

# **TCAAP Redevelopment Code**

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Attachments:

- 1: Regulating Plan
- 2: Palette of Open Space Types
- 3: Development Review Chart
- 4: Street Cross Sections
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- 6: Recommended Color Palette
- 7: Audubon Minnesota Bird-Safe Building Guidelines
- 8: TCAAP Energy Integration Resiliency Framework

## Introduction

In 2013, the City of Arden Hills hired the consultant team to create a Master Plan for the Twin Cities Army Ammunition Plant (TCAAP) site, to conduct an Alternative Urban Area Wide Review (AUAR), and to draft local regulations and policies to implement the Master Plan. The Master Plan will amend the City of Arden Hills 2030 Comprehensive Plan in an effort to successfully integrate the TCAAP site into the rest of the City. This plan will also help ensure that appropriate development and economic growth occurs and is in line with the vision set forth by the City of Arden Hills and the owner of the property, Ramsey County.

It is the goal of this project to “Develop TCAAP in a way that accommodates a mix of land uses that is sensitive to the natural environment, economically sustainable, and a benefit to the community” (Arden Hills 2030 Comprehensive Plan, 4). This initiative will be economically and environmentally sustainable and provide for a range of uses and development types.

A comprehensive community process resulted in a long-term vision for the redevelopment of this brownfield ammunitions plant site into a true mixed-use development area that incorporates regional employment, shopping and dining and a variety of housing options. This document provides the regulatory tools for redevelopment consistent with the TCAAP Master Plan for this area.

### 1.1 Purpose and Intent

The purpose of the TCAAP Redevelopment Code (TRC) is to implement the vision for a walkable, mixed-use, resilient, and vibrant TCAAP development (hereinafter, “Plan Area”) by:

- (a) Creating regulations that realize market potential and promote the creation of jobs and economic development;
- (b) Developing a regulatory process that encourages quality growth and saves time in the development process;
- (c) Focusing on predictability for both developers and the community; and
- (d) Providing a Natural Resources Corridor that offers active and passive recreational features and is an amenity to the site.

Therefore, the goals of the TRC are to promote and to provide a more functional and attractive community through the use of recognized community design principles and to allow property owners, applicants or developers flexibility in land use, while prescribing a higher level of detail in building design and form than in the current standards of the Arden Hills City Code (AHC). The standards in this code are not intended to stifle creativity nor over-regulate building design but rather encourage better functional building patterns and to create higher quality pedestrian environments along most streets.

### 1.2 Relationship to Adopted Plans

- (a) **Arden Hills Comprehensive Plan:** In addition to implementing several goals of the Arden Hills Comprehensive Plan, the TRC specifically implements the following goals:
  1. Develop and maintain a land use pattern that strengthens the vitality, quality, and character of the residential neighborhoods, commercial districts and industrial areas, while protecting the community’s natural resources to develop a sustainable pattern for future development.

2. Develop TCAAP in a way that accommodates a mix of land uses that is sensitive to the natural environment, economically sustainable and a benefit to the community.
3. Promote the development, redevelopment and maintenance of a viable, innovative and diverse business environment that serves Arden Hills and the metropolitan area.
4. Develop and maintain a strong, vital, diverse and stable housing supply for all members of the community.
5. Enhance the health, safety and well-being of all who live, work and play in the City.
6. Create a comprehensive, maintained and interconnected system of parks, pathways and open spaces, as well as a balanced program of recreational activities for residents of all ages, incomes and abilities.
7. Preserve, protect and restore the community's natural resources, including open spaces, lakes, wetlands other significant natural features, and historic resources.

## 2.0 Components of the Code

### 2.1 The Regulating Plan

The TCAAP Redevelopment Regulating Plan map (herein known as the Regulating Plan) (Attachment 1) is hereby adopted as the official zoning map for the Plan Area. Within any area subject to the approved Regulating Plan, this TRC becomes the exclusive and mandatory regulation unless specified in Section 3.2. It shall establish the following development standards for all properties within the Plan Area:

- (a) **Establishment of TCAAP Zoning Districts** – The Plan Area is distinguished into different specialized zoning districts. Each zoning district is intended to create a distinct development pattern based on the TCAAP Master Plan for different sections within the Plan Area. Each zoning district shall establish use and building development standards including standards for building height, bulk, location, functional design and parking. The Regulating Plan classifies all lots within the Plan Area into one of the following seven (7) zoning districts:
- 1) Campus Commercial (CC) – The Campus Commercial Zoning District facilitates a building format that allows multiple, single tenant buildings or campuses within the northern “Thumb” site of the Plan Area. The goal is to allow for an individual plan approach for each campus or building, based on user preferences within a range of requirements.
  - 2) Town Center (TC) – The Town Center Zoning District creates a vibrant commercial and residential environment that maximizes the potential for an outdoor experience. This district promotes walkability through allowing for housing, office, retail, restaurant, and civic uses all within close proximity of each other.
  - 3) Office Mixed-Use (OMU) – The Office Mixed-Use Zoning District creates a flexible zone that allows and promotes a seamless transition from Retail Mixed-Use but focuses on employment and other compatible uses. This district promotes employment as a primary use, but allows for other commercial, and up to ten percent retail uses.
  - 4) Retail Mixed-Use (RMU) – The Retail Mixed-Use Zoning District creates a flexible zone that allows and promotes a seamless transition from Office Mixed-Use but focuses on retail and compatible uses. This district promotes retail as a primary use, but allows for other commercial uses.
  - 5) Flex Office (FO) – The Flex Office Zoning District creates an opportunity for large scale development for employment and manufacturing uses that take advantage of the highway frontage and automobile access.
  - 6) Civic District (C) – The Civic District is intended to allow civic and community uses.
  - 7) Neighborhood (NR) – The Neighborhood Zoning District provides for a range of attached and detached single-family residential uses.
- (b) **Street Designations** – The Streets within TRC shall be classified in two different ways.
- 1) *Street Cross Sections* shall address vehicular lane widths, number of lanes, pedestrian accommodation, street tree requirements, on-street parking, snow storage and parkway and median standards. These standards are laid out in Section 8.0 and Attachment 4.
  - 2) *Street Priority* shall establish the phasing significance (Required or Recommended) of different street segments within the Plan Area. Refer to Section 8.0: Street Design Standards and Attachment 5 for the detailed regulations.

- (c) **Building Frontage Standards** – Building Frontage designations shall classify different block frontages based on the pedestrian priority goals of the TCAAP Master Plan on the Regulating Plan (Attachment 1). They shall be classified into one of three frontage designations: (i) Pedestrian Priority Frontage with the highest quality standards for pedestrian-oriented building design; (ii) Pedestrian-Friendly Frontage that balances pedestrian-oriented building design standards while accommodating some service and parking functions; and (iii) General Frontage which mainly accommodates service, utilities and parking functions.
- (d) **Open Space Designation** – Open Space within the TRC shall be categorized as Required Open Space. The detailed Open Space Standards for different open space types are included in Section 9.0 and Attachment 2 of this Code. These standards include general character, typical size, frontage requirements and typical uses.
- (e) **Gateway Overlay Designation** – The Gateway Overlay District indicates where additional aesthetic treatments are required to create a welcoming environment that establishes the character of the TCAAP Redevelopment Area. The specific standards are included in Section 7.6 of this Code.

**2.2 Development Standards:** The TRC text portion of this Code enumerates the development standards with text and graphics for Zoning Districts, Frontage Types, building form, landscape, building design, signage, and lighting.

### **2.3 Using This Code**

The following basic steps should be followed to determine the uses and development standards applicable on property within the Plan Area:

- (a) Review Table 3-1 to evaluate the applicability of the TRC based on scope of the proposed development.
- (b) Locate the subject property on the Regulating Plan (Attachment 1).
- (c) Identify the Zoning District in which the property is located.
- (d) Review the Schedule of Uses by Zoning District as listed in Table 5-1 to determine allowed uses.
- (e) Examine the corresponding zone standards in the Building and Site Development Standards in Section 6 to determine the applicable development standards and any Frontage standards.
- (f) Refer to Section 7.0 for Building Design Standards

The information listed in these graphics explain where the building will sit on the lot, the limits on its physical form, the range of uses and the palette of materials that will cover it.

### **3.0 Administration**

#### **3.1 Applicability**

- (a) The uses and buildings on all properties within the Plan Area shall conform exclusively to the requirements of the TRC unless specifically referenced as otherwise in the TRC.
- (b) Table 3-1 (Applicability Matrix) shall determine the extent to which different sections of the TRC apply to any proposed development.
- (c) In addition, Table 3-2 shall determine which sections of the TRC apply at which time in the development review process such as Subdivision Review, Site Plan Review or Building Permit Review.
- (d) Provisions of the TRC are activated by “shall” when required; “should” or “may” when recommended or optional.
- (e) Terms used throughout the TRC are defined in Section 4.0: Definitions. For those terms not defined in Section 4.0, definitions in various sections of the AHC shall apply. For terms not defined in either section, they shall be accorded commonly accepted meanings. In the event of conflict, the definitions of the TRC shall take precedence.
- (f) Where in conflict, numerical metrics shall take precedence over graphic metrics.

#### **3.2 Relationship to other City Ordinances**

- (a) For all properties within the Plan Area, the standards in this Code shall supersede standards under:
  - i. Commercial and Multi-Family Design Standards under Chapter 13, of the AHC, as amended, except as specifically referenced herein.
  - ii. Sign Standards under Chapter 12, as amended, except as specifically referenced herein.
  - iii. Landscaping Standards under Chapter 13, as amended, except as specifically referenced herein.
  - iv. Subdivision Ordinance under Chapter 11, as amended, except as specifically referenced herein.
- (b) Development standards not addressed in this TRC shall be governed by the AHC, to the extent the AHC standards are not in conflict with the TRC.

