



CITY OF CAMBRIDGE

Community Development Department

To: Louis A. DePasquale, City Manager

From: Iram Farooq, Assistant City Manager for Community Development
Nancy E. Glowa, City Solicitor

Date: April 26, 2021

Re: **Green Roofs Zoning Petition**

IRAM FAROOQ
*Assistant City Manager for
Community Development*

SANDRA CLARKE
*Deputy Director
Chief of Administration*

KHALIL MOGASSABI
*Deputy Director
Chief of Planning*

Following the March 31, 2021 Ordinance Committee hearing on this Zoning Petition and subsequent discussion at the City Council on April 12, 2021, CDD and Law Department staff in consultation with the Inspectional Services Department (ISD) have prepared the following materials for consideration if the City Council chooses to take final action on this petition:

- Suggestion of an effective date for the proposed requirements, so that developments already in the design review process but not yet permitted would not be unreasonably impacted. Included is a list of developments currently under review, but without a filed special permit or building permit (in cases where a special permit is not required), which would be affected if the petition were adopted.
- Information on green roof requirements in other cities.
- Per Policy Order #9 of April 12, 2021, report on the impact of eliminating parking decks from the list of rooftop areas not considered "available" per the Petition.
- Per policy order #10 of April 12, 2021, amendment to exempt affordable housing.
- Determination of appropriate mitigation costs.
- Careful review of the proposed zoning text, in the version recommended by the Ordinance Committee, to identify technical issues that may be problematic when applying the proposed language and to suggest alternative language where appropriate.

Narrative responses are included on the following pages, and an annotated markup version of the zoning text is attached.

Effective Date

Typically, when an amendment to the Zoning Ordinance is adopted, it would affect any development that has not yet been issued a special permit, or a building permit if a special permit is not required, by the date of first advertisement of the zoning petition – in this case, ca. January 21, 2021. The following is a list of projects that had not yet been issued a permit by that date, including developments that have submitted an application or have begun a community engagement process. Language to include an effective date is included in the attached zoning text.

- The list includes Affordable Housing Overlay (AHO) Projects that have begun their community review process; however, because AHO Projects do not require a special permit, they would not be “protected” from zoning amendments until they receive a building permit.
- The list includes projects involving a total of 25,000 square feet or more, including new buildings and alterations/additions. As discussed further below, it is unclear from the current zoning petition language if alterations/additions would be subject to the requirements or not.

Project Location/Name	Status	Project Type / Approx. Size	Use
CambridgeSide PUD	Special permit issued 2/17/2021	New buildings + alterations (1,665,000 SF)	Multi-Site Mixed-Use
51 Vassar St	Approved, special permit not filed	New building (174,000 SF)	Academic
269-301 Vassar St (MIT Grad Housing)	Planning Board Review	New building (327,000 SF)	Academic / Dormitory
2072 Massachusetts Ave	BZA Review (Comp. Permit)	New building (57,395 SF)	Affordable Housing
727 Massachusetts Ave	Planning Board Review	Addition + alteration (41,895 SF)	Hotel
600-624 Main St (Ragon Institute)	Planning Board Review	New building (185,810 SF)	Laboratory
600 Massachusetts Ave	Planning Board Review	Addition (79,203 SF)	Residential + Retail
MIT Volpe PUD	Planning Board Review	New buildings (2,820,000 SF)	Multi-Site Mixed-Use + Cmty Ctr.
585 Third St (Constellation Site)	Pre-application (PUD special permit)	New building (525,000 SF)	Commercial Lab + Arts Center
Metropolitan Warehouse - MIT Architecture Dept	Pre-application (building permit)	Alteration (1,155,468 SF)	Academic
Alewife Park / Jerry's Pond	Pre-application (special permit)	New buildings + alterations (735,494 SF)	Multi-Site Commercial
MXD amendment (Eversource Substation)	Pre-application (special permit)	New buildings (1,200,000 SF)	Multi-Site Mixed-Use + Utility
52 New St (Just-A-Start)	Community Process (AHO)	New building (150,000 SF)	Affordable Housing
278 Rindge Ave (Jefferson Federal)	Community Process (AHO)	New buildings (379,925 SF)	Affordable Housing
102 Sherman St (Walden Square Apts.)	Community Process (AHO)	New building (145,323 SF)	Affordable Housing
Tobin School	Community Process (City meetings)	New building (TBD)	City School

