is maximized, will not be more than 10 percent of the power needed by the building, and cannot provide all power needed for normal operations. A CHP system could be used to provide limited ongoing operation, but the economics of such a system when compared to the likelihood of repeated power outages in the Kendall Square area would not be favorable. Storm response actions and resiliency measures will be incorporated into leasing agreements or tenant guidelines, including guidance related to tenant fit-out of commercial space, particularly those located on the lower floors.

8.7 HEALTH AND WELLNESS

Human health and wellness is addressed in the Project through design, operations, and occupant behavior. Within each Project Component, special attention will be given to address human health and comfort during construction and once the building is occupied. This will be accomplished by implementing pollutant reduction strategies, using non-toxic materials, providing fresh air to occupants, installing individual lighting and heating controls, and by providing natural daylight and views to outdoor green spaces. Tenant Design and Construction Guidelines will include comfort related requirements such as installing CO2 sensors in all regularly occupied spaces.

The Applicant is also exploring the use of principles of the WELL Building Standard, which place human health and wellness at the center of design and can encourage and educate future tenants on healthy living practices. Active design principles, encouraging physical and social activity, will be employed where possible. The Project's master site and individual building sites will be vibrant spaces where people can safely walk, bike, use transit, and access open spaces. Individual buildings will be designed wherever possible to include visible, attractive and well-lit stairs, communal services such as break areas and copy services, and a variety of public gathering spaces and individual relaxation spaces. Ground level outdoor spaces will be easily accessible to both building occupants and visitors alike.

8.8 SUSTAINABLE TENANT GUIDELINES

Tenant Design and Construction Guidelines will be provided to office and retail tenants as a guide to use when fitting out their spaces. The intent of these guidelines is to educate tenants about implementing sustainable design and construction features in their tenant improvement build-out as well as adopting green building practices that support the overall sustainability goals of the Project. The guidelines will also communicate the sustainable and resource-efficient features incorporated into the base building(s) and provide specific suggested sustainable strategies enabling tenants to coordinate their leased space design and construction with the rest of the building systems.

In summary, the guidelines may include the following information:

- Descriptions of sustainable design, construction and operations features of the proposed building(s), including resource conservation goals and features for tenant fit-out spaces (e.g., low-flow plumbing fixtures, sub-metered systems, lighting controls) as well as building certifications (i.e., LEED certification).
- Encourage tenant commitments for meeting various energy and water conservation goals.
- Descriptions of current regulatory requirements that pertain to leasable spaces.
- Strategies for energy efficiency, such as those for HVAC equipment recommendations, lighting and lighting controls, and low-flow, high-efficiency plumbing fixture recommendations.
- Information on the various high performance building rating systems, such as EPA's ENERGY STAR and LEED for Commercial Interiors (CI) as well as information on how the design of the base building(s) can contribute towards these certifications.
- Waste reduction goals and recycling facilities/programs.
- Information on green cleaning guidelines and policies.
- Information regarding project-wide features that aim to encourage alternative transportation and TDM measures.
- Information on how to train and inform maintenance staff and employees on operations related to sustainable design features and systems.

8.9 OTHER DISTRICT-WIDE SUSTAINABLE STRATEGIES

Following the EcoDistrict model, in addition to district-wide energy and water management strategies and transportation efforts, other innovative, scalable solutions such as composting and urban farming will be considered. A composting program, as a strategy to reduce waste and ultimately reduce GHG emissions at landfills, will be studied as an additional measure to the existing waste management and recycling programs that are already included in the district. Composting can be addressed on a building-by-building basis and large-scale collection can be implemented district-wide. In addition to the network of farmers markets, a local urban farming initiative will be considered to engage community members in building a healthier and more locally based food system. Sites for urban garden plots could be identified in the district for businesses and community members who want to grow their own food.

8.10 LEED CREDIT NARRATIVE

Refer to the Sustainability Support Documentation in Appendix D for individual Project Component reports.

9. PHASING PLAN

9.1 PHASING PLAN

The evolution of the Project is expected to occur over three major phases consisting of the following generally described components:

- Phase 1 (Commercial Building A) The commercial space and associated ground floor retail or active use at 145 Broadway
- Phase 2 (Residential Building South) The residential space on the South side of the existing Blue Garage consisting of both rental apartments and home ownership units
- Phase 2 (Commercial Building B) The commercial space and associated ground floor retail or active use at 250 Binney Street
- Phase 3 (Residential Building North) The residential space on the North side of the existing Blue Garage consisting of either rental apartments or home ownership units.

The specific timing of each of the phases depends upon the duration required for permitting, the leasing conditions within the Cambridge sub-market and the construction logistics associated with staging and the demolitipon of portions of the Blue Garage. Additionally, the phasing plan is governed by the requirements of 14.32.1 of the Zoning Ordinance that requires the commencement of construction of at least 200,000 square feet of residential preceding any commercial development that exceeds 375,000 of Infill GFA.

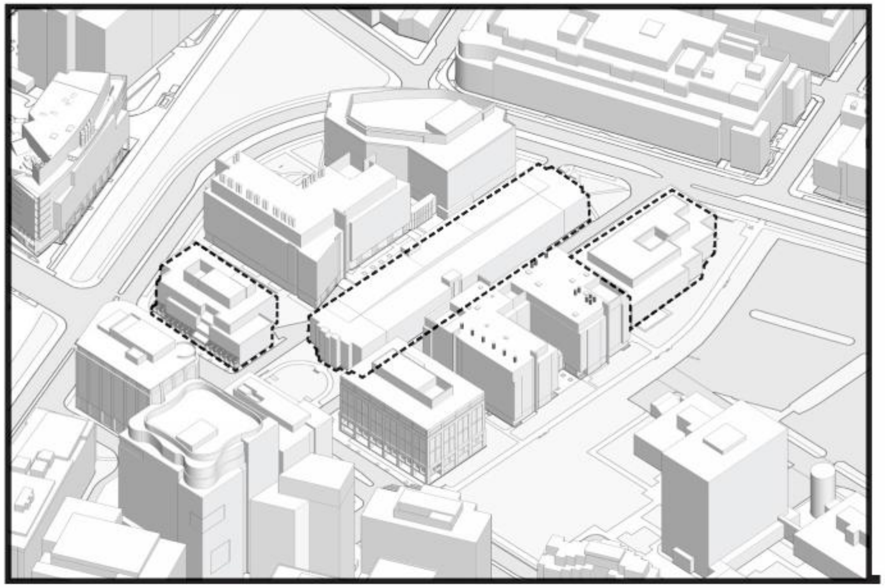
As of the date of this submission, market conditions allow for the immediate commencement of Phase 1 as soon as a special permit is received for the Concept Plan and the associated approval of the Design Review Submission for Commercial Building A.

Table 9-1 summarizes the approximate GFA and program by phase along with the public benefits associated with each phase of development.

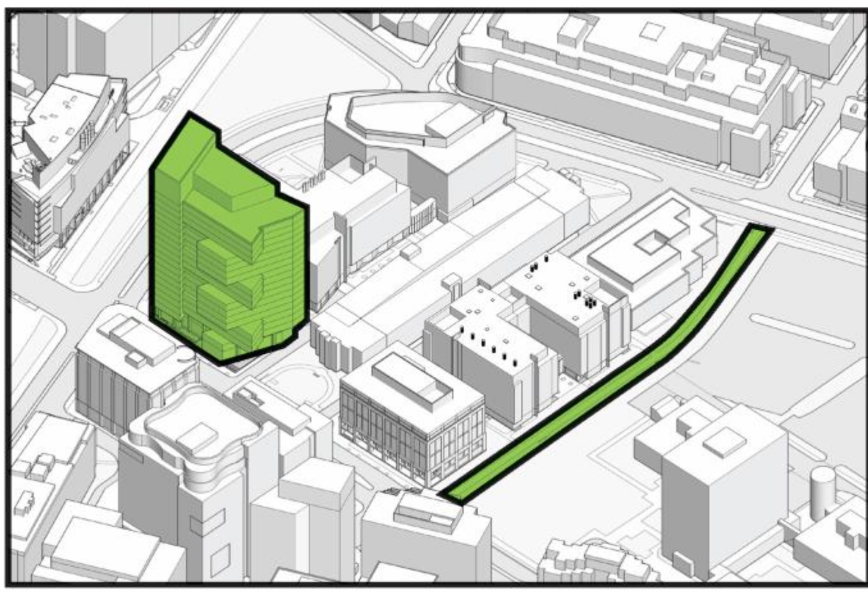
ANTICIPATED PHASING PLAN WITH PUBLIC BENEFITS				
	Phase 1	**Phase 2**		**Phase 3**
	Commercial Bldg A (145 Broadway)	Commercial Bldg B (250 Binney Street)	Residential South (Blue Garage)	Residential North (Blue Garage)
Commercial GFA	443,731	310,615	0	0
Residential GFA	0	0	350,000	70,000
Active Use/Retail GFA	10,037	8,029	0	1,300
Existing GFA	*(78,636)*	*(62,576)*	0	0
NET NEW GFA	**375,132**	**256,068**	**350,000**	**71,300**
Open Space Improvements	6th Street Connector	E/W Connector	Broadway Park & E/W Connector	Binney Park
Innovation Space at 255 Main	62,522	42,678	0	0
Vehicle parking	374	650	(156)	(59)
Long Term Bike Parking	112	75	372	74
Short Term Bike Parking	33	24	36	9
Market Rate Housing	0	0	266,666 GFA	53,334 GFA
Affordable Housing	0	0	66,667 GFA	13,333 GFA
Middle Income Housing	0	0	16,667 GFA	3,333 GFA

TABLE 9-1 GROSS FLOOR AREA

9.1 PHASING TIMELINE

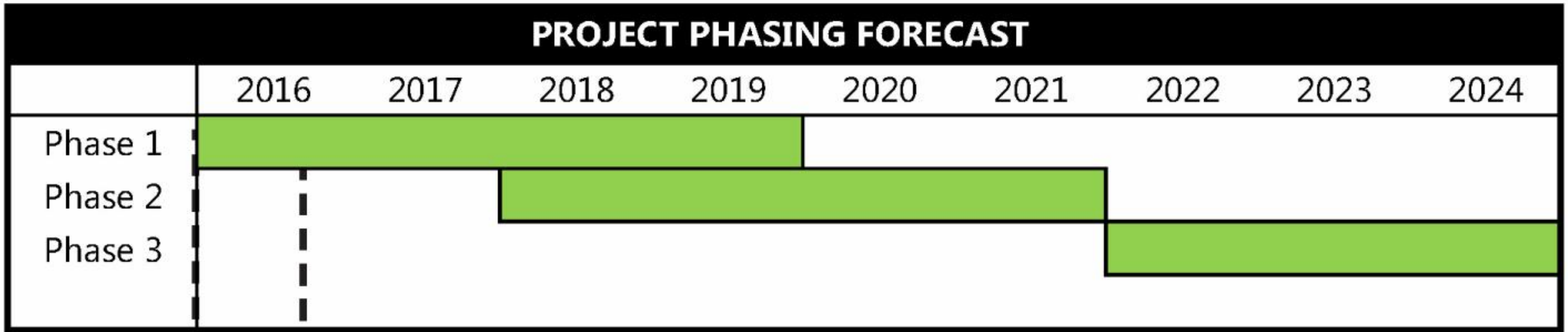


EXISTING

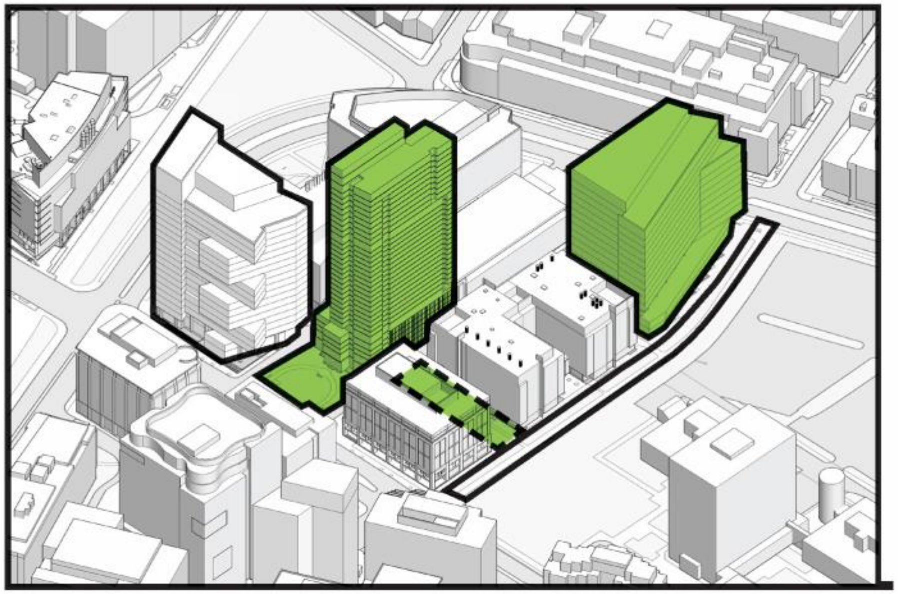


PHASE ONE

PHASE 1 will consist of the demolition of the existing building at 145 Broadway and the construction of the Commercial Building A. In addtion Phase 1 will include the planned enhancements to the 6th Street Connector.