**Table 3-1: Applicability Matrix**

Legend

● = Section of the Code Applies

Blank denotes Standards in this Section of the Code does not apply

Code Section	Section 5.0: Schedule of Uses				Section 6.0: Building and Site Development Standards				Section 7.0: Building Design Standards	Section 8.0: Street Design Standards	Section 9.0: Open Space Standards	Section 10.0: Streetscape and Landscape Standards				Section 11.0: Sign Standards
	Build-to zones and setbacks	Building Frontage	Building Height	Parking and Service Access	Sidewalk, Street Trees and Streetscape	Street Screen and Parking Lot Landscaping	Street Lighting and Furniture	Utilities								
<b>Type of Development</b>																
1) Commercial (retail, office, restaurant), lodging, mixed-use building, apartment/multi-family building (3 or more units per lot), and live-work units (more than one of the following may apply to one application based on the scope of the application)																
a. New Construction		All Sections of the TRC apply														
b. Existing Building Remodel: Existing non-complying structures or sites may be repaired, maintained or altered provided that such repair, maintenance, or alteration shall <u>not create any new non-compliance</u> of all or any part of such structure or site.																
i. Change of Use/Expansion of Existing Use (without expansion of conditioned building area) (to a permitted or conditional use in the designated Zoning District)		●				●							●		●	
ii. Expansion of Existing Buildings (regardless of size of expansion): Structures or sites may be enlarged or expanded provided that such enlargement shall <u>not create any new non-compliance</u> of all or any part of such structure or site. The TRC applicable sections shall apply only to proposed building expansions.		●	●	●	●	●	●	●	●	●	●	●	●	●	●	
c. Expansion of parking area only (with or without a building or use expansion) (includes off-site or accessory parking)																
i. Up to ten (10)spaces				●		●										
ii. Eleven (11) or more additional spaces				●		●							●			
d. Existing Signage																
i. Refacing or changing a panel on an existing sign																

Legend

● = Section of the Code Applies

Blank denotes Standards in this Section of the Code does not apply

Code Section	Section 5.0: Schedule of Uses				Section 6.0: Building and Site Development Standards		Section 7.0: Building Design Standards	Section 8.0: Street Design Standards	Section 9.0: Open Space Standards	Section 10.0: Streetscape and Landscape Standards				Section 11.0: Sign Standards
	Build-to zones and setbacks	Building Frontage	Building Height	Parking and Service Access	Sidewalk, Street Trees and Streetscape	Street Screen and Parking Lot Landscaping				Street Lighting and Furniture	Utilities			
<b>Type of Development</b>														
<i>Table 3-1 Continued</i>														
ii. Signs may be repaired, maintained, altered, or replaced as allowed by state law (M.S. 462.357, Subd. 1e) provided that such repair, maintenance, alteration, or replacement shall <u>not create any new non-compliance, or expansion of any existing nonconformity</u> , of all or any part of such a sign. (applies during sign permit review only)														●
f. New sign or expansion of an existing sign (applies during sign permit review only)														●
<b>2. Residential Buildings (single family detached, single-family attached, twin home buildings; (1-2 units)</b>														
a. New construction	●	●	●	●	●	●			●	●				
b. Change of Use (to a permitted or conditional use in the designated Zoning District)	●				●									
c. Existing Building Remodels: Structures or sites may be repaired, maintained or altered provided that such repair, maintenance, or alteration shall <u>not create any new non-compliance</u> of all or any part of such structure or site.							●							

Legend

● = Section of the Code Applies

Blank denotes Standards in this Section of the Code does not apply

Code Section	Section 5.0: Schedule of Uses				Section 6.0: Building and Site Development Standards				Section 7.0: Building Design Standards	Section 8.0: Street Design Standards	Section 9.0: Open Space Standards	Section 10.0: Streetscape and Landscape Standards				Section 11.0: Sign Standards
	Build-to zones and setbacks	Building Frontage	Building Height	Parking and Service Access	Sidewalk, Street Trees and Streetscape	Street Screen and Parking Lot Landscaping	Street Lighting and Furniture	Utilities								
<b>Type of Development</b>																
<i>Table 3-1 Continued</i>																
d. Expansion of existing use/structure (building additions and new accessory building/structure on the lot): Structures or sites may be enlarged provided that such enlargement shall <u>not create any new non-compliance</u> of all or any part of such structure or site. Standards in the TRC applicable sections shall apply only to the building expansions. It shall allow addition of non- conditioned space such as patios, porches, arcades, canopies, private open space, recreational amenities and courtyards/forecourts.																
	●	●	●	●	●	●				●	●					

**Table 3.2 Application Review Specific Matrix**

Legend  = Standards in this Section of the Code applies      NA = Standards in this Section of the Code does not apply

Code Section	Section 5.0: Schedule of Uses						Section 6.0: Building and Site Development Standards					Section 7.0: Building Design Standards	Section 8.0: Street Design Standards	Section 9.0: Open Space Standards	Section 10.0: Streetscape and Landscape Standards			Section 11.0: Sign Standards	
	Build-to zones and setbacks	Building Frontage	Building Height	Lot Standards	Parking and Service Access	Street Trees and Streetscape	Street Screen and Parking Lot Landscaping	Street Lighting and Furniture	Utilities										
Type Application Review																			
1. Subdivision Plan Review (includes revised plats)																			
2. Site Plan Review																			
3. Building Permit Review																			*

 = Applies for residential development only

\* = Applies during Sign Permit review only

### 3.3 JDA Development Review Process

- (a) **Pre-submittal Meeting Required:** All projects shall have a pre-submittal meeting with the JDA Development staff prior to submitting the approved application form for development in the Plan Area. At the pre-submittal meeting, the staff shall provide information on the requirements for development and submittal within the Plan Area, including related necessary City building permit and related final construction approvals.
- (b) **Site Plan Required:** A Site Plan shall be required for all proposed developments within the Plan Area. Requirements for Site Plans are listed per Section 1355.03 of the AHC. A site plan is reviewed by staff prior to preliminary plat submittal.
- (c) **JDA Review Generally:** Projects that comply with all standards of the TRC and projects that require Permitted Adjustments shall be processed by the Joint Development Authority (JDA). The JDA shall review and consider projects which meet all TRC standards as recommended by staff, with approval of such projects subject to a majority vote of all the members of the JDA. Please refer to Attachment 3 Development Review flow chart for information on the development review process. The JDA may amend its development review process at any time, subject to any applicable requirements of the Joint Powers Agreement (the "JPA").
- (d) **JDA Permitted Adjustments:** The JDA may approve Permitted Adjustments per the criteria set in Table 3-3 below, subject to a three-fifths (3/5) vote of the JDA. The Permitted Adjustment process may be used only to authorize a less restrictive standard and may not be used to impose a higher standard than is established under the TRC on the subject property. A JDA Development staff report and recommendation is required for the JDA to make a determination on a Permitted Adjustment. Public notices shall be issued for all Permitted Adjustment hearings; however, such hearings may be combined with any other JDA hearing process, such as for consideration of approval of a project and its related transactional documents.
- (e) In reviewing any Permitted Adjustment request, the JDA shall use the following criteria:
  - i. The goals, intent and vision of the adopted Regulating Plan Map and TCAAP Master Plan;
  - ii. The extent to which the proposal fits the adjoining design context by providing appropriate building scale and use transitions;
  - iii. The extent to which the proposal provides public benefits such as usable civic and open spaces, livable streets, affordable housing, living wage jobs, structured and/or shared parking and linkages to transit;
  - iv. The extent to which the proposal does not hinder future opportunities for higher intensity development;
  - v. The extent to which the proposal provides a demonstration of advanced energy resilience which may have an educational value; and
  - vi. Considerations of health and welfare to the general public.
- (f) In reviewing any Permitted Adjustment, the JDA shall not grant flexibility for the following:
  - i. Deviation from requirements of Section 5.0 (Schedule of Uses);
  - ii. Building height;
  - iii. Definitions included in Section 4.0;
  - iv. Density parameters for residential land uses;
  - v. Clear height;
  - vi. Minimum Multi-Family Unit Sizes