Green Roofs in Other Cities

Many cities have adopted policies that incentivize or mandate green roofs but have taken a variety of regulatory approaches. A few key examples of cities noted by the Council that have prescriptive green roof requirements are discussed here. Other cities known for their leadership in green roofs, such as Chicago and Washington, D.C., rely on incentives and other programs rather than prescriptive requirements.

Denver, CO

Denver passed a green roofs ordinance in 2017 that required new buildings over 25,000 square feet to install a green roof and existing buildings over 25,000 square feet to install a green roof when the roof is replaced. However, implementation of the ordinance revealed several limitations, including conflicts with the building code and state water regulations, an inequitable burden of compliance on different building types and uses, and high construction costs. In response, the city formed a green roofs review task force that worked with a consultant to evaluate whether alternatives to green roofs would provide the same function. As a result, Denver passed a new ordinance in 2018 that now requires buildings over 25,000 square feet to meet a cool roof requirement and one of five options, as shown in the image below.



Image 1: Options for Green Building compliance in Denver (source: <https://crej.com/news/program-offers-options-for-green-building-compliance/>)

Staff at the City and County of Denver report that the most common measure that is pursued is the energy program, which allows several different options. Some development projects have installed ground-level vegetation, but there have only been a couple of green roof installations. Denver has also not seen much utilization of the payment in lieu of installation option because the fee is high enough to discourage its usage.

It is also important to note that the ordinance defines “available roof area” separately from the full extent of the roof area and offers two ways of calculating area, allowing the applicant to choose the lesser of the two. In addition, Denver does not have a green building requirement for new development of this scale like Cambridge does in Article 22.000 of the Zoning Ordinance.

Portland, OR

Portland has an “ecoroofs” requirement, which is mandated for all new buildings in the “central city” area with a net building area of at least 20,000 square feet. Ecoroofs must cover all parts of the building’s roof area that are not exempted. The exempted areas include roof top parking, roof area with a slope greater than 25%, and other rooftop systems including mechanical equipment, photovoltaic arrays, and stairwell enclosures, up to 40% of the roof area. The City also offers a Gross Floor Area (GFA) bonus for development projects in mixed-use zones outside of the central city that install green roofs or solar roofs. The ecoroofs requirement was outlined in the Portland Central City 2035 Plan (CC2035 Plan) and went into effect July 2018.

Toronto, Ontario, Canada

Toronto was the first city in North America to require green roofs on new development. The Green Roof Bylaw sets a graduated requirement for new developments that are over 2,000 square meters (approximately 21,500 square feet). As shown below, depending on the size of the building, between 20-60% of the available roof area for commercial, institutional, and residential development must meet the green roof standard.

Gross Floor Area of Building	Coverage of Available Roof Space
2,000-4,999 m ²	20%
5,000-9,999 m ²	30%
10,000-14,999 m ²	40%
15,000-19,999 m ²	50%
20,000 m ² or greater	60%

Residential buildings less than six stories or 65’ height are exempt from being required to have a green roof. Industrial buildings are required to have 10% green roof coverage or 100% “cool roof” coverage and compliance with stormwater management performance measures. In all instances, Available Roof Space is defined in the Green Roof Bylaw as the total roof area minus areas designated for renewable energy; residential private terraces; residential outdoor amenity space (to a maximum of 2m²/unit); and a tower roof on a building with a floor plate less than 750m². Toronto also offers a payment-in-lieu option that funds an Eco-Roof Incentive Program.