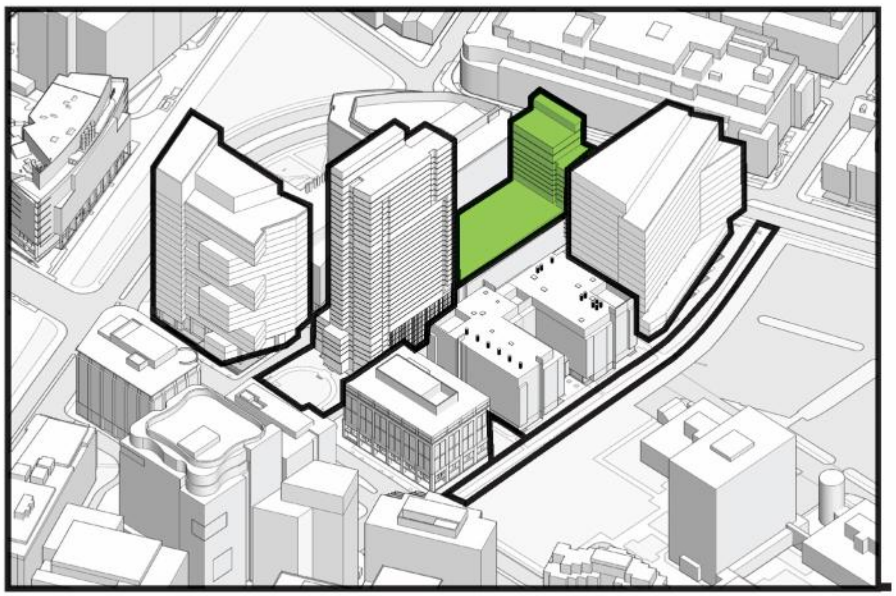

PROJECT PHASING FORECAST
2016
2017
2018
2019
2020
2021
2022
2023
2024
Phase 1
Phase 2
Phase 3

9.1 PHASING TIMELINE



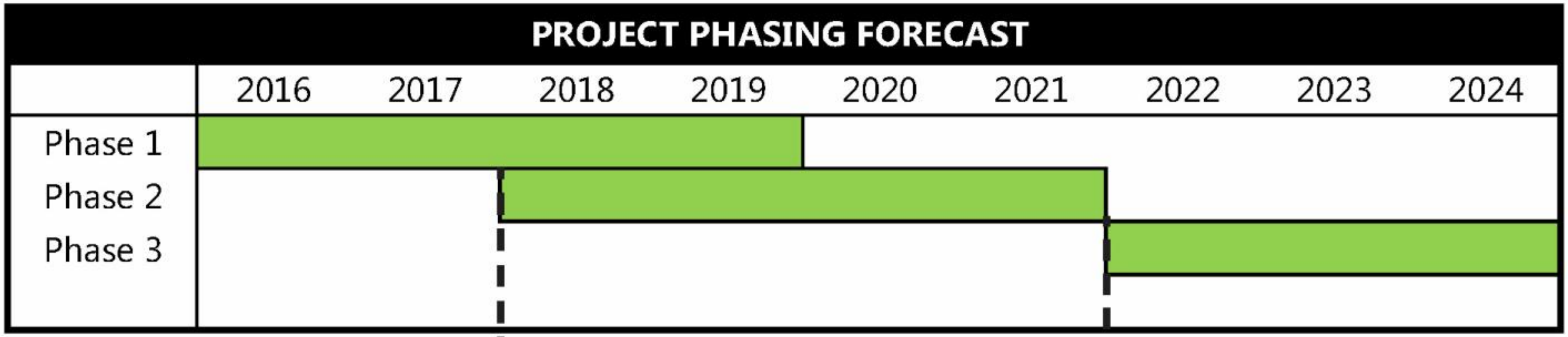
PHASE TWO

PHASE 2 will consist of both the Residential Building South and Commercial Building B which will likely start construction at different times depending on site logistics, relative complexity of each building, and market conditions. The Residential Building South will require demolition and reconfiguration of the south side of the Blue Garage. Commercial Building B will require demolition of the existing building at 250 Binney. Phase 2 will also include the planned enhancements to Broadway Park and the East West Connectors.



PHASE THREE

PHASE 3 will consist of the demolition and reconfiguration of the north portion of the Blue Garage and the construction of Residential North Building. Phase 3 will also include the planned enhancements to Binney Park.


PROJECT PHASING FORECAST
2016
2017
2018
2019
2020
2021
2022
2023
2024
Phase 1
Phase 2
Phase 3

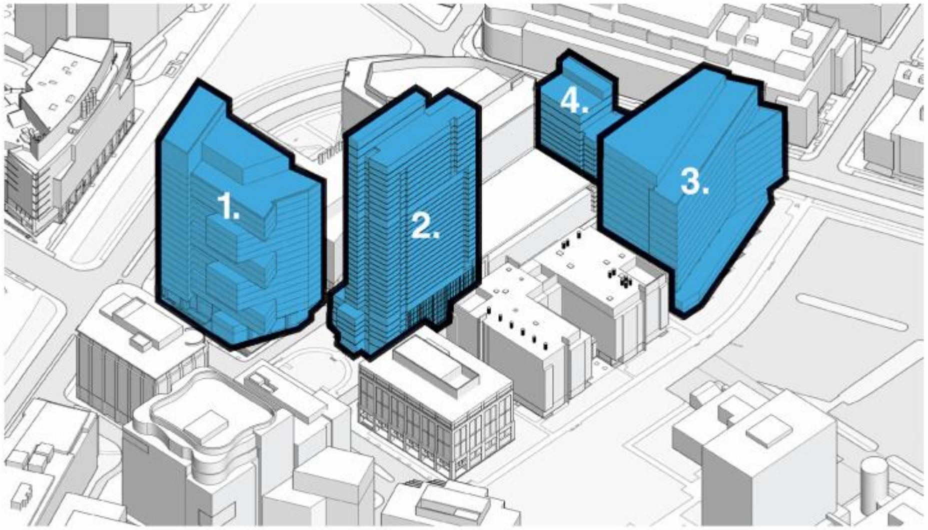
10. DESIGN GUIDELINES

10.1 URBAN REALM DESIGN GUIDELINES

Referencing the Kendall Square Design Guidelines of 2013 (K2) and Kendall Square Urban Renewal Plan of 2015, the four proposed buildings of the MXD Concept Plans are programmed and designed to ensure a lasting contribution to the character and vitality of the surrounding community and public realm. The following design guidelines establish foundational design principles in order to provide a clear blueprint for creating a robust mix of uses and vibrant public realm and open spaces, further contributing to the unique character and vitality of Kendall Square.

The following Urban Realm Design Guidelines graphically communicate the complete spectrum of existing regulations, site assumptions, architectural and urban design principles through a series of clear diagrams and associated annotations.

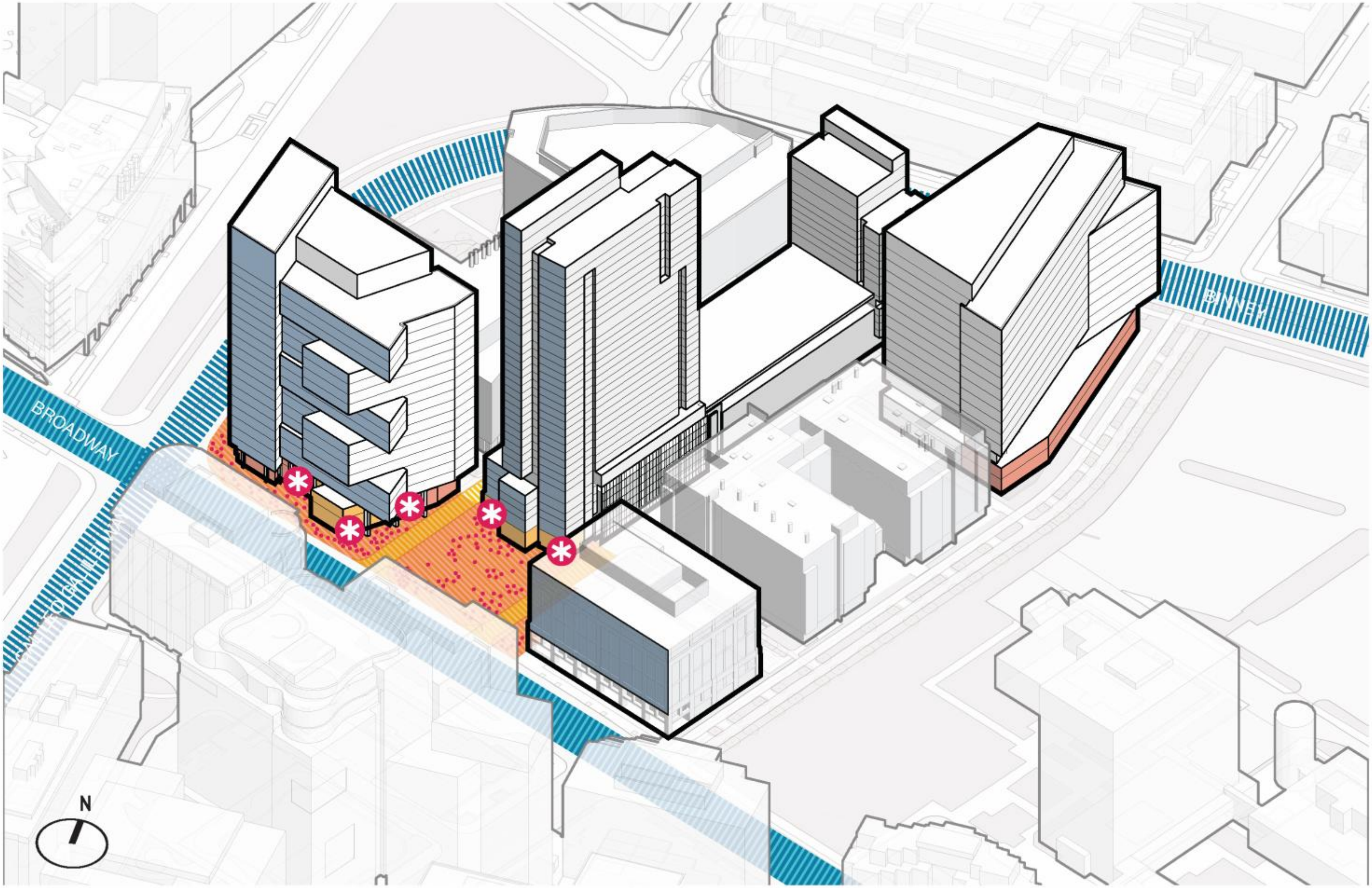
The specific building massing shown responds to the directives and suggestions outlined in this document and the final architectural scheme will conform to the design guidelines, but may evolve as the design of specific project components is developed. Unless otherwise noted, illustrations in this document represent existing development surrounding the Project site.