**Table 3-3: Permitted Adjustments Table**

Code Standard	Extent of Adjustment Permitted	Criteria
<b>1. Regulating Plan Map</b>		
<p>a. Location of any Required Street (Town Center, Retail Mixed-Use, Office Mixed-Use,)</p>	<p>Streets shall be on a grid system with block faces (measured right-of-way to right-of-way) no less than 200 feet and no more than 500 feet. Block faces may be adjusted no more than 50%. Block faces longer than 500 feet shall include mid-block pedestrian connections. Pedestrian connections to adjacent park and open space areas shall be no further apart than 750 feet. Pedestrian connections to parks and open space areas shall be at least 20 feet wide. Pedestrian mid-block connections shall be 20 feet.</p>	<ul style="list-style-type: none"> <li>i. Shall maintain the connectivity intended by the Regulating Plan</li> <li>ii. Shall maintain the continuation and/or connectivity with any existing streets where possible</li> <li>iii. Pedestrian connectivity must be maintained</li> <li>iv. JDA staff, City Community Development and Public Works staff approval</li> </ul>
<p>b. Location of any Required Street (Neighborhood District)</p>	<p>Streets shall be on a modified grid pattern. Public views and access to open space areas are required. The use of cul-de-sacs should be minimized and must include pedestrian connections from the cul-de-sac to streets or open space located behind private lots. Block faces longer than 500 feet shall include mid-block pedestrian connections. Pedestrian connections to adjacent park and open space areas shall be no further apart than 750 feet. Pedestrian connections to parks and open space areas shall be at least 50 feet wide and dedicated as public right-of-way. Pedestrian mid-block connections shall be 20 feet.</p>	<ul style="list-style-type: none"> <li>i. Shall maintain the connectivity intended by the Regulating Plan</li> <li>ii. Shall maintain the continuation and/or connectivity with any existing streets where possible</li> <li>iii. JDA staff, City Community Development and Public Works staff approval</li> </ul>
<p>c. Area and Location of any Required Open Space</p>	<p>The area of any required Open Space may be reduced by no more than 3%. The location of Open Space in the Hill and Creek Neighborhoods may be moved within those neighborhoods.</p>	<ul style="list-style-type: none"> <li>i. Shall include required amenities identified by the City's TCAAP Master Parks and Open Space Plan</li> <li>ii. JDA staff, City Community Development and Public Works staff approval</li> </ul>
<b>2. Building Form and Development Standards</b>		
<p>a. Build to zones/setbacks</p>	<p>No more than a 10% change in the maximum or minimum setback applicable or 6 feet whichever is greater.</p>	<ul style="list-style-type: none"> <li>1) Changes to the build-to-zones and setbacks may only occur when there is cause by one or more of the following:                             <ul style="list-style-type: none"> <li>i. A change to the street cross sections established in Attachment 4; or</li> <li>ii. Need to accommodate existing buildings and structures on the lot that meet the overall intent and vision for redevelopment in the Plan Area; or</li> <li>iii. Need to accommodate other required modes of transportation (transit, bike, pedestrian), storm water drainage, water quality, or low impact development (LID) elements on the site; or</li> <li>iv. Need to accommodate overhead or underground utilities and/or easements; or</li> <li>v. Need to preserve existing heritage trees on the property.</li> </ul> </li> <li>2) In no case shall the sidewalk be less than 8 feet in width along the "Spine Road" and 6 feet in width along all other streets when sidewalks will be publicly maintained.</li> </ul>

b. Building Frontage	No more than a 10% reduction in the required building frontage (applicable in the designated zoning district) along each block or subject lot with Pedestrian Priority Frontage designation or no more than a 10% reduction in the required building frontage (applicable in the designated zoning district) along each block or subject lot of a Pedestrian-Friendly Frontage designation.	Any reduction in the required building frontage shall be to address one or more of the following: <ol style="list-style-type: none"> <li>i. To accommodate porte-cocheres for drop-off and pick-up; or</li> <li>ii. To accommodate existing buildings and site elements; or</li> <li>iii. To accommodate other required transit, bike and pedestrian related, storm water drainage, water quality, or low impact development (LID) elements on the site.</li> </ol>
	Parking garages and porte-cocheres are allowed along Pedestrian Priority Frontage and Pedestrian-Friendly streets.	Allowed when necessary for building design.
c. Corner Lot Building Frontage	Reduction of no more than 10% of the building frontage requirements for lots with two or more Pedestrian Priority frontages (applicable Frontage Standard for the zoning district of the subject corner lot)	Frontage requirement along <u>one</u> Pedestrian Priority designated frontage may be replaced with the corresponding standard for Pedestrian-Friendly frontage designation instead. In determining which Pedestrian Priority frontage may be changed to a Pedestrian-Friendly frontage, precedence shall be given to matching any existing building Pedestrian Priority frontages of adjoining blocks or lots on either side of the street.
	Reduction of no more than 10% of the building frontage requirements for lots with two or more Pedestrian-Friendly frontages (applicable Frontage Standards for the designated zoning district of the subject corner lot)	Frontage requirement along <u>one</u> Pedestrian-Friendly designated frontage may be replaced with the corresponding standard for General frontage designation instead. In determining which Pedestrian-Friendly frontage may be changed to a General frontage, precedence shall be given to matching any existing building Pedestrian-Friendly frontages of adjoining blocks or lots on either side of the street.
d. Sidewalk and Streetscape standards	No more than 10% reduction in the sidewalks, street tree planting, street lighting, and other streetscape standards may be adjusted based on the development context and street cross section.	Any changes to the streetscape standards shall be based on specific development context such as existing vegetation, natural features, drainage, and fire access and is subject to approval by the JDA.
e. Required Parking Spaces	Reduction in the number of required parking spaces up to 10% of total spaces	Reduction in the number of parking spaces shall be based on one or more of the following: <ol style="list-style-type: none"> <li>i. A shared parking plan for parking within 1,000 feet of the subject property; or</li> <li>ii. A parking study for the uses proposed on the site; or</li> <li>iii. A combination of the above</li> </ol>
<b>3. Other</b>		
a. Any other numerical standard in the code	A modification up to 10% (increase or decrease)	<ol style="list-style-type: none"> <li>i. A modification of a numerical standard is needed to accommodate existing conditions.</li> <li>ii. The proposed development still meets the intent of the TRC.</li> </ol>
b. Phased Developments	Deferment of building frontage standards	<ol style="list-style-type: none"> <li>i. Phased developments may defer building frontage requirements as long as they meet the build-to-zone and parking setback requirements</li> </ol>

- 3.4. TCAAP Regulating Plan Map and TCAAP Master Plan Modifications:** Upon denial by the JDA of an application which requires an amendment to the TCAAP Regulating Plan Map (the “Map”) and/or the TCAAP Master Plan (individually or collectively a “Plan Amendment”), or a modification of the text of the TRC (“Text Change”), or where the applicant has requested such a change, the application shall be referred by the JDA to the City Council for its consideration. A Community Development staff report and recommendation is required for a Plan Amendment or Text Change request to be heard by the City Council. Public notices shall be issued for all Plan Amendment or Text Change hearings. The City Council shall consult with the County in the Council’s consideration, approval or denial of a Plan Amendment or Text Change as required by § 3.0 of JPA.
- i. If the City Council approves the Plan Amendment or Text Change, the JDA shall consider the application, as amended pursuant to such approval.
  - ii. A proposed denial of a Plan Amendment or Text Change by City Council shall not be delivered to the JDA and such decision shall constitute final denial of the application.
  - iii. Upon such final denial of a Plan Modification or Text Change, the applicant may reapply to the JDA to seek JDA approval of a revised project meeting the requirements of the TRC, or a revised project requiring a Permitted Adjustment consistent with Table 3-3.
- 3.5 Plat Approval:** The TRC incorporates by reference Chapter 11 of the AHC for plat approval for the purpose of design review, subject to the requirements for public infrastructure per the TRC. This process includes City approval of grading/erosion control plans and utilities plans. Fees or charges for public infrastructure or facilities established by or applicable to subdivisions processed under the AHC shall be applied to subdivisions processed under the TRC.
- 3.6 Hearing Requirements:** The JDA shall conduct public hearings for consideration of all development applications for the Plan Area. A notice of the time, place and purpose of the hearing shall be published in the official newspaper of the City at least ten (10) days prior to the day of the hearing. In addition, JDA action on subdivision requests in the Plan Area shall be governed by Minnesota Statutes 462.358.

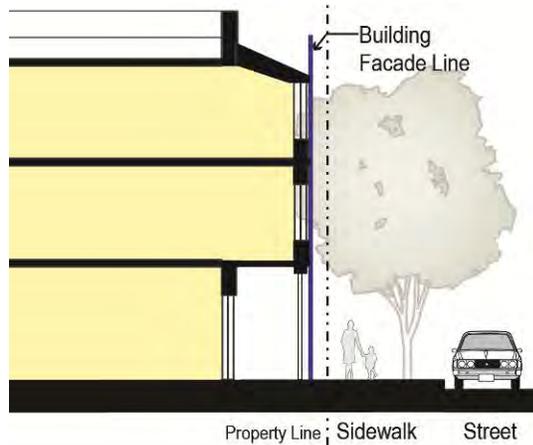
#### 4.0 Definitions

Many terms used in this document are defined in the AHC, Chapters 1 and 13. Definitions are only included here if not defined in the AHC, or if the definition for this document differs from the AHC. In case of a conflict between the definitions under this Section and the AHC, Chapters 1 and 13, the definitions in this section shall supersede.

### A

#### *Arcade*

A portion of the main façade of the building that is at or near the property line and a colonnade supports the upper floors of the building. Arcades are intended for buildings with ground floor commercial or retail uses and the arcade may be one or two stories. The ground floor area within the arcade may be conditioned or non-conditioned space.

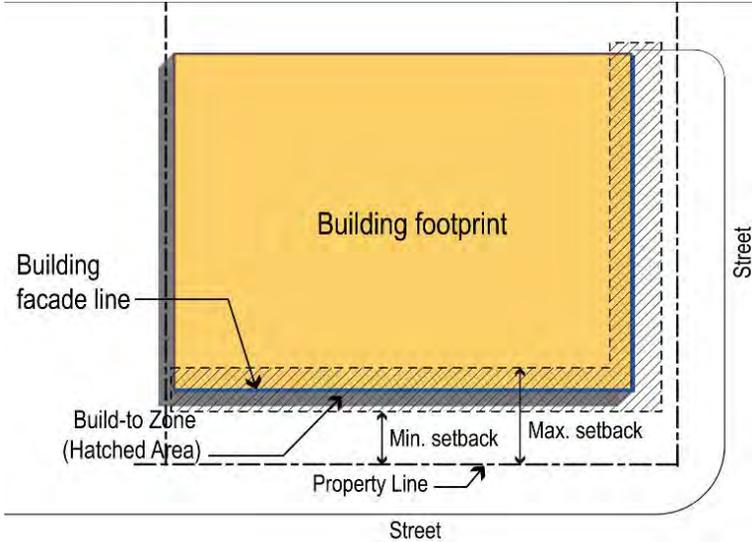


*Images of Arcade Buildings*

**B**

**Build-to Zone (BTZ)**

The area between the minimum and maximum front setbacks from the property line. The principal building façade line shall be located within this area.