Copenhagen, Denmark

CDD staff reached out to staff in the City of Copenhagen to learn more about the City’s policies on resilient roofs. The Danish planning framework and energy system design is very different from the United States or Massachusetts, with much of the planning done at a neighborhood level rather than through citywide development regulations, so direct comparisons are difficult. Copenhagen does not require green roofs but has adopted general guidelines that recommend green roof installation where possible depending on roof slope. There is no specific guidance on solar panel installation and staff had not observed examples of tilted solar panels installed over green roofs or other types of flat roofs.

Parking Decks

The Petition currently lists “Vehicular parking decks” as one of the areas considered “not available” in the context of the green roof requirement. It is unusual for parking spaces to be provided on the roof of a building with another use, so this is most likely to apply to cases where open, above-grade parking garages are proposed. These types of parking facilities are also rare but are built in some places where flood risk is an issue, particularly in Alewife. The Alewife District Plan identifies parking garage roofs as opportunities for creating solar canopy or green roof coverage, because they tend to be flat areas with few other rooftop mechanical needs.

Eliminating parking decks from the “not available” category in the Petition would mean that parking garages would be required to meet the same requirements for green roof / solar energy system coverage as other buildings. The additional cost is unknown, but is likely higher than a typical rooftop installation, because it would require additional structure to create a canopy above the parking spaces. Because above-grade structured parking is counted as gross floor area (unless the zoning allows an exemption), it is not likely to conflict with floor area limitations, but it could be affected by the height limit in the zoning district if the additional canopy increases the height of the structure.

Affordable Housing Exemption

We have inserted text in Section 22.35.1 reflecting the City Council’s vote on April 12th regarding Policy Order #10. For the sake of future implementation, we recommend clarifying the projects that are eligible for the affordable housing exemption, e.g., projects that include a minimum percentage of Gross Floor Area (GFA) that is affordable and to families with an income of up to a certain percentage of Area Median Income (AMI). Affordable Dwelling Units are currently identified in Article 2.000 of the Zoning Ordinance; additional definitions relating to projects that include Affordable Dwelling Units are identified in Section 11.207 regarding the Affordable Housing Overlay.

Mitigation Costs

The intent of the Petition, if adopted, would be to mitigate the impacts of climate change by requiring green roof and/or solar energy system installations. In order to provide an alternative payment that is consistent with the intent, the amount and use of the payment would need to be connected to the mitigation that is achieved by meeting the requirement. In this case, the payment should provide the needed funds to enable the City to provide green roof and/or solar installations with comparable benefits.

A future study will be needed to gather sufficient information to calculate the alternative payment rate. For comparison, the City of Denver (see above) performed a “rate study” that included a review of green space costs, using actual examples, to calculate a fee (currently set at \$50 per square foot of green space not constructed – noting that Denver’s requirement can also be met with ground-level green space). (Source: <https://denver.legistar.com/View.ashx?M=F&ID=6674299&GUID=AC3409A8-D999-4D5E-9222-1622D3C1DF75>.)

As noted below, the zoning text should be clarified to determine what is included in the calculation. Based on the Denver example, the following considerations could be included:

- The payment rate should be based on the average costs of green roof and rooftop solar energy systems in Cambridge and calculated using actual cost figures to the extent possible.
- The calculation should include the total costs associated with design, installation, and ongoing operation and maintenance of the green roof or rooftop solar energy system.
- The rate should be subject to annual adjustment based on standard construction cost indices and recalculated from time to time. The rate should also be based on an established time frame for operation and maintenance.

Zoning Text Issues

CDD and Law Department staff reviewed the latest text of the Petition (recommended by the Ordinance Committee on 3/31/2021) with ISD to identify practical issues that could complicate the implementation of the petition if it is adopted. The following is a set of issues that were identified, some of which are addressed in the attached zoning text revisions.