1. Commercial Building A (145 Broadway)
2. Residential Building South
3. Commercial Building B (250 Binney St.)
4. Residential Building North

DESIGN GUIDELINES

MAJOR PUBLIC STREET ENGAGEMENT

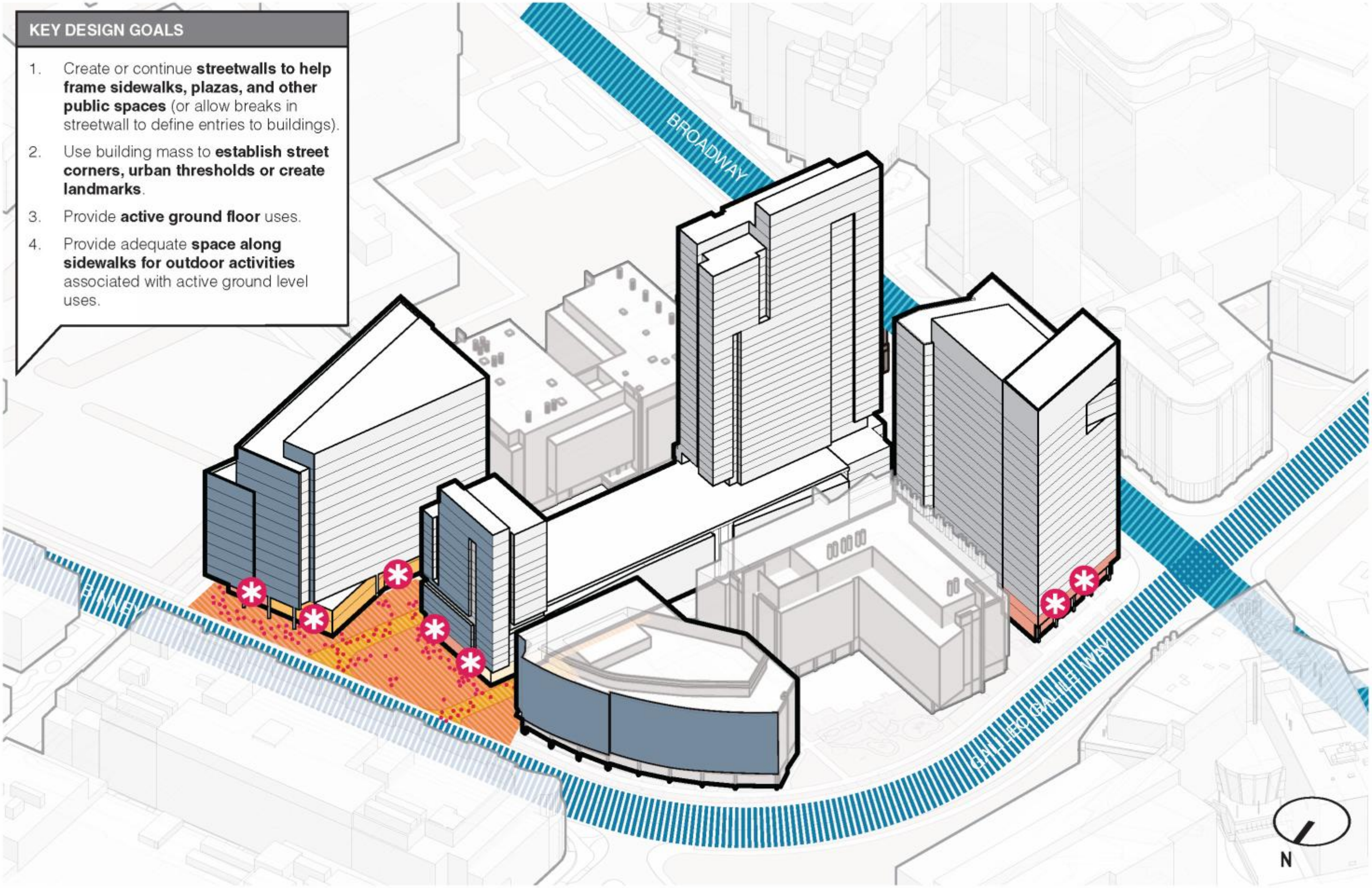


SOUTH EAST AXON

- Major Public Street
- Primary Retail Corridor
- Lobby
- Active Use
- Streetwall
- Public Outdoor Space
- Pedestrian Activity
- Building Entry

KEY DESIGN GOALS

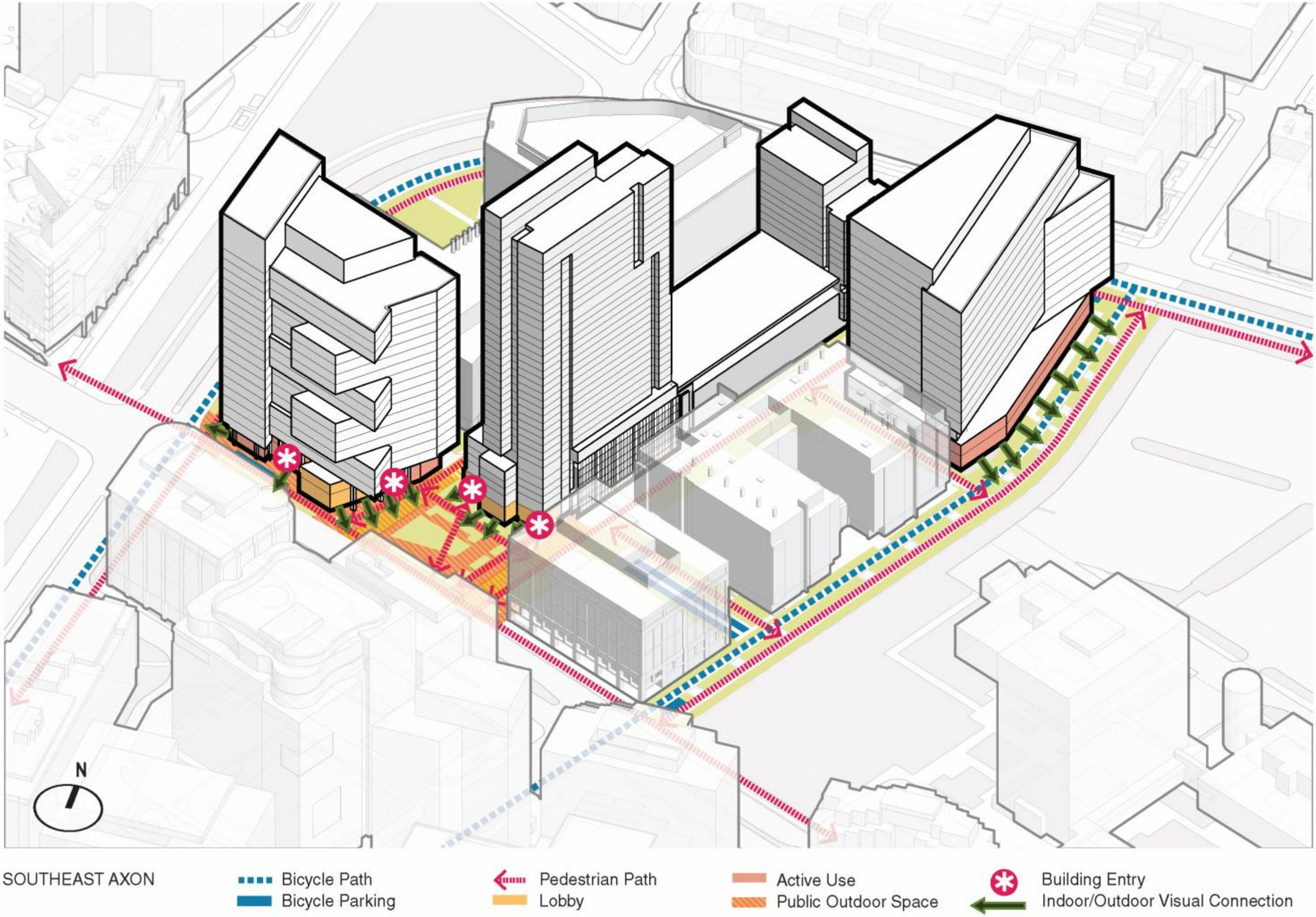
1. Create or continue **streetwalls to help frame sidewalks, plazas, and other public spaces** (or allow breaks in streetwall to define entries to buildings).
2. Use building mass to **establish street corners, urban thresholds or create landmarks**.
3. Provide **active ground floor** uses.
4. Provide adequate **space along sidewalks for outdoor activities** associated with active ground level uses.



NORTH WEST AXON

DESIGN GUIDELINES

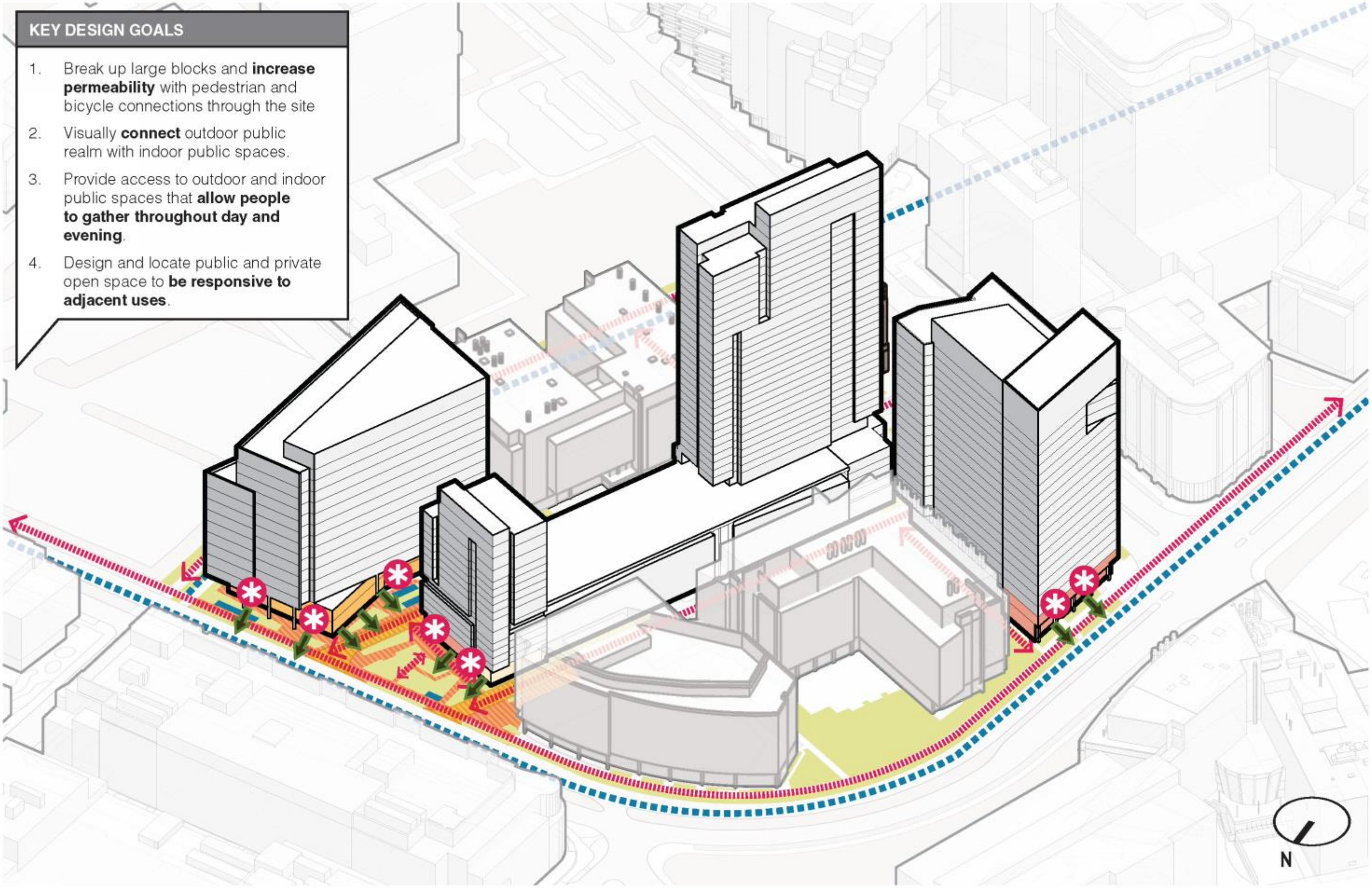
WALKABILITY, PERMEABILITY, AND PUBLIC REALM