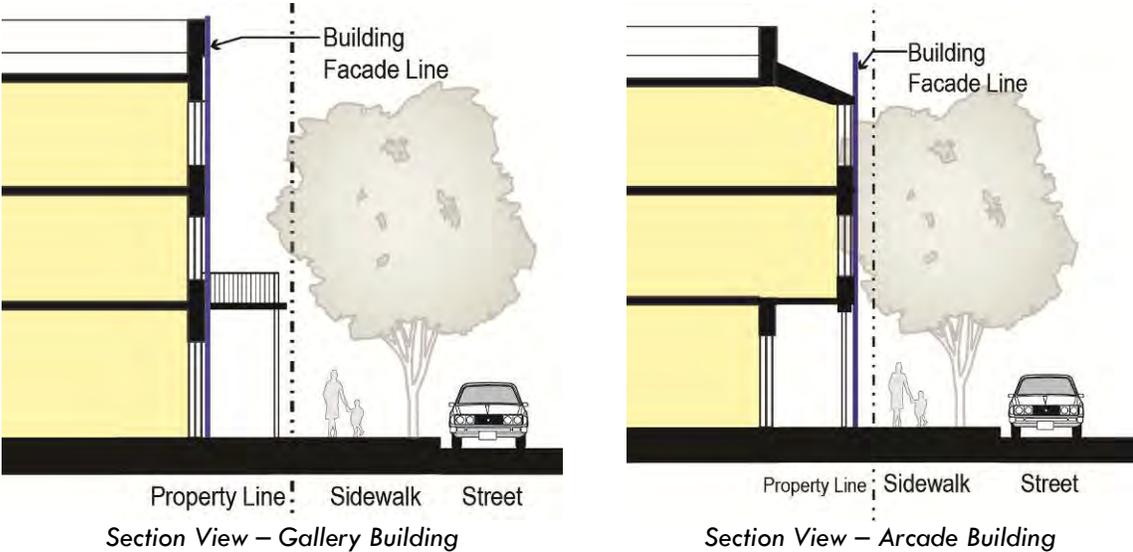
*Illustration indicating the location of the build-to zone relative to the minimum and maximum setbacks and the building façade line*

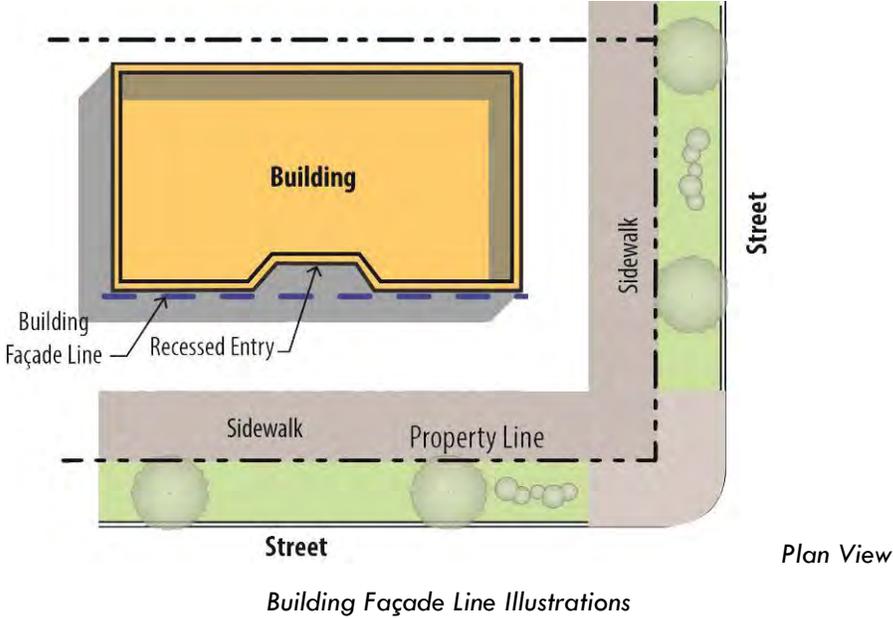
**Building and Site Development Standards**

The standards established for each Zoning District including but not limited to building placement, building height, parking, service access, and other functional design standards.

**Building Façade Line**

The location of the vertical plane of a building along a street frontage.





**Building Frontage**

The percentage of a building's façade line that is required to be located within the Build-to Zone (BTZ) as a proportion of the lot's width along the fronting public street. Required stairs to access entrances, parks, plazas, squares, improved forecourts, and pedestrian breezeway frontages shall count towards the required building frontage.

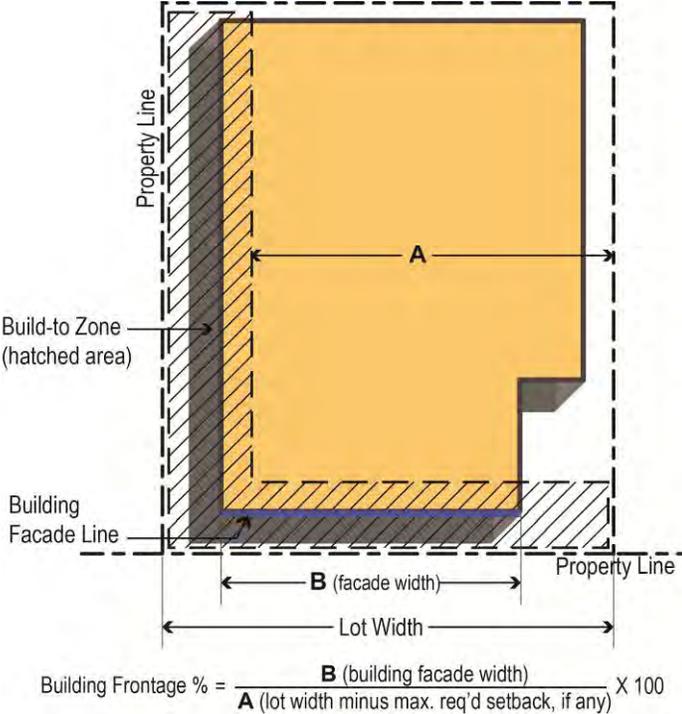


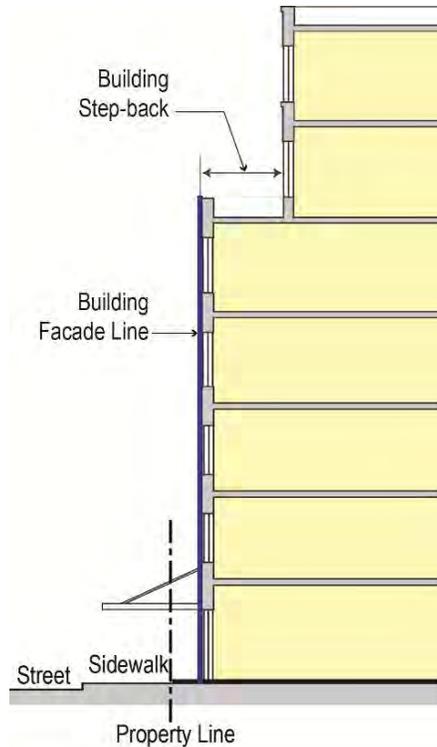
Image showing Building Frontage calculation

**Building Height**

The vertical distance from the average elevation of the grade along a face of a building to the highest point of the roof surface of flat roofs, the deck line of mansard roofs, or the average height between the eaves and the highest ridge of gable, hip, or gambrel roofs. The height of a stepped or terraced building shall be the height of the tallest segment of the building.

**Building Step-Back**

Building step-back is the setting back of the building façade line away from the street at a specific floor or height.



*Illustration of a Building Step-Back*

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**C D**

**Clear Height**

The distance from the top of the finished floor to the bottom of the finished ceiling in portions of commercial buildings used for warehousing or manufacturing.

**Complete Street**

A complete street is a transportation policy and design approach that requires streets to be planned, designed, operated, and maintained to enable safe, convenient and comfortable travel and access for users of all ages and abilities regardless of their mode of transportation.

### **Cottage/Patio Home**

The Cottage or Patio Home building type consists of small, one and two-story single-family detached residential units that are built close to the street and each other. They are typically sideyard/zero lot line homes with a small yard or patio space. This type of building enables appropriate infill residential within existing neighborhoods and is important for providing a broad choice of housing types and promoting walkability.



*Image of a Cottage or Patio Home*

### **Cottage Court**

The Cottage Court building type consists of a series of small, detached structures, providing multiple units arranged to define a shared court that is typically perpendicular to the street. The shared court takes the place of a private rear yard and becomes an important community-enhancing element. This residential building type is appropriately-scaled to fit as transitions between single-family neighborhoods and commercial corridors. It enables appropriately-scaled, well-designed infill residential and is important for providing a broad choice of housing types and promoting walkability.