1. Existing Green Roofs Zoning. The Petition creates a section heading “22.30 – Green Roofs” and new Sections 22.31-22.34; however, those sections already exist. Current zoning defines “Functional Green Roof Area,” clarifies that it is allowed and does not count as Gross Floor Area, and provides a limited exemption for usable rooftop space (such as roof decks) in combination with green roofs. The Petition states that it “offers no revisions” to the current Zoning Ordinance, in which case the Petition should be amended to fit within the current Section 22.30.
2. Conflicting “Green Roof” Definitions. It may be helpful to resolve discrepancies between the Petition’s definition of “Green Roof” and the current definition of “Functional Green Roof Area” to avoid ambiguity. For example, “Functional Green Roof Area” is defined as being “open to the sky and air,” which could conflict with the intent of “biosolar” roofs that might be partially covered by solar panels.
3. Definition of “Biosolar.” Although the intent was described by the petitioners, “biosolar” is not an industry term with a precise meaning. The Petition defines it as “Green roof surfacing and solar technologies intermingled ...” but the term “intermingled” would be difficult to apply when reviewing different possible combinations of planted area and solar energy installations.
4. Applicability Threshold. The Petition would apply requirements to “new construction of buildings equaling or exceeding 25,000 square feet of gross floor area,” which seems intended to include new buildings but might be interpreted to mean alterations or additions to existing buildings. Clarifying language is provided if the intent is to only apply to new buildings, consistent with similar language used elsewhere in the Zoning Ordinance.
5. Accessible Roof Areas. The exclusion of “Areas designed and managed for code-compliant access and use by building occupants or general public” may be difficult for ISD to apply when reviewing development plans. In the past, ISD has interpreted “occupiable space” to include space used by principal users of a building (e.g., residents, office workers) but not space

accessible only for maintenance, service, life safety, or other ancillary functions. Rooftops may require space to access and maintain mechanical equipment, Fire Department access, or other reasons in order to comply with building and safety codes. Green roofs themselves often require spacing for access and maintenance. The Petition in its current form may require these areas to meet the 80% vegetation requirement, which could conflict with other codes.

6. Mechanical Appurtenances. The Petition only provides for “isolated intrusions” less than four square feet in plan area. On a larger building, nearly all mechanical equipment, penthouses, elevator overrides, chimneys, other appurtenances, or even skylights (where installed) tend to be significantly larger than four square feet. Moreover, per the City’s urban design guidelines, they tend not to be distributed across the rooftop as isolated features, instead they are organized and consolidated into areas that can be screened visually and acoustically from abutting buildings. As mentioned above, some mechanical equipment also requires spacing around it for proper functioning, maintenance, and safety, and also requires conduit to attach to building systems, in which case surrounding them with vegetation is not feasible. If the intent of the Petition is to make allowances for necessary mechanical equipment, the approach of only allowing isolated appurtenances would not be effective.
7. Compensating Payment. The Petition delegates to CDD the calculation of a per-square-foot cash contribution that is “roughly comparable to the average price of a green roofing over-burden system,” but that term is not defined in the Zoning Ordinance. A search indicates that in the green roof industry, the term “overburden” could refer to the entire green roof assembly above the roof membrane, and also refers to a type of warranty for removal. Clarifying the basis for the payment is important for the reasons discussed above, and suggested language is provided in the attached zoning text.

Zoning Text Legend:

- Unformatted: Current Section 22.30 of the Zoning Ordinance
- Underline: Green Roofs Zoning Petition text
- Double underline / ~~double strikethrough~~ markup: CDD/Law Dept. suggested alternative text

Add the following definitions of “Green Roof Area” and “Green Roof Area, Biosolar” to Article 2.000 Definitions

Green Roof Area. Area atop a roof surface on a building covered by a layer of living vegetation planted in a minimum of four (4) inches of growth medium over a waterproofing system ~~that is installed on top of a flat or slightly sloped roof, and is not intended for use or occupancy.~~
(Also known as a vegetated roof.)