SOUTHEAST AXON

KEY DESIGN GOALS

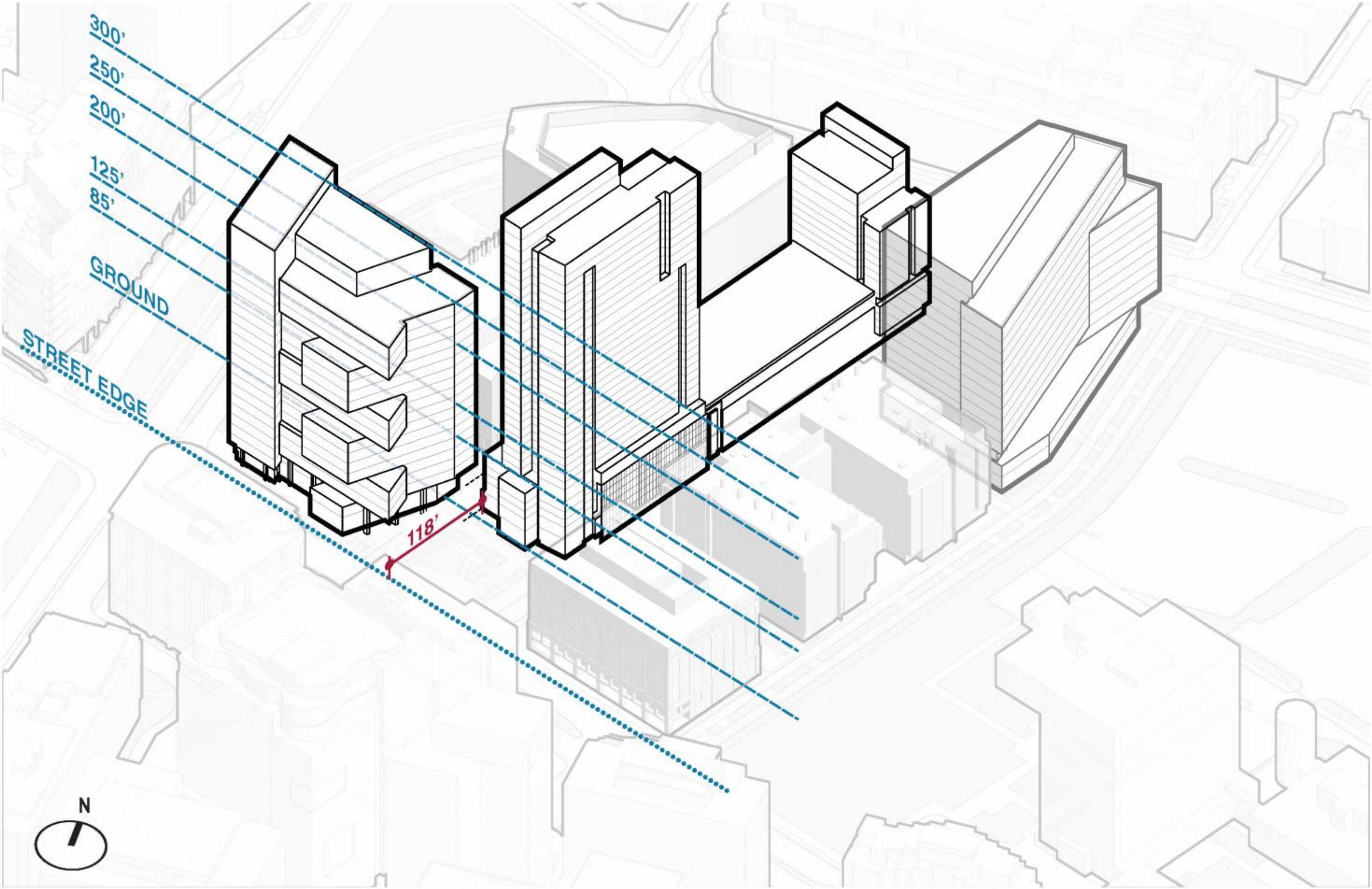
1. Break up large blocks and **increase permeability** with pedestrian and bicycle connections through the site
2. Visually **connect** outdoor public realm with indoor public spaces.
3. Provide access to outdoor and indoor public spaces that **allow people to gather throughout day and evening**.
4. Design and locate public and private open space to **be responsive to adjacent uses**.



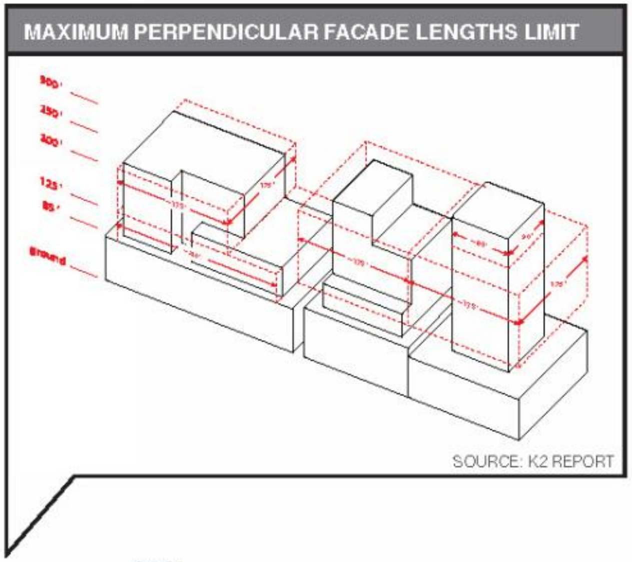
NORTHWEST AXON

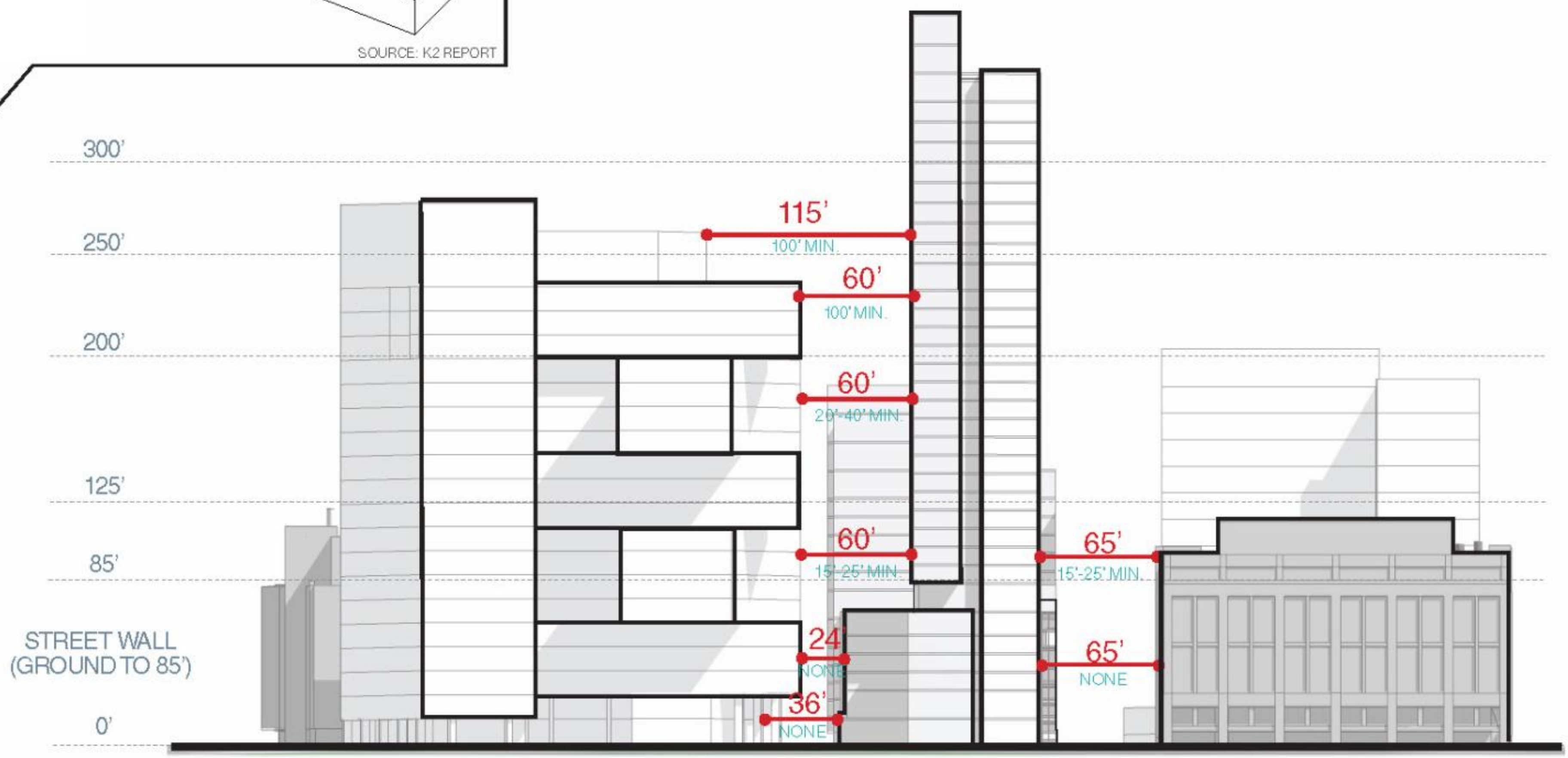
DESIGN GUIDELINES

BUILT FORM - BUILDING SEPARATION AND FACADE LENGTHS



SOUTHEAST AXON





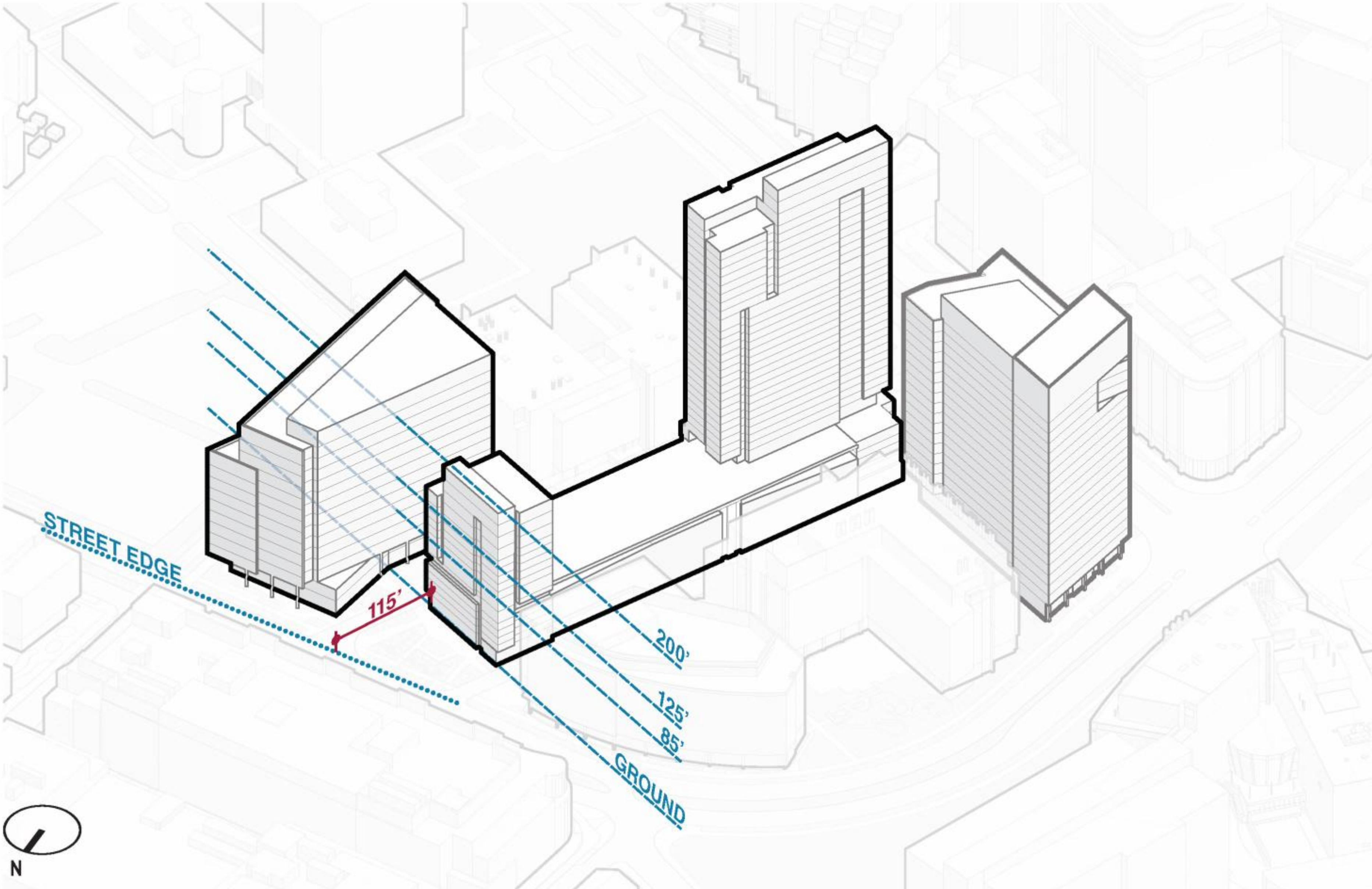
PROPOSED DIMENSION
K2 REPORT SUGGESTED DIMENSION