*Image of a Cottage Court*

## **E**

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### **Encroachment**

Any structural or non-structural element such as a sign, awning, canopy, terrace or balcony that breaks the plane of a vertical or horizontal regulatory limit, extending into a setback, into the public right-of-way, or above a height limit.

## F

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### ***Façade Area***

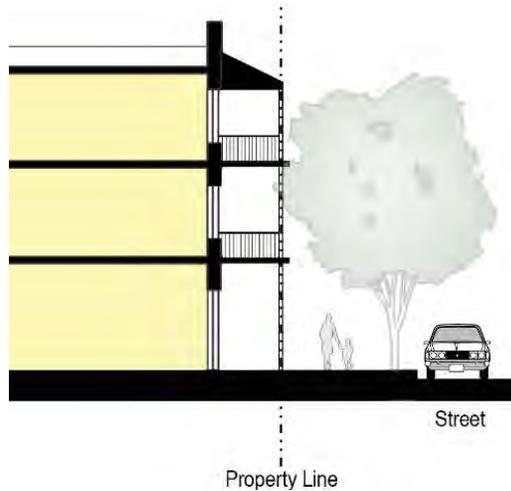
The surface area of a building's elevation (including all floors) not counting minor indentations fronting a particular street. Ground floor façade area is the surface area of a building's ground floor elevation not counting minor indentations fronting a particular street. Upper floor façade area is the surface area of a building's upper floor elevations not counting minor indentations fronting a particular street.

## G H I

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### ***Gallery***

A roofed promenade or canopy, especially one extending along the wall of a building and supported by arches or columns on the outer side. The gallery space is unenclosed (non-conditioned) space and may be two (2) or more stories tall.



*Illustration of a Gallery*

### ***Gross Density***

The number of residential dwelling units per acre of a given land area, including public rights-of-way for Town and Collector Streets but excluding publicly-owned recreation areas or open space and public right-of-way for arterial roads.

## J K

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### **J-Swing Garage**

A home with a driveway that loads from the primary street and swings into the side of the home to enter the garage. Two of these homes side-by-side should share a driveway or a curb-cut to driveways and have garages facing each other.



*Images of a home with a J-Swing Garage from the front and side of home.*

## L

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### **Large Multi-Family**

A building containing more than fifty (50) residential units, which may include apartments or condominiums.

### **Live-Work Unit**

A dwelling unit that is also used for work purposes, provided that the 'work' component is restricted to the uses of professional office, artist's workshop, studio or other similar use as allowed as a home occupation under the AHC and is located on the street level and constructed as a separate unit under a condominium regime or as a single unit. The 'live' component may be located on the street level (behind the work component) or any other level of the building. Live-work unit is further distinguished from a home occupation otherwise defined by the AHC in that the work use is not required to be incidental to the dwelling unit; non-resident employees may be present on the premises and customers may be served on site.

## M

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### ***Manor Home/Multi-Unit House***

A multi-unit building (3 to 8 units) that is designed to appear as a large home from the exterior, but functions as a multi-unit building on the interior. Manor Homes have one main front door for the building, but may also have side and rear entries. Parking is accessed from an alley or a driveway to the rear of the lot. Parking does not face a public right-of-way.



*Image of Manor Home*

### ***Medium Multi-Family Use***

A building containing nine to fifty (9-50) multi-family units, which may include stacked flats, apartments, or condominiums.

### ***Mixed-Use Building***

A building that includes a combination of commercial, retail, residential, civic, or institutional uses inside a single structure.

## N O

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### ***Numerical Standard***

Any standard that has a numerical limit (minimums and maximums) or value as established within both the text and graphic standards of the TRC.

## P Q

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### ***Parking Setback Line***

The distance that any surface parking lot is to be set back from either the principal building façade line or property line along any street frontage (depending on the specific standard in the Zoning District). Surface parking may be located anywhere behind the parking setback line on the property.

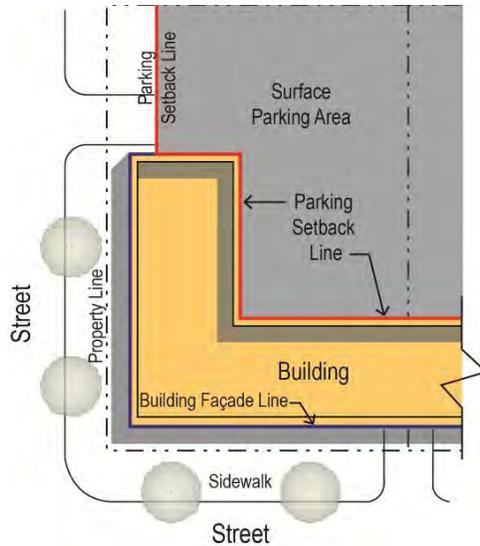


Illustration of a parking setback line

### Perimeter Frontage

The measurement of the proportion of public street frontage of the total exterior perimeter of a park or open space area.

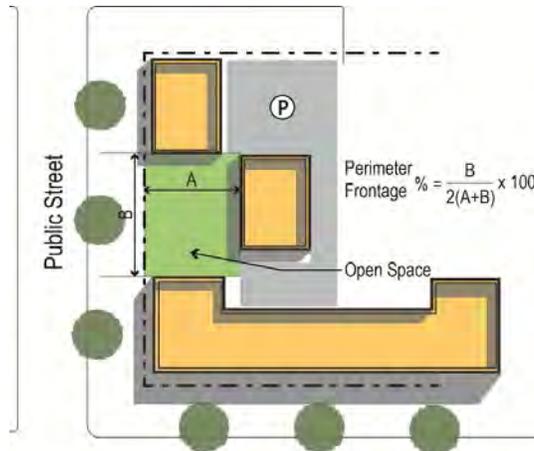


Illustration showing how Perimeter Frontage is calculated for Open Space along a Public Street

### Permitted Adjustment

A requested modification to TRC zoning district standards per the Permitted Adjustment provision of Section 3.0. The JDA shall have the authority to approve a request for a Permitted Adjustment.

### Primary Entrance

The public entrance located along the front of a building facing a street or sidewalk that provides access from the public sidewalk to the building. It is different from a secondary entrance which may be located at the side or rear of a building providing private controlled access into the building from a sidewalk, parking or service area.

***Private Common Open Space***

A privately owned outdoor or unenclosed area, located on the ground or on a terrace, deck, porch, or roof, designed and accessible for outdoor gathering, recreation, and landscaping and intended for use by the residents, employees, and/or visitors to the development. This may or may not be accessible to the public, but shall be maintained privately.

***Property Line***

A line dividing one lot or property, from another, or from a right-of-way.

***Public Open Space***

A publicly accessible open space in the form of parks, courtyards, forecourts, plazas, greens, playgrounds, squares, etc. provided to meet the standards in Section 9.0 of this Code. Open Space may be privately or publicly owned and/or maintained.

**R**

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***Residential Use Building***

A building that is built to accommodate only residential uses on all floors of the building such as a detached single-family home, attached single-family home (i.e., townhome), two family home (i.e. twin home), Manor Home (3 to 8 units), or apartment building (under single ownership or under multiple owners within a condominium regime).

***Right-of-Way***

An area dedicated to public use for vehicular and bicycle movement. Pedestrian facilities, public utilities, and private utilities may be accommodated within the right-of-way or outside of the right-of-way within public easements on private property.

***Right-of-Way Line***

The lines that form the boundary of a publicly-owned right-of-way.

**S**

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***Service-Related Uses***

All uses that support the principal use on the lot including parking access, garbage/trash collection, utility meters and equipment, loading/unloading areas and similar uses.

***Setback***

The minimum distance by which any building or structure must be separated from a right-of-way or property line.

***Single Family Use***

A building containing one or two primary living units and which may include twin homes, detached townhomes and cottage/patio homes.

***Small Lot Single Family***

A single-family residential lot that measures less than fifty feet wide.



*Image of a Small Lot Single Family*

**Small Multi-Family Use**

A building containing three to eight (3-8) residential units and which may include townhomes, row homes, manor homes/multi-unit houses, stacked flats, or triplexes/quadplexes.

**Small Retail or Office Building**

The Small Retail/Office Building is a commercial building that is generally located at street intersections or as transitions between higher intensity commercial uses and lower intensity residential uses. The ground floor space can be used for office, personal service or retail uses. It is especially appropriate for incubating neighborhood-serving retail and service uses and allowing some adjoining streets and multi-modal corridors to expand as the market demands.

**Stacked Flats**

Stacked flats building type is a medium-sized structure that consists of less than twelve (12) side-by-side and/or stacked dwelling units, typically with one shared entry. This type of building can include a courtyard apartment. This residential building type is appropriately-scaled to fit within medium-density neighborhoods or as transitions between neighborhoods and commercial corridors. It enables appropriately-scaled, well-designed infill residential and is important for providing a broad choice of housing types and promoting walkability.



*Image of a Stacked Flat*

**Street Frontage Designation**

As identified on the Regulating Plan, existing and recommended streets in the TRC area are designated as Pedestrian Priority, Pedestrian-Friendly or General Streets. Each frontage designation establishes a certain development context in order to improve walkability and pedestrian orientation within the TRC Plan Area.

### **Street Screen**

A freestanding wall or living fence or combination fence built along the frontage line or in line with the building façade along the street. It may screen a parking lot or a loading/service area from view or provide privacy to a side yard and/or strengthen the spatial definition of the public realm.



*Image of a combination masonry  
and living street screen*

### **Street Wall**

Indicates the creation of a “wall,” or a sense of enclosure along the street with buildings placed immediately adjacent to the street/sidewalk. A street wall has a “void” if there is a surface parking lot or service area adjacent to the sidewalk/street.