~~1- Green Roof Area, Biosolar.~~ Green Roof Area incorporating or adjacent to a Solar Energy System ~~roof surfacing and solar technologies intermingled in an area of roof.~~

Amend Section 22.30 Green Roofs to read as follows:

22.30 - GREEN ROOFS

22.31 *Purpose.* The purpose of this Section is to remove potential impediments to the development of green roof systems on new and existing buildings by clarifying that such systems should not count against a building's Gross Floor Area, and by providing for limited access and enjoyment of green roofs by occupants of a building, and to require new buildings of substantial size to include vegetation and/or solar energy roofing systems on much or most of the available roof area.

~~22.32 Functional Green Roof Area shall be as defined in Article 2.000 of this Zoning Ordinance as area atop a roof surface on a building, open to the sky and air, which is surfaced with soil and living plant materials for the purpose of retaining rainwater and absorbing heat from sunlight. The depth of soil and planted material shall be at least two (2) inches to be considered Functional Green Roof Area. For the purposes of maintaining the plant material, Functional Green Roof Area may be accessible by means of a roof entrance.~~

22.33 *Floor Area Exemptions for Functional Green Roof Area.*

22.33.1 Spaces meeting the definition of ~~Functional Green Roof Area as defined in Subsection 22.32 above,~~ which are to be accessed only for maintenance purposes and are not intended to be used by building occupants or others, shall be exempt from the calculation of Gross Floor Area of a building.

22.33.2 Spaces meeting the definition of ~~Functional Green Roof Area as defined in Subsection 22.32 above~~, which are intended to be accessed for use by occupants of the building or others, and which are located above the third floor of the building, may be exempted from the calculation of Gross Floor Area of a building only after the granting of a special permit by the Planning Board. The proponent seeking such a special permit must demonstrate that the ~~Functional Green Roof Area~~ is designed such that the vegetation will withstand the foot traffic associated with its anticipated use. The Planning Board shall also consider the potential visual, noise and privacy impacts of the anticipated use on neighbors. Unless such a special permit is granted, any ~~Functional Green Roof Area~~ located above the third floor of a building that is intended to be accessed for use by building occupants or others shall be counted as Gross Floor Area.

22.34 *Floor Area Exemptions for Patios or Decks Adjacent to ~~Functional Green Roof Area~~.*

22.34.1 In non-residential zoning districts and in Residence C-1A, C-2, C-2A, C-2B, C-3, C-3A, and C-3B zoning districts, where a rooftop surface above the third floor includes ~~Functional Green Roof Area as defined in Section 22.32 above~~, adjacent open-air outdoor space intended for use by building occupants or other persons that does not meet the definition of ~~Functional Green Roof Area~~, such as a patio or deck, shall be exempted from the calculation of Gross Floor Area of the building, provided that the total space exempted in such a manner shall not exceed fifteen percent (15%) of the amount of ~~Functional Green Roof Area~~ on the building and that all such usable outdoor space shall be set back at least ten (10) feet from all outer roof edges.

22.34.2 In residential zoning districts not listed in Section 22.34.1 above, where a rooftop surface above the third floor includes ~~Functional Green Roof Area as defined in Section 22.32 above~~, adjacent open-air outdoor space intended for use by building occupants or other persons that does not meet the definition of ~~Functional Green Roof Area~~, such as a patio or deck, may be exempted from the calculation of Gross Floor Area of the building only after the granting of a special permit by the Planning Board. The total space exempted in such a manner shall not exceed fifteen percent (15%) of the amount of ~~Functional Green Roof Area~~ on the building and all such usable outdoor space shall be set back at least ten (10) feet from all outer roof edges. In granting the special permit, the Planning Board shall consider the location and orientation of the patio or deck in relation to adjacent properties and potential visual, noise and privacy impacts of the anticipated use on abutters.