BROADWAY STREET

SOUTH ELEVATION

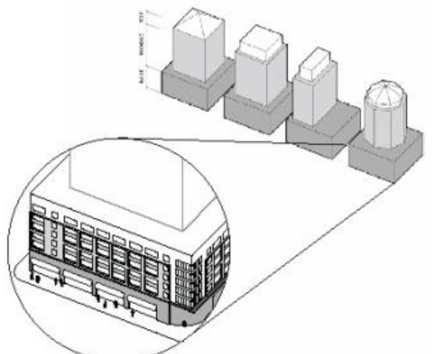
DESIGN GUIDELINES

BUILT FORM - BUILDING SEPARATION AND FACADE LENGTHS

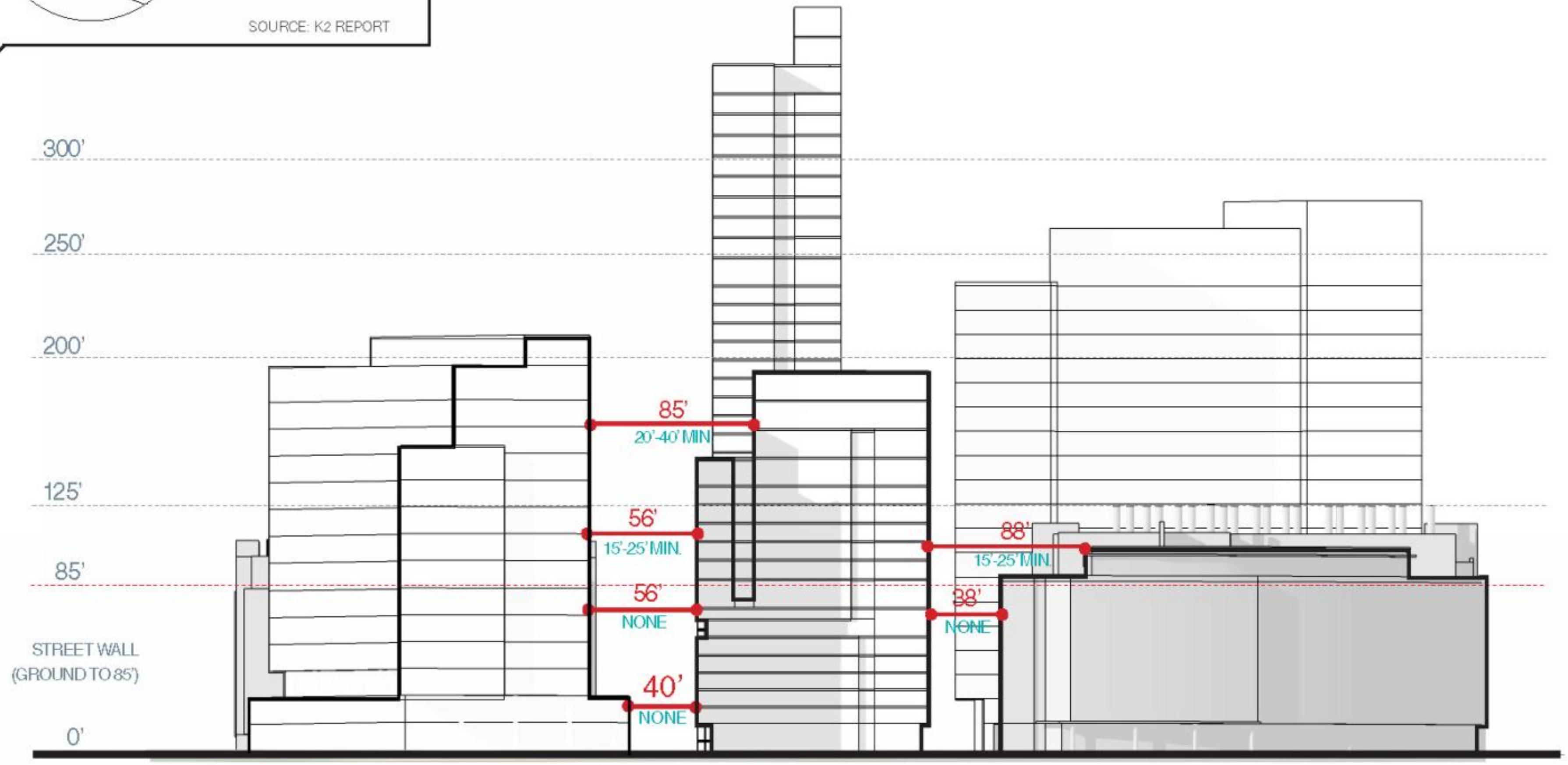


SOUTH EAST AXON

BREAKING DOWN SCALE: BASE, MIDDLE, TOP



SOURCE: K2 REPORT



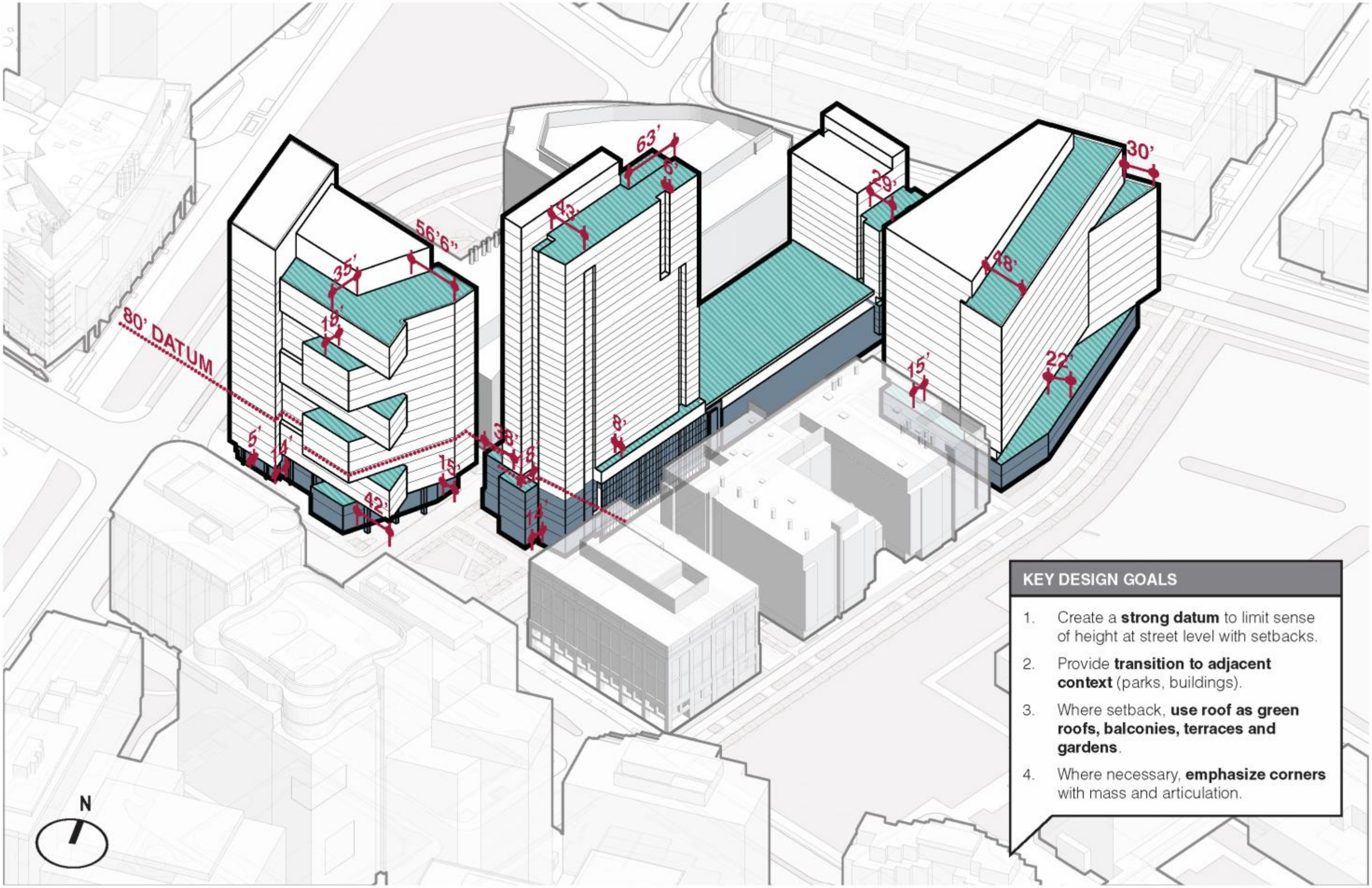
PROPOSED DIMENSION
K2 REPORT SUGGESTED DIMENSION

BINNEY STREET

NORTH ELEVATION

DESIGN GUIDELINES

BUILT FORM - MASSING, SETBACKS, AND DATUM



KEY DESIGN GOALS

1. Create a **strong datum** to limit sense of height at street level with setbacks.
2. Provide **transition to adjacent context** (parks, buildings).
3. Where setback, **use roof as green roofs, balconies, terraces and gardens**.
4. Where necessary, **emphasize corners** with mass and articulation.