## **T U V W X Y Z**

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### **TCAAP Natural Resources Corridor**

The Natural Resources Corridor within the TCAAP Site Redevelopment will be designed with the goal of maximizing compatibility and functionality of regional storm water, wetland mitigation, the Rice Creek re-meander, floodplain restoration, and groundwater requirements. An additional goal is to provide visual features and active and passive recreational amenities to support adjacent land uses.

### **TCAAP Redevelopment Regulating Plan (Regulating Plan)**

The official Zoning Map for the TRC Plan Area. The Regulating Plan graphically depicts development standards including Zoning Districts, Street Designations and Special Requirement(s) applicable to properties within the TRC Plan Area.

### **Townhouse/Rowhouse**

The Townhouse or Rowhouse is a small- to medium-sized typically attached structure that consists of three to eight (3-8) houses attached horizontally, not stacked vertically. This type of residential building is typically located in a location that transitions from a single-family neighborhood into a commercial corridor. This type of building enables appropriately-scaled, well-designed residential infill and is important for providing a broad choice of housing types and promoting walkability. A townhouse/rowhouse is a single structure and does not require adjacent townhomes/rowhomes to maintain stability.

### **Triplex/Quadplex**

A Triplex/Quadplex building is a medium-sized attached structure that consists of three to four (3-4) houses placed side-by-side and/or stacked dwelling units. This residential building type is typically located in a location that transitions from a primarily single-family neighborhood into a commercial corridor. This building type enables appropriately-scaled, well-designed residential infill and is important for providing a broad choice of housing types and promoting walkability.



*Image of a Triplex/Quadplex*

***Twin Home***

The Twin Home, also known as a duplex, is a small- to medium-sized structure that consists of two side-by-side or stacked dwelling units, both facing the street, and within a single building structure. This residential building type has the appearance of a medium to large single-family home and is appropriately-scaled to fit within primarily single-family neighborhoods or medium-density neighborhoods. It enables appropriately-scaled, well-designed residential infill and is important for providing a broad choice of housing types and promoting walkability.



*Image of a Twin Home*

## 5.0 Schedule of Permitted Uses

- 5.1 Applicability:** General use categories have been identified by Zoning District (Table 5-1). Uses that are not listed are prohibited. Uses that are allowed as accessory uses may only remain in conjunction with an active principal use.

Table 5-1: TRC Zoning District Land Use Table													
P = Permitted   -- = Prohibited   P/C = Permitted with Criteria in Table 5.2													
A = Accessory   A/C = Accessory with Criteria in Table 5.2													
Zoning District	Campus Commercial	Town Center 1	Town Center 2	Town Center 3	Office Mixed-Use	Retail Mixed-Use	Flex Office	Neighborhood 1	Neighborhood 2	Neighborhood 3	Neighborhood 4	Civic	Additional Requirements
Uses													
Sub-District		TC-1	TC-2	TC-3				NR-1	NR-2	NR-3	NR-4		
<b>Residential Uses</b>													
Bed & Breakfast	--	P	P	P	--	--	--	P/C	P/C	P/C	P/C	--	See Table 5-2
Home Occupation: Class I	--	A	A	A	--	--	--	A	A	A	A	--	
Large Multi-Family	--	P/C	P/C	P/C	--	--	--	--	--	--	--	--	See Table 5-2
Live/Work	--	P	P	P	--	--	--	--	--	--	--	--	
Medium Multi-Family	--	P/C	P/C	P/C	--	--	--	--	--	--	--	--	See Table 5-2
Assisted Living, Memory Care and Skilled Nursing	--	--	--	P	--	--	--	--	--	--	P/C	--	See Table 5-2
Residential Facility	--	P/C	P/C	P/C	--	--	--	P/C	P/C	P/C	P/C	--	See Table 5-2
Senior Independent Living	--	--	P	P	--	--	--	--	P/C	P/C	P/C	--	See Table 5-2
Single Family	--	--	--	--	--	--	--	P	P	P	--	--	
Small Lot SF Residential	--	--	--	--	--	--	--	--	P	P	--	--	
Small Multi-Family	--	--	--	--	--	--	--	--	--	P/C	P/C	--	See Table 5-2
<b>Commercial Uses</b>													
Automotive Washing	--	--	--	--	P/C	P/C	P/C		--			--	See Table 5-2
Brewpub	--	P	P	P	P	P	P		--			--	
Business service	P	P	P	P	P	P	P		--			--	
Clinic, medical office	P	P	P	P	P	P	P		--			--	
Club, sports & fitness	A	P	P	P	P	P	P		--			--	

**Table 5-1: TRC Zoning District Land Use Table**

**P = Permitted | -- = Prohibited | P/C = Permitted with Criteria in Table 5.2**

**A = Accessory | A/C = Accessory with Criteria in Table 5.2**

Zoning District	Campus Commercial	Town Center 1	Town Center 2	Town Center 3	Office Mixed-Use	Retail Mixed-Use	Flex Office	Neighborhood 1	Neighborhood 2	Neighborhood 3	Neighborhood 4	Civic	Additional Requirements
Uses													
Sub-District		TC-1	TC-2	TC-3				NR-1	NR-2	NR-3	NR-4		
Cocktail Lounge	--	P	P	P	P	P	--	--	--	--	--	--	
Commercial Off-Street Parking	P/C*	P/C*	P/C*	P/C*	P/C*	P/C*	P/C*	--	--	--	--	--	* Permitted as an accessory use with a primary building only
Commercial recreation - indoor	--	--	--	--	--	--	P	--	--	--	--	--	
Daycare Facility	A	P	P	P	P	P	P	--	--	--	--	--	
Daycare, family - 10 or less		P	P	P	P	P	P	--	--	--	--	--	
Dog kennel	--	--	--	--	--	--	P*	--	--	--	--	--	* Completely enclosed; no outside runs
Drive-Up Windows	A	--	--	--	P/C	P/C	P/C	--	--	--	--	--	See Table 5-2
Dry cleaning & laundry, pick-up station	--	P	P	P	--	P	--	--	--	--	--	--	
Dry cleaning & laundry, self-service laundry	--	P	P	P	--	P	--	--	--	--	--	--	
Financial Institution & service	P	P	P	P	P	P	P	--	--	--	--	--	
Food Preparation	P	P	P	P	P	P	P	--	--	--	--	--	
Hotel/ motel	P	P	P	P	P	P	P	--	--	--	--	--	
Liquor Store	--	P	P	P	--	P	--	--	--	--	--	--	
Microbrewery	--	P	P	P	--	P	P	--	--	--	--	--	
Microdistillery	--	P	P	P	--	P	P	--	--	--	--	--	
Mortuary, funeral home	--	--	--	--	--	--	P/C	--	--	--	--	--	See Table 5-2
Office	P	P	P	P	P	P	P	--	--	--	--	--	
Personal services	A	P	P	P	P	P	P	--	--	--	--	--	
Pet Services	P	P	P	P	P	P	P	--	--	--	--	--	

**Table 5-1: TRC Zoning District Land Use Table**

**P = Permitted | -- = Prohibited | P/C = Permitted with Criteria in Table 5.2**

**A = Accessory | A/C = Accessory with Criteria in Table 5.2**

Zoning District  Uses	Campus Commercial	Town Center 1	Town Center 2	Town Center 3	Office Mixed-Use	Retail Mixed-Use	Flex Office	Neighborhood 1	Neighborhood 2	Neighborhood 3	Neighborhood 4	Civic	Additional Requirements
		TC-1	TC-2	TC-3				NR-1	NR-2	NR-3	NR-4		
Research and development facility	P	--	--	--	P	--	P	--	--	--	--	--	
Restaurant and restaurant fast-food	A	P/C	P/C	P/C	P/C	P/C	P/C	--	--	--	--	--	See Table 5-2
Retail sales & service	--	P	P	P	P/C	P	P	--	--	--	--	--	See Table 5-2
Service station	--	--	--	--	--	P/C	P/C	--	--	--	--	--	See Table 5-2
Storage, exterior	--	--	--	--	--	--	--	--	--	--	--	--	
Studio	--	P	P	P	--	P	P	--	--	--	--	--	
Theater, indoor	--	--	--	P	--	--	--	--	--	--	--	--	
Vehicle – motorized, leasing and rentals	--	--	--	--	P/C	--	P/C	--	--	--	--	--	See Table 5-2
Vehicle – motorized, service	--	--	--	--	P/C	P/C	P/C	--	--	--	--	--	See Table 5-2
<b>Civic Uses</b>													
Antenna or Tower	P/C	P/C	P/C	P/C	P/C	P/C	P/C	--	--	--	--	A/C	See Table 5-2
Club or lodge (non-profit)	--	P	P	P	P	P	P	--	--	--	--	--	
Community Center	--	P	P	P	--	--	--	--	--	--	--	P	
House of worship	--	P	P	P	P	P	P	--	--	--	--	--	
Library	--	P	P	P	P	P	P	--	P	--	--	P	
Municipal Building	--	P	P	P	P	P	P	--	--	--	--	P	
Park Facilities (Public)	P	P	P	P	P	P	P	--	P	--	--	P	
School, general education	--	P	P	P	--	--	--	--	P	--	--	--	
School, specialized education	--	P	P	P	P	P	--	--	--	--	--	--	