22.30 – GREEN ROOFS

22.35 Green Roofs Requirement

~~22.35.1 Purpose and Applicability. This Section 22.35, et. seq., shall apply to any new building or structure of twenty-five thousand (25,000) gross square feet or more, except it shall not apply to the development of affordable housing projects, including those that fall under the Affordable Housing Overlay (AHO) as defined in Section 11.207. requires new construction of buildings equaling or exceeding 25,000 square feet of gross floor area to include green or biosolar green roofing on much or most of the available roof area.~~

~~22.35.2 Requirement. Of the available roof area as calculated by 22.31, at least 80% of that area shall be devoted to green and biosolar green roof construction. Available roof is the entire area of the roof as visible in plan view, but excluding the following:~~
22.35.2 Requirement. At least 80% of the roof area of the building as measured in plan view, excluding those portions of the roof listed below, that area shall be devoted to Green Roof Area, Biosolar Green Roof Area, or Solar Energy Systems green and biosolar green roof construction. Available roof is the entire area of the roof as visible in plan view, but excluding the following:

1. Areas having a slope greater than 3 in 12 or twenty-five percent (25%).
2. Areas designed and managed for ~~code-compliant access and~~ use by building occupants or the general public.
3. Vehicular parking decks.
4. Chimneys, water towers, air conditioning equipment, elevator bulkheads, skylights, ventilators and other necessary features appurtenant to buildings which are usually carried above roofs and are not used for human occupancy, in addition to conduit, visual and acoustical screening, access routes for maintenance and service, and other areas that must be clear of obstruction to comply with applicable building and safety codes.

~~22.32 Requirement. Of the available roof area as calculated by 22.31 at least 80% of that area shall be devoted to green and biosolar green roof construction. Isolated intrusions into green roofing surfacing that are less than 4 square feet in plan area, inclusive of penthouses and head houses, roof hatches, elevator over rides, vent stacks, skylights and mechanical and electrical equipment, may be counted as contributing to the required green roof area.~~

~~22.35.3 Exemption. By special permit of the Planning Board green roof construction may be granted below the area required by Section 22.35.2, provided that each square foot so exempted reduced be compensated by a unit price contribution to the Cambridge Affordable Housing Trust. This unit price shall be roughly comparable determined based on the average costs to design, install, and maintain green roofs and rooftop solar energy systems in Cambridge using actual cost figures to the extent possible, shall be subject to annual adjustment based on standard construction cost indices, equivalent to the average price of a green roofing over burden system, and shall be calculated, and occasionally revised as needed, recalculated from time to time, by the Cambridge Community Development Department. All such funds contributed to the Trust shall be dedicated to the design and incorporation of green and biosolar roofing Green Roof Area, Biosolar Green Roof Area, or Solar Energy Systems into new or existing affordable housing developments.~~

22.35.3 Exemption. By special permit of the Planning Board green roof construction may be granted below the area required by Section 22.35.2, provided that each square foot so exempted reduced be compensated by a unit price contribution to the Cambridge Affordable Housing Trust. This unit price shall be roughly comparable determined based on the average costs to design, install, and maintain green roofs and rooftop solar energy systems in Cambridge using actual cost figures to the extent possible, shall be subject to annual adjustment based on standard construction cost indices, equivalent to the average price of a green roofing over burden system, and shall be calculated, and occasionally revised as needed, recalculated from time to time, by the Cambridge Community Development Department. All such funds contributed to the Trust shall be dedicated to the design and incorporation of green and biosolar roofing Green Roof Area, Biosolar Green Roof Area, or Solar Energy Systems into new or existing affordable housing developments.

22.35.4 Effective Date. The provisions of this Section 22.35, as adopted on April 26, 2021, shall not apply to structures lawfully in existence or lawfully begun before April 26, 2022, or to a building or special permit issued before April 26, 2022, and shall take effect on April 26, 2022.