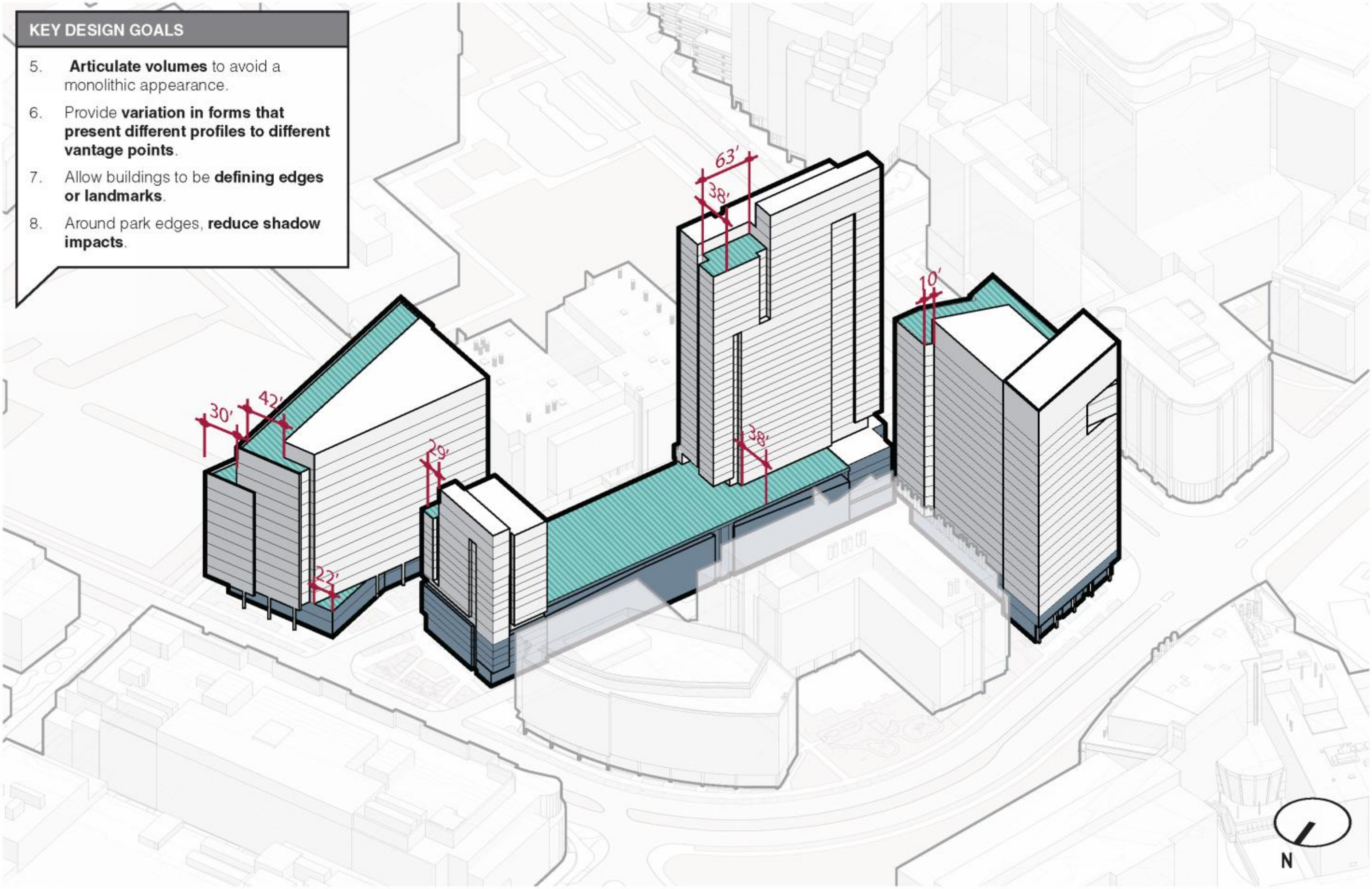
SOUTH EAST AXON

Roof Amenity Opportunity

Ground Floor or Base Condition

KEY DESIGN GOALS

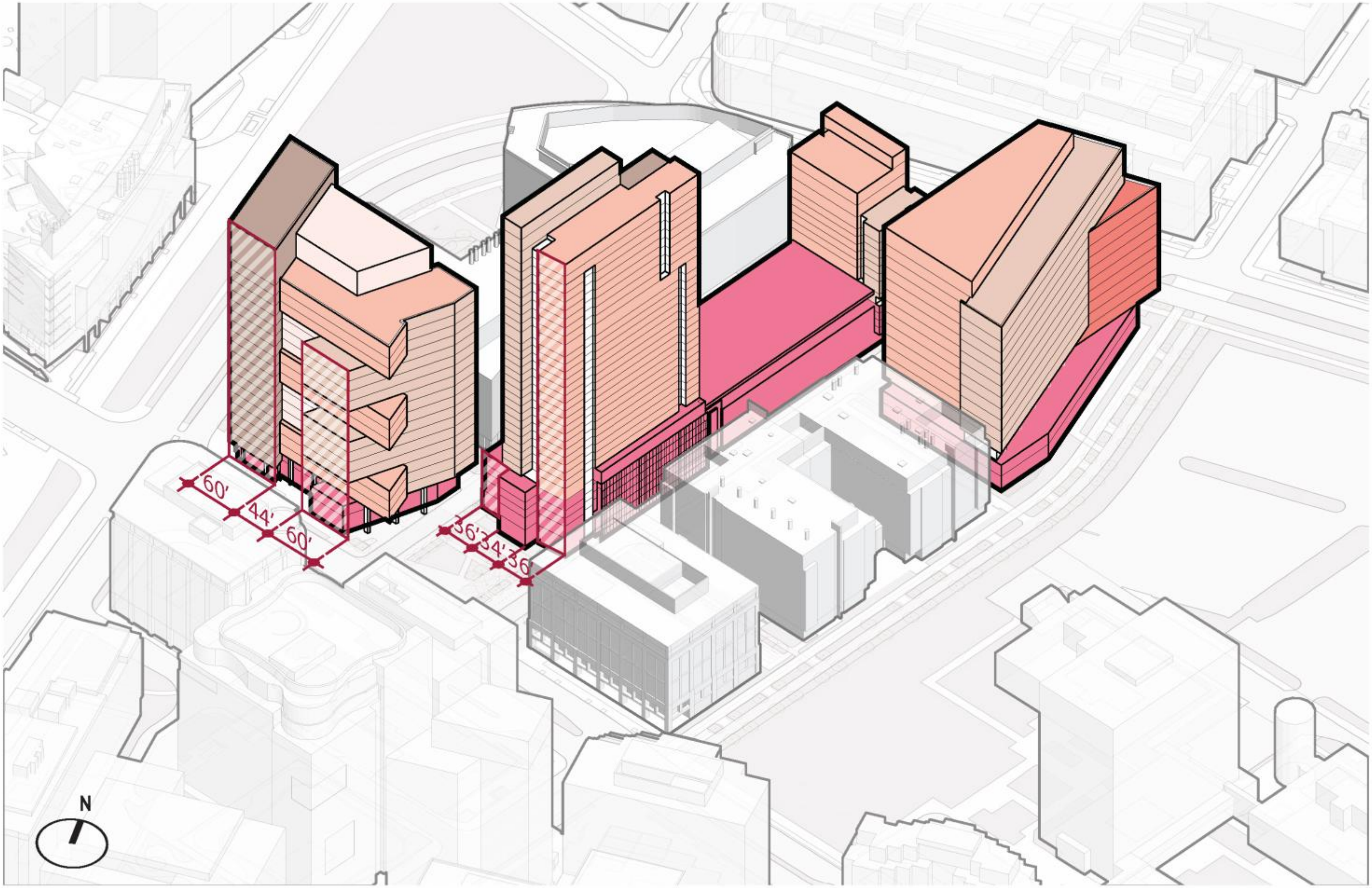
5. **Articulate volumes** to avoid a monolithic appearance.
6. Provide **variation in forms that present different profiles to different vantage points**.
7. Allow buildings to be **defining edges or landmarks**.
8. Around park edges, **reduce shadow impacts**.



NORTH WEST AXON

DESIGN GUIDELINES

BUILT FORM - MASSING AND VISUAL INTEREST

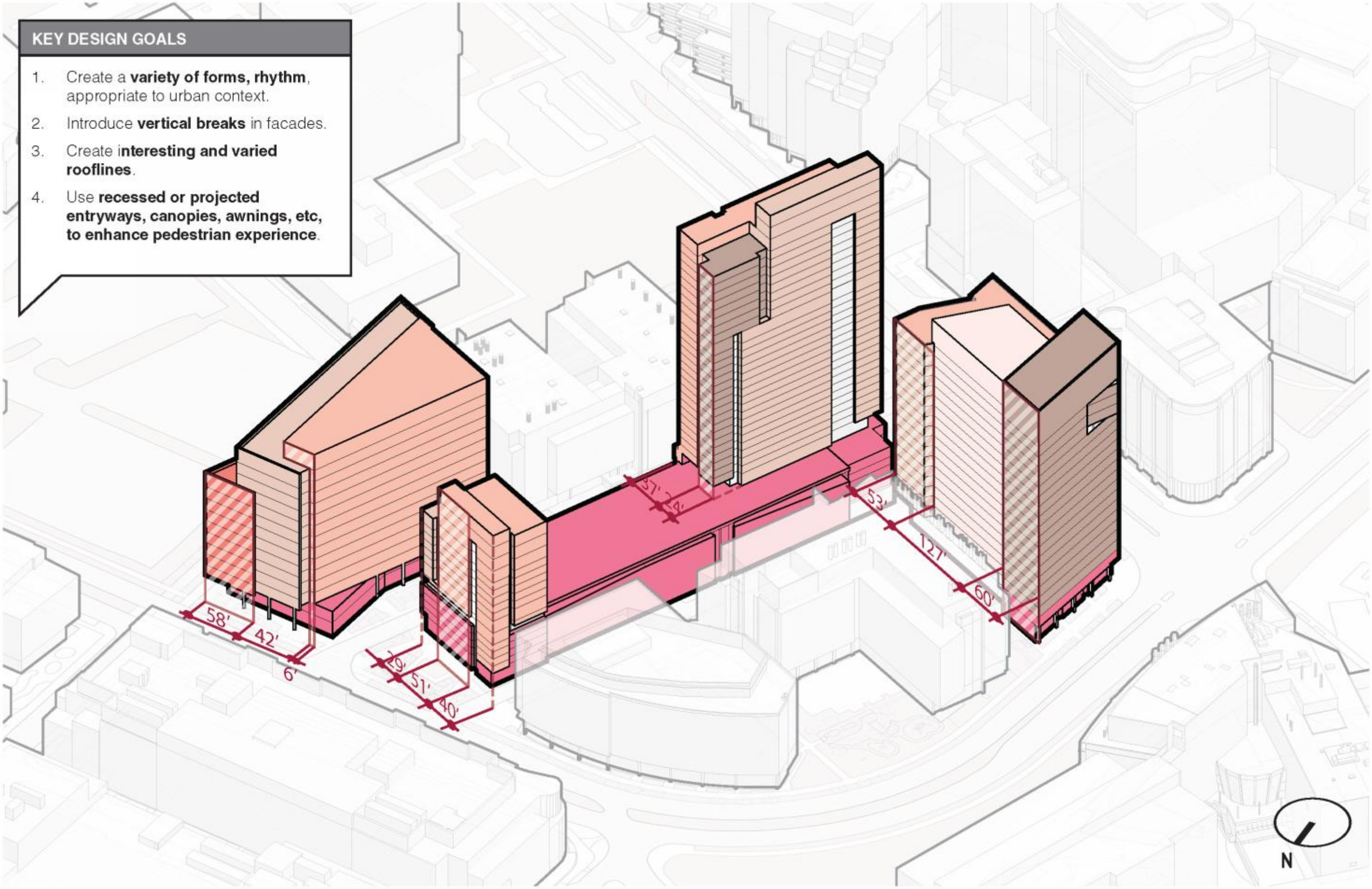


SOUTH EAST AXON

- Base volume
- Distinct volume
- Distinct volume
- Distinct volume
- Distinct volume
- Vertical bay

KEY DESIGN GOALS

1. Create a **variety of forms, rhythm**, appropriate to urban context.
2. Introduce **vertical breaks** in facades.
3. Create i**nteresting and varied rooflines**.
4. Use **recessed or projected entryways, canopies, awnings, etc, to enhance pedestrian experience**.



NORTHWEST AXON

DESIGN GUIDELINES

COMMERCIAL BUILDING A (145 BROADWAY)

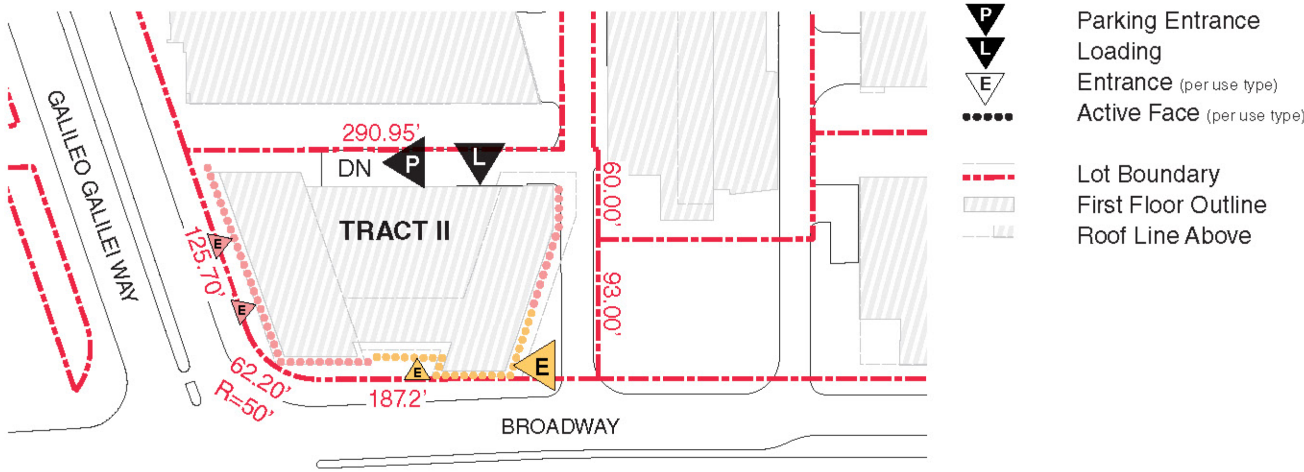
Located at the intersection of Broadway & Galileo Galilei Way, Commerical Building A at 145 Broadway Street is proposed to be an office building. It is a highly visible gateway, as it occupies two major public streets, Broadway and Galileo Galilei Way. The following are the design guidelines for Commercial Building A:

- Activate the adjacent public realm with public plaza, active use, and lobby spaces.
- Active use space on the ground floor extends along Broadway and wraps the corner of Galileo Galilei Way .
- Enhance the connection to the proposed Broadway Park and Binney Street Park.
- Massing at the corner of Broadway and Galileo Galilei Way establishes a strong urban presence and highlights the entry into the district.
- Interlocking forms face Broadway Park to reduce a monolithic reading of the building, multiple roof terraces and to provide visual interest to the adjacent public space.
- Capitalize on relationship to West Service Road by tucking loading and service access away from Broadway and in the service roadway.