<b>Table 5-1: TRC Zoning District Land Use Table</b>													
<b>P = Permitted   -- = Prohibited   P/C = Permitted with Criteria in Table 5.2</b>													
<b>A = Accessory   A/C = Accessory with Criteria in Table 5.2</b>													
<b>Zoning District</b>	<b>Campus Commercial</b>	<b>Town Center 1</b>	<b>Town Center 2</b>	<b>Town Center 3</b>	<b>Office Mixed-Use</b>	<b>Retail Mixed-Use</b>	<b>Flex Office</b>	<b>Neighborhood 1</b>	<b>Neighborhood 2</b>	<b>Neighborhood 3</b>	<b>Neighborhood 4</b>	<b>Civic</b>	<b>Additional Requirements</b>
<b>Uses</b>													
<b>Sub-District</b>		<b>TC-1</b>	<b>TC-2</b>	<b>TC-3</b>				<b>NR-1</b>	<b>NR-2</b>	<b>NR-3</b>	<b>NR-4</b>		
Theater, performing arts center	--	P	P	P	--	--	--	--				P	
<b>Industrial Uses</b>													
Garage, Truck	--	--	--	--	--	--	--	--				--	
Manufacturing & processing: Class I	P/C	--	--	--	--	--	P/C	--				--	Warehousing permitted as an accessory use
Manufacturing & processing: Class II	--	--	--	--	--	--	--	--				--	
Utility Substation	p*	--	--	--	--	--	p*	--				--	*Equipment shall be screened to not be seen from any public right of way and shall not be placed in the front of any parcel
Warehousing	A/C	--	--	--	--	--	A/C	--				--	
<b>Other Uses</b>													
Adult-Oriented Businesses	--	--	--	--	--	--	--	--				--	

**5.2 Additional Use Criteria:** All uses listed as P/C in Table 5-1 shall also meet the following standards in Table 5-2.

<b>Table 5-2 Additional Use Criteria Table</b>		
<b>Use</b>	<b>Zoning District</b>	<b>Location &amp; Design Criteria</b>
<b>Residential Uses</b>		
Bed & Breakfast	Neighborhood	No more than six(6) rentable rooms permitted. Shall be owner-occupied. Parking shall be placed behind the building, or screened from view of the public right-of-way.
Large Multi-Family Medium Multi-Family	Town Center	Buildings with Pedestrian Priority or Pedestrian Friendly Frontage shall be required to include ground floor commercial uses for a minimum of fifty percent (50%) of their street frontage as measured in linear feet.
Assisted Living, Memory Care or Assisted Living Senior Independent Living	Neighborhood	i. Homes shall be designed as either a collective of single-family or duplex homes to fit the scale of the surrounding development. ii. These homes may also be mixed with mixed-generational housing.
Residential Facility	Town Center	i. Residential Facility shall be licensed by the State of Minnesota; and ii. Residential Facility shall serve no more than sixteen (16) residents at any given time.
	Neighborhood	i. Residential Facility shall be licensed by the State of Minnesota; ii. Residential Facility shall serve no more than six (6) residents at any given time.
Small Multi-Family	Neighborhood	i. Parking shall be placed against an alley or in the rear of the lot and be screened from the public right-of-way. ii. Entrances to units that are not accessible from the front entries may have access from the rear or the side of the building.
<b>Commercial Uses</b>		
Automotive Washing Vehicle – motorized, leasing and rentals Vehicle- motorized, service	Office Mixed-Use Flex Office Retail Mixed-Use	i. Automotive drive through lanes, service bays, and/or gas station canopies shall meet the design standards in Section 7, Building Design Standards of this code. ii. Outdoor storage of vehicles or other products sold shall NOT have direct frontage along Pedestrian Priority Streets. Outdoor storage of vehicles and/or other products sold shall be screened with a required street screen along Pedestrian-Friendly Streets and General Streets (see Section 10 for standards).
Service Station	Retail Mixed-Use Flex Office	
Commercial Off-Street Parking	Campus Commercial Town Center Office Mixed-Use Retail Mixed-Use Flex Office	i. New surface parking lots shall be permitted as an interim use only in the case of phasing. ii. Applications for new surface lots shall include in-fill building concepts on the lot with a site plan that meets the build-to-zone and building frontage standards of the specific character zone. iii. New surface parking shall be set back a minimum of thirty feet (30') from the edge of the right-of-way of Pedestrian Priority Streets. iv. New surface parking shall not be located at a street intersection (of any Pedestrian Priority and Pedestrian-Friendly Streets only) for minimum of thirty feet (30') from the intersection along each street.
Mortuary, funeral home	Flex Office	i. Pick-up and drop-off lanes, storage of vehicles, service areas, and drive through facilities shall NOT have direct frontage along Pedestrian Priority Streets. ii. All such areas along other streets shall be screened with a required street screen (see Section 10 for standards).
Drive-Up Windows	Retail Mixed-Use Flex Office Office Mixed-Use	Drive through or drive-up facilities shall meet the design standards in Section 7, Building Design Standards of this code.

<b>Table 5-2 Additional Use Criteria Table</b>		
<b>Use</b>	<b>Zoning District</b>	<b>Location &amp; Design Criteria</b>
Restaurant and Restaurant, Fast Food	Campus Commercial Town Center Office Mixed-Use Retail Mixed-Use Flex Office	i. May be integrated within a building that has another permitted primary use in the Campus Commercial Zone ii. Six (6) queuing spaces per drive-through menu board.
Retail sales and services	Office Mixed-Use	i. Retail sales and service uses may not comprise more than ten percent (10%) of the total gross square footage of building space within the Office Mixed-Use District. ii. Accessory retail uses associated with medical office clinics, including but not limited to pharmaceutical and corrective lens sales, shall not be counted towards the maximum square footage of retail sales and service uses permitted in the Office Mixed-Use District, but may not exceed twenty-five percent (25%) of the gross square footage of the building in which they are located..
<b>Civic Uses</b>		
Antenna or Tower	Campus Commercial Town Center Office Mixed-Use Retail Mixed-Use Flex Office	i. Located on top of a building or architectural component only. ii. Shall conform to additional design and location requirements for antennas and towers included in Section 1325 of the AHC.
<b>Industrial Uses</b>		
Manufacturing and Processing: Class I	Campus Commercial Flex Office	For buildings where manufacturing and processing are a principal or accessory use, a minimum of thirty percent (30%) of the gross building square footage must be in office use.
Warehousing	Campus Commercial Flex Office	Warehousing is only allowed as an accessory use to Manufacturing and Processing. For buildings where warehousing is an accessory use, a minimum of thirty percent (30%) of the gross building square footage must be in office use.

## 6.0 Building and Site Development Standards

All parcels within the TRC are assigned to one of seven (7) Zoning Districts:

1. Campus Commercial
2. Town Center
3. Office Mixed-Use
4. Retail Mixed-Use
5. Flex Office
6. Civic
7. Neighborhood

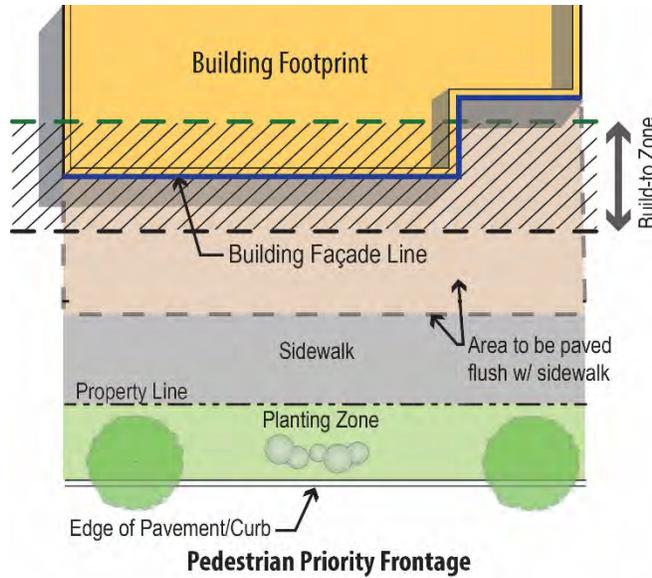
In addition to standards that apply to all Zoning Districts, Building and Site Development standards applicable to each Zoning District are described in Sections 6.2 – 6.8.

The images and graphics in the first subsection of each zoning district standards are provided as illustrative of intent and are advisory only without the power of law. Refer to the standards on the following pages for the specific Building and Site Development Standards.

In addition, the graphics used to illustrate the building and development standards in each Zoning District are NOT intended to indicate exact conditions within each Zoning District. Rather, illustrations are conceptual and standards are to be applied based on the specific frontage types designated along the subject property or site. For example, a specific site may not have frontages along all streets as indicated in the illustrations and only the standards applicable to designated building frontages on the property should be used. In addition, the illustrations may depict other site elements to establish context and only the standards regulated by the specific subsection shall apply. For example, the Building Placement graphics may depict sidewalks for context purposes only and the graphic should only be used to establish standards for building placement on the site. Building form graphics in these sections are NOT TO SCALE.