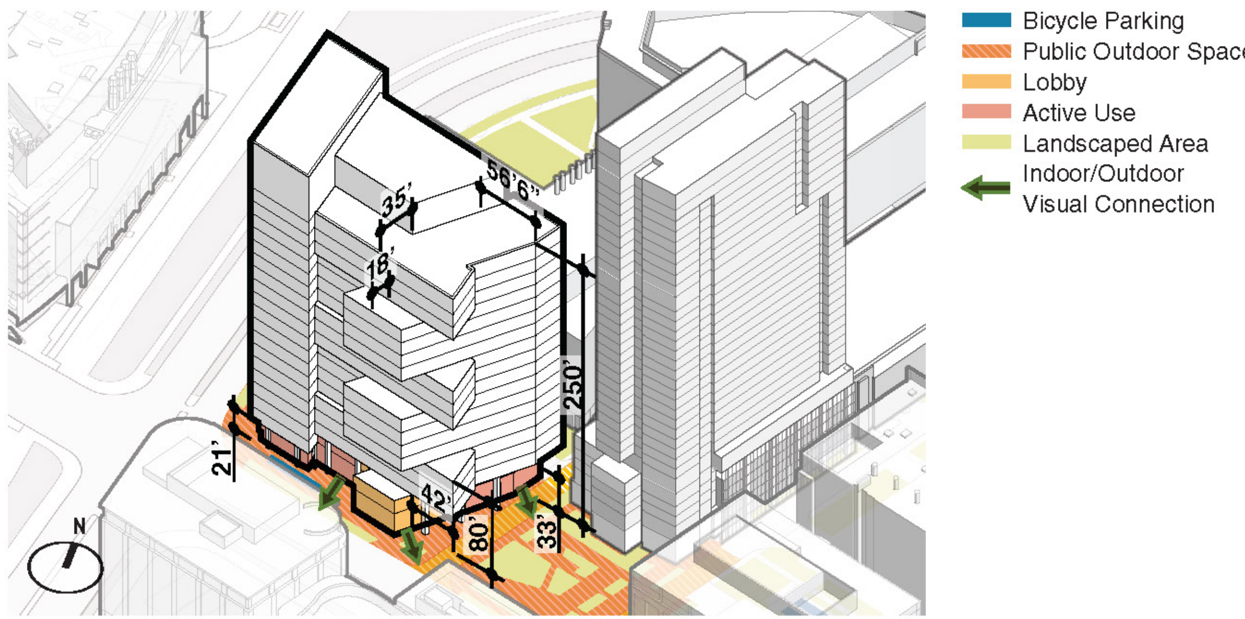
COMMERCIAL BUILDING A (145 BROADWAY)

LOT Size Existing:	37,862 SF
LOT Size Proposed:	56,760 SF
GFA:	443,731*
FAR:	7.81
USE:	Commercial
PARKING:	374
MAXIMUM HEIGHT:	250 FT
LOT COVERAGE:	39%*

*Numbers reflect revised lot.



PARCEL BOUNDARY



SAMPLE MASSING- SOUTHEAST AXON

DESIGN GUIDELINES

RESIDENTIAL BUILDINGS NORTH AND SOUTH (BLUE GARAGE)

Located in the center of Parcel 2, the proposed Residential Buildings North and South contributes to the housing needs of the City of Cambridge through the offering of a broad spectrum of residential units. Comprised of two standalone buildings, one facing Binney Street to the North and the other facing Broadway Street to the South, the new construction will mask the existing parking deck, significantly improving the streetscape and pedestrian exerience within the neighborhood. The following are the design guidlines for South and North Buildings:

South Building

- Setback from Broadway Street, fronting the Broadway Park.
- Standing at 350 feet, provides an opportunity for a landmark building and can be seen from afar.
- Provides home ownership and rental units.
- Dedicated loading off West Service Road, away from major pedestrian and traffic paths.
- Two active lobbies on ground floor facing Broadway Park.
- Massing of building emphasize slender, vertically-oriented proportions and vertical breaks as necessary to minimize monolithic form.
- Social space/roof deck atop

North Building

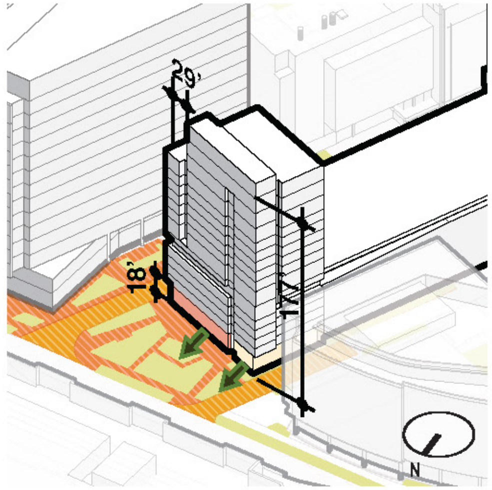
- Setback from Binney Street, fronting Binney Park.
- Stands at 157 feet, in respect to lower height of the neighborhood to north.
- Accomodates a proportionate share of affordable, middle-income and three-bedroom units.
- Ground floor plan contains active lobby as well as dedicated retail or active use space.
- Dedicated service and loading off East Service Road.
- Vertical breaks in the facade regulate massing.
- Social space/roof deck atop

RESIDENTIAL BUILDINGS NORTH AND SOUTH (BLUE GARAGE)

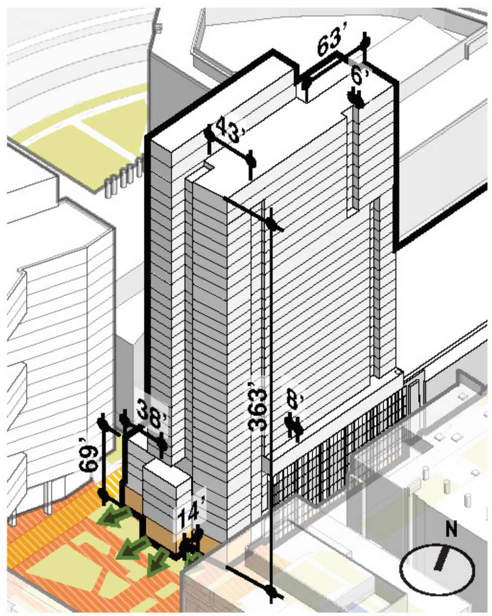
Lot Size Existing:	91,848 SF
Lot Size Proposed:	72,950 SF
GFA:	421,300
FAR:	5.77
USE:	Residential
PARKING:	955*
MAXIMUM HEIGHT:	350 FT
LOT COVERAGE:	71%**

* Current parking 1170 (-215 spaces)

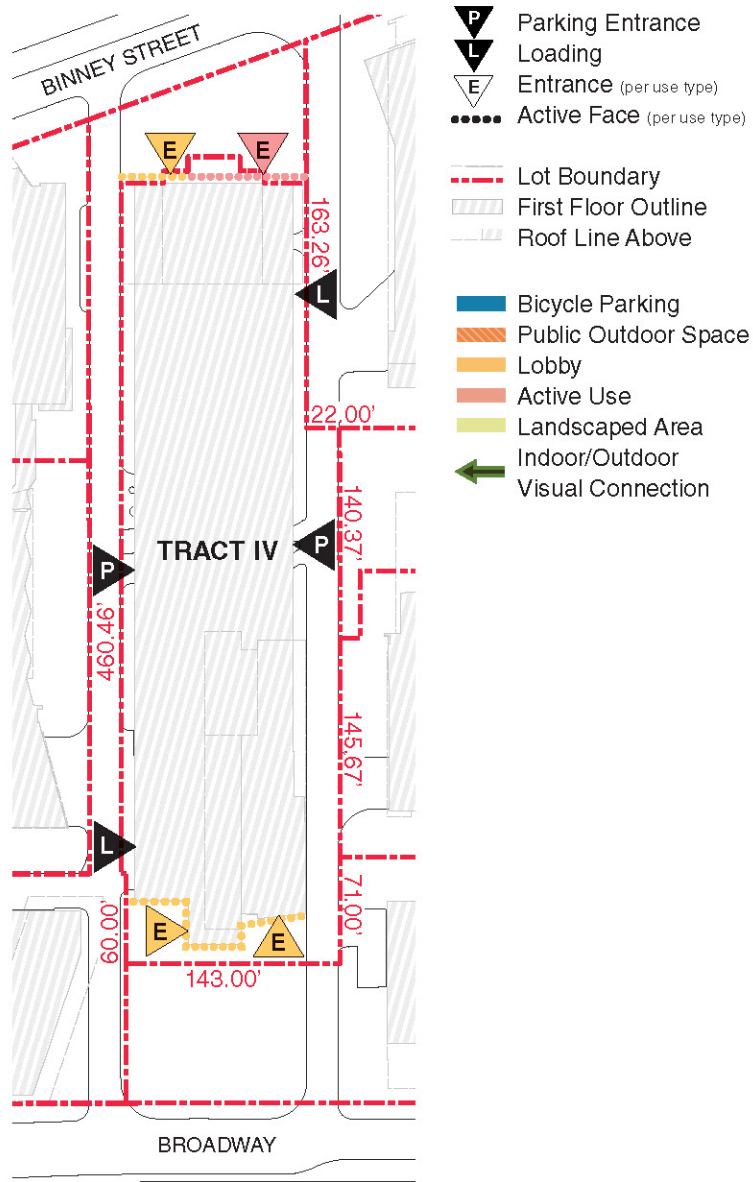
** Number reflects revised lot.



NORTH WEST AXON



SOUTH EAST AXON



GROUND FLOOR LOT BOUNDARY

DESIGN GUIDELINES

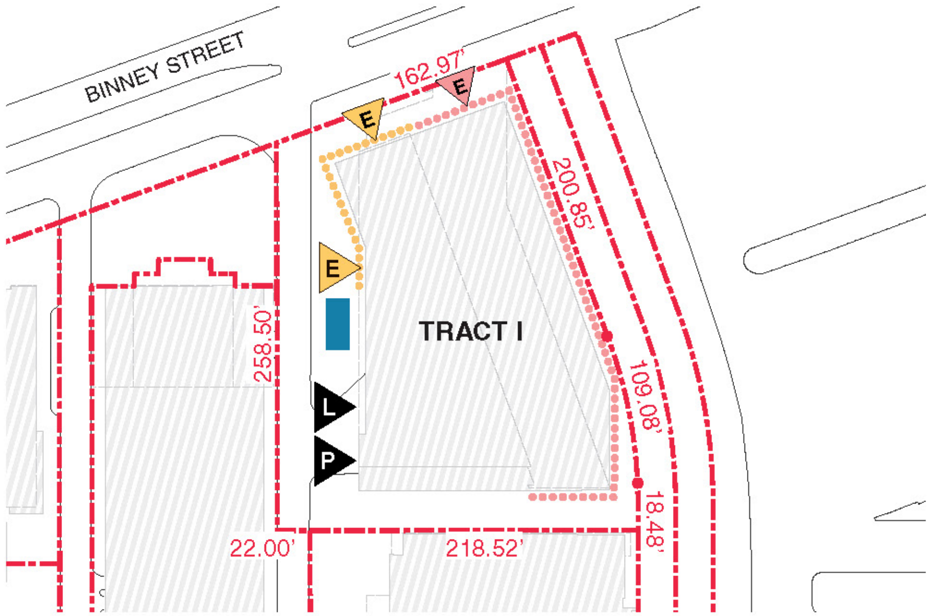
COMMERCIAL BUILDING B (250 BINNEY STREET)

Located along Binney Street, next to the 6th Street Connector, the proposed scheme for Commercial Building B responds to the site's irregular perimeter resulting in a trapezoidal floor plate and building form, while individual facades respond to site-specific conditions on each side of the building. The following are the design guidlines for Commercial Building B:

- Ground floor steps back to provide a more generous path of travel for pedestrians and cyclists.
- Active use space facing Binney Park angles to align to Binney Street and to provide a frontage to the public realm.
- Massing of volume is read as a series of overlapping conditions and setbacks.
- Building steps down toward 6th Street Connector with green roof amenities.
- Vertical breaks alleviate the reading of the volume.
- Active use and active lobby establishes the program on the ground floor.
- Service and loading is located on East Service Road.

COMMERCIAL BUILDING B (250 BINNEY STREET)

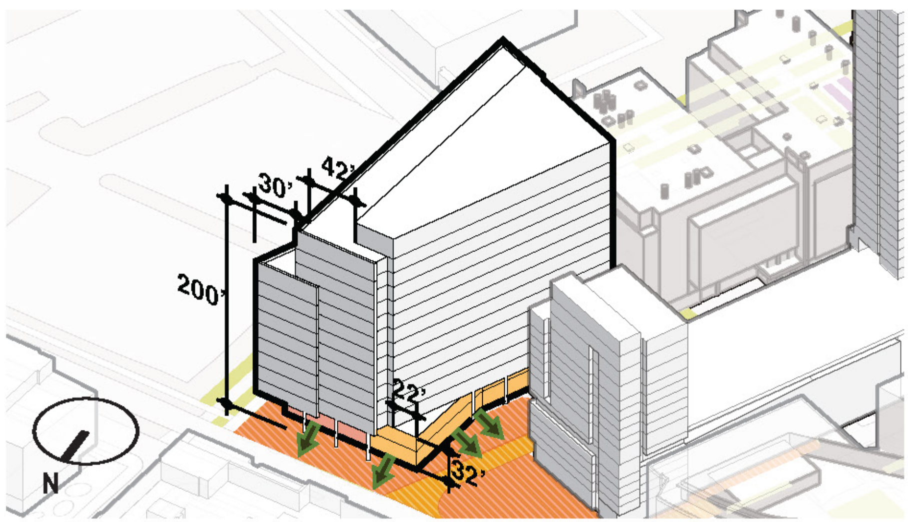
Lot Size:	60,622 SF
GFA:	318,644 SF
FAR:	5.25
USE:	Commercial
PARKING:	Up to 650
MAXIMUM HEIGHT:	Up to 200'
LOT COVERAGE:	58%



PARCEL BOUNDARY

Parking Entrance
Loading
Entrance (per use type)
Active Face (per use type)

Lot Boundary
First Floor Outline
Roof Line Above



SAMPLE MASSING- NORTHWEST AXON

Bicycle Parking
Public Outdoor Space
Lobby
Active Use
Landscaped Area
Indoor/Outdoor Visual Connection

LANDSCAPE MATERIALS GUIDELINES

PAVING

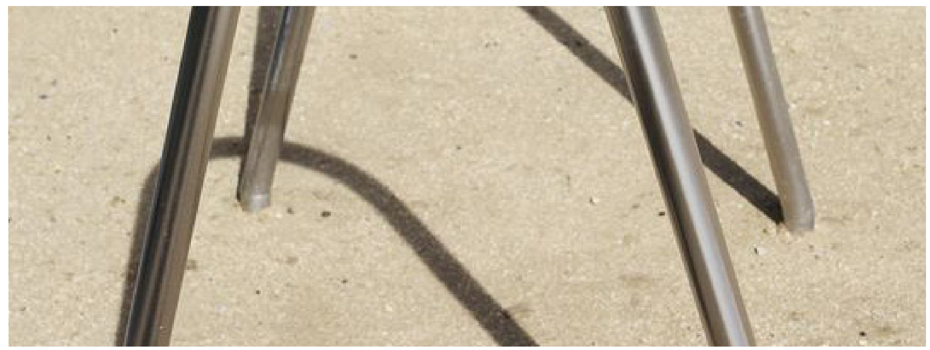
All paving materials should be able to withstand high volumes of pedestrian movement and harsh weather conditions. Paving should be able to accommodate garage entrances, retail loading areas, vehicular crossings, and potentially de-icing treatments, if needed. In the event of damage, repair or utility work, paving should be easily repairable. Pavements must be slip resistant and safe for pedestrian traffic. Paving that utilizes lighter coloring can help reduce heat island effect and can count towards LEED credits. The following are pavement recommendations:

Field paving should be predominantly used to minimize tripping hazards along the pedestrian movements. Pave the sidewalk predominantly with field paving to minimize tripping hazards in the pedestrian travel way.

Specialty paving should be used to highlight entries to buildings or park, mid block crossings or even public art. Paving over tree spaces should be porous, either by utilizing porous pavers, setting unit pavers on a pervious setting bed or using tree grates.

Within the district, concrete pavers may be used along the eastern facade of 145 Broadway, adjacent to Broadway Park to signify primary building entries and stairs. Sidewalks along Broadway, and Galileo Galilei Way will typically be cast in place concrete with saw cut joints, scoring patterns, and/or texture. Decomposed granite and or a Flexi-pave surface material could be considered an option for surfacing below bicycle parking.

CONCRETE UNIT PAVER



DECOMPOSED GRANITE

CAST-IN-PLACE CONCRETE

CONCRETE UNIT PAVER

FURNISHINGS

BENCHES, TABLES, AND SEATING

Benches, tables and other types of seating should be located in a variety of settings to allow a choice of scenery and social settings. Within the district, a mix of fixed and movable chairs, as well as tables will be provided to allow for informal gatherings, outdoor eating, studying and socializing.

If located in sunny areas, umbrellas or shading devices will be considered.

In addition to movable tables and chairs, fixed benches may be used along the East West Connector, or potentially near building entrances, including vestibules, and other covered spaces.

SEAT WALLS

Within the district core, seat walls or colored concrete benches (with or without wooden seats) will be used to provide seating in or around the edges of these spaces. Walls shall be concrete and be compatible in material, pattern and color with immediately adjacent buildings. Capstones will be granite or precast concrete. Seat walls should be set level.

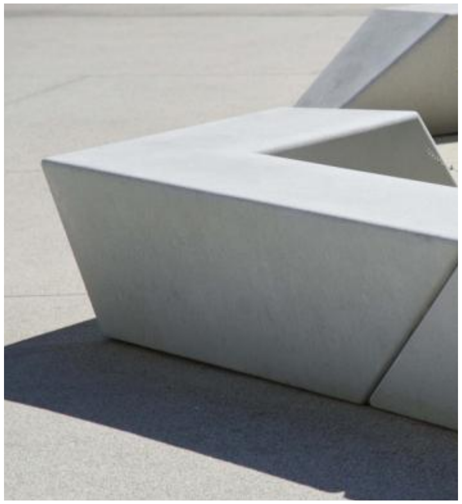
LITTER AND ASH RECEPTACLES

The litter receptacle that should be used throughout the district is the ‘collect’ as supplied by “landscapeforms,” with top or side opening, or similar. Finish shall be polyester powder coat in color ‘silver,’ ‘titanium,’ or ‘black,’ matching the color chosen for the benches.

BICYCLE RACKS

In all district areas, the ‘Bola Rack’, or similar, shall be used. Racks should be anchored to a concrete base, and shall preferably be stainless steel, receive a hot dipped galvanized finish, or a powder coat finish in black. Spacing of the ranks shall conform to Bicycle Rack Cambridge Standards.

LITTER RECEPTACLES



SEATING WALLS

BIKE RACKS

LANDSCAPE MATERIALS GUIDELINES

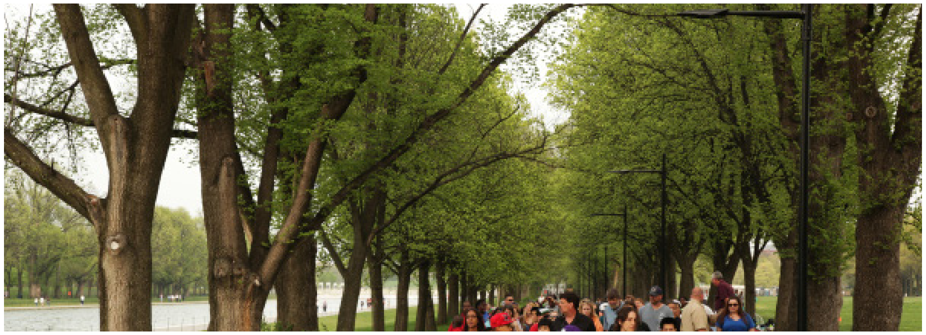
LIGHTING

The primary function of exterior lighting is the safety of drivers, cyclists and pedestrians at night, but it plays an equally important role in complementing architecture and urban form to provide a sense of place before and after sunset. Exterior lighting sources shall be light emitting diode (LED), unless approved by city staff. All exterior lighting fixtures must be submitted and approved by the CRA and city staff. Developments in the district shall observe the following guidelines with respect to exterior lighting:

Building lighting – Exterior walls of buildings should be illuminated at a regular interval by wall-bracketed or accent up light fixtures, and such fixtures should complement the building's architectural expression. Where a feature such as a soffit or arcade is employed in the architectural design of a building, lighting should be recessed into that feature. Exposed light sources shall not be permitted around buildings.

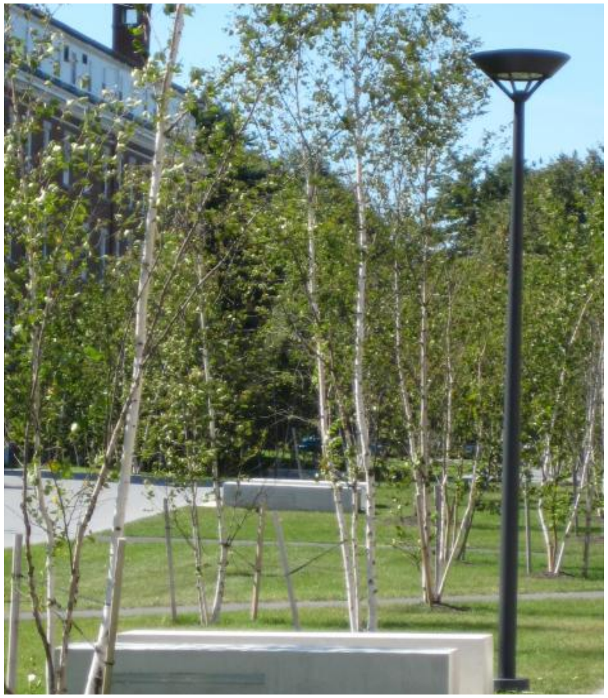
Pedestrian lighting – Pedestrian light fixtures should be no more than 14 feet (14') tall, and be anchored by a pedestal base that is of proportion to the height and circumference of the pole of a complementary material.

AMENITY LIGHTING



FULL CUTOFF STREETLIGHT / PEDESTRIAN LIGHT

POST TOP PEDESTRIAN LIGHT



POST TOP PEDESTRIAN LIGHT

LANDSCAPE MATERIALS GUIDELINES

WATER FEATURE

Water features of the proposed public realm can play a vital role in providing places to create visual interest and serve as a landmarks or focal points. Within Broadway Park, a water feature will serve the purpose of distinguishing the park from buildings along the Broadway streetscape. The design will integrate water features in the urban landscape as stormwater collection, storage and or circulation. Guiding principles for introducing water features into the pedestrian realm are as follows:

1. Use of high-quality stone products and applications that complement adjacent architecture.

2. Locate water features with the landscape zone, building zone, or open space locations. Water features should be kept out of the sidewalk zone of the streetscape, in order to not impede pedestrian movement.

3. Design considerations should take into account the appearance during winter months or during periods of drought.

4. Increase the recycling, storage and recirculation of stormwater.

5. Compliance with the City of Cambridge Standards for drainage.

WATER FEATURE / RUNNEL

RUNNEL SIGNAGE

DECOMPOSED GRANITE

WATER SPOUTS