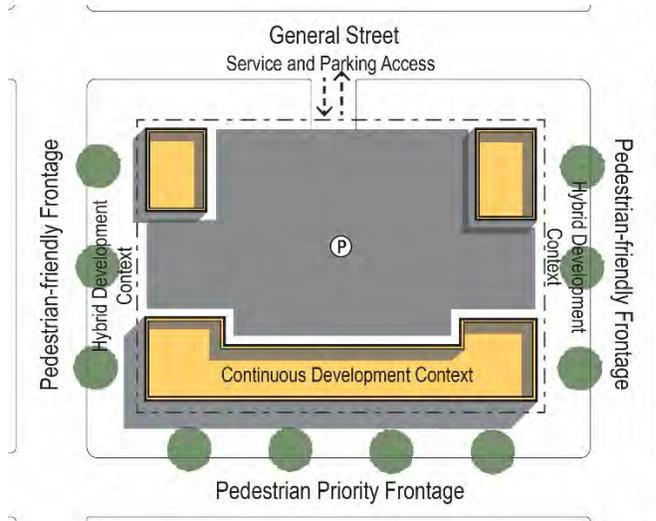
### 6.1 General to All Zoning Districts

- (a) **Building Frontage Designations:** The Building Frontage designations are established on the Regulating Plan (Attachment 1) to specify certain building and site development standards along each street based on the priority placed on pedestrian-orientation. The Regulating Plan illustrates the Building Frontage designations within the TRC. For the purposes of this code, all Building Frontages are classified into one of the following three categories:
  - i. **Pedestrian Priority Frontages –** Pedestrian Priority Frontages are intended to provide the most pedestrian-friendly and contiguous development context. Buildings and sites along Pedestrian Priority Frontages shall be held to the highest standard of pedestrian-oriented design and few, if any, gaps shall be permitted in the ‘Street Wall’. Breaks in the street wall may be permitted for courtyards, forecourts, sidewalk cafes and pedestrian connections between the individual sites and the public sidewalk. These street frontages are the main retail, restaurant, entertainment streets, or are important neighborhood connectors, as identified in the Regulating Plan.
    1. **Specific to Pedestrian Priority Frontages:** The area between the building facade and property line or edge of any existing sidewalk along any street with Pedestrian Priority Frontage shall be designed such that the sidewalk width shall be a minimum as determined by the street type (see Attachment 4) and the remainder of any setback area shall be paved flush with the public sidewalk. Sidewalk cafes, public art, landscaping within tree-wells or planters may be incorporated within this area.



*Illustration showing requirements along Pedestrian Priority Frontages only*

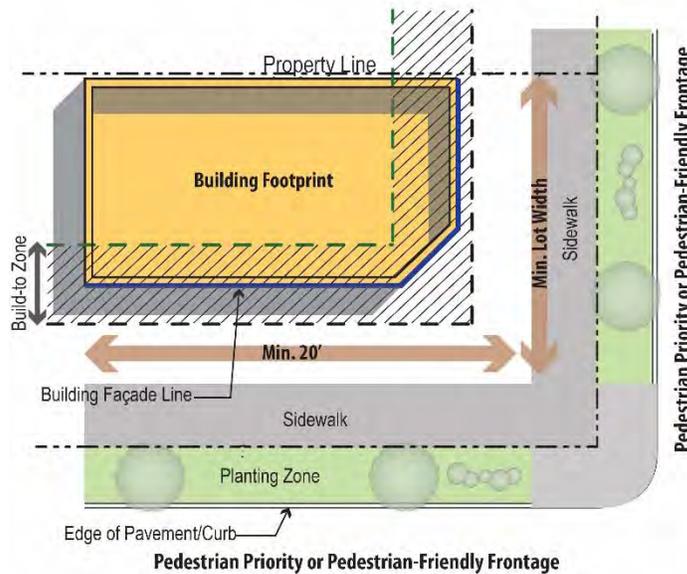
- ii. **Pedestrian-Friendly Frontages** – Pedestrian-Friendly Frontages are also intended to be pedestrian-oriented with a mostly contiguous development context. However, in some locations, where access to a General Frontage street or Alley is not available, Pedestrian-Friendly Frontages may need to accommodate driveways, parking, service/utility functions, and loading and unloading. In such cases, Pedestrian-Friendly Frontages may balance pedestrian orientation with automobile accommodation. Typically, they shall establish a hybrid development context that has a more pedestrian-supportive development context at street intersections and accommodates auto-related functions and surface parking in the middle of the block. Surface parking shall be screened from the roadway following the Street Screen Standards in Section 10.4. Pedestrian-Friendly Frontages are designated on the Regulating Plan.
- iii. **General Frontages** – General Frontages are intended to accommodate more auto-oriented uses, surface parking and service functions on a site with a more suburban/automobile orientation. The General Frontages shall be building frontages not designated as either a Pedestrian Priority or Pedestrian-Friendly Frontage on the Regulating Plan. Surface parking shall be screened following the Street Screen Standards in Section 10.4.



*Graphic Illustrating the Application of Street Type Designation Based on the Development Context*

**(b) Treatment of Street Intersections:**

- i. Corner building street facades along intersections of Pedestrian Priority Frontages and Pedestrian-Friendly Frontages shall be built to the BTZ for a minimum of twenty feet (20') from the intersection along each street or the width of the corner lot, whichever is less regardless of the building frontage percentage required along that street. This requirement shall not prohibit incorporation of curved, chamfered building corners or recessed entries or civic/open spaces at such intersections. In addition, this standard shall apply regardless of the frontage requirement along the intersecting street even if it is a General Street.



*Illustration showing minimum frontage requirements at street intersections*

- ii. **Corner Building Height Allowance:** Corner buildings may exceed the maximum building height by 25% along no more than 20% of the building's frontage along each corresponding street façade. The purpose of the allowance is to encourage inclusion of architectural features and no mechanical equipment shall be located on top of a roof area that takes advantage of this allowance. Corner Building Height Allowances are not permitted in the Neighborhood Zone.

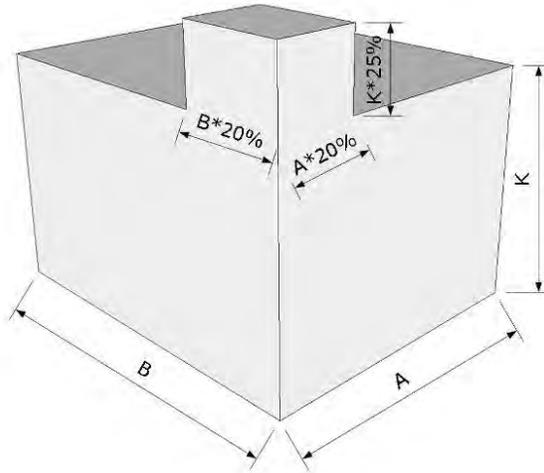


Illustration showing Corner Building Height Allowance

**(c) Parking and Service Access:**

- i. Location of parking (both structured and surface) shall be per the Zoning District specific building standards (Section 6.2 – 6.8).
- ii. Required off-street parking spaces shall be provided per Table 6-1 below.

**Table 6-1 Parking Ratios**

Zoning District	TC/OMU/RMU/C	CC/FO	NR	Additional Criteria
<b>Min. Off-Street Vehicular Parking Requirement</b>				
Retail and Similar Uses <sup>1</sup>	1 space/200 sq. ft. of gross retail sales floor area	1 space/200 sq. ft. of gross retail sales floor area.	N/A	<ul style="list-style-type: none"> <li>1. Plans that include shared parking or a reduction in the required number of parking spaces may be approved by the JDA as a Permitted Adjustment with the provision of a parking demand study (See Section 3.0).</li> <li>2. On-street parking located along any public street shall count towards the required off-street parking.</li> <li>3. Landscaping within surface parking lots shall meet standards in Section 10.0 of this Code.</li> </ul>
Office and Similar Uses <sup>2</sup>	1 space/250 sq. ft. of gross floor area	1 space/250 sq. ft. of gross floor area.	N/A	
Industrial Uses	N/A	1 space/500 sq. ft. of gross floor area for general manufacturing/ industrial; 1 space/ 1,000 sq. ft. of gross floor area for warehousing/storage	N/A	
Auto-related Uses <sup>3</sup>	4 spaces for each service bay	N/A	N/A	
Assembly Uses <sup>4</sup>	1 space/3 seats	1 space/3 seats	1 space/3 seats	
Daycare	1 space/employee and 1 space/5 persons cared for	1 space/employee and 1 space/5 persons cared for	N/A	
Clinic, Medical Office	1space/employee plus 1 space/200 sq. ft. of gross floor area	1space/employee plus 1 space/200 sq. ft. of gross floor area	N/A	
Indoor Recreation <sup>5</sup>	One space per each 200 sq. ft. non-tennis/racquetball court area. Two spaces per tennis/racquetball court. One space per each 50 sq. ft. deck area for a swimming pool.	One space per each 200 sq. ft. non-tennis/racquetball court area. Two spaces per tennis/racquetball court. One space per each 50 sq. ft. deck area for a swimming pool.	N/A	

Zoning District	TC/OMU/RMU/C	CC/FO	NR	Additional Criteria
<b>Min. Off-Street Vehicular Parking Requirement</b>				
School, General	1 space/employee plus 3 space/classroom	N/A	1 space/employee plus 3 space/classroom	
School, Specialized Education	1 space/employee plus 1 space/4 students	N/A	N/A	
All other Non-Residential Uses	1 space/300 sq. ft. of gross floor area.	1 space/300 sq. ft. of gross floor area	1 space/400 sq. ft. of gross floor area.	
Residential – Single Family and Two-Family Uses	N/A	N/A	2.0 spaces/dwelling unit	--
Residential – Multi-Family Uses	1.0 space/efficiency and one-bedroom units; 1.5 spaces/two-bedroom+ units	N/A	1.0 space/efficiency and one-bedroom units; 2.0 spaces/two-bedroom+ units	<ol style="list-style-type: none"> <li>See Section 1325.045 of the Arden Hills Code for additional criteria for multi-family uses.</li> <li>Plans that include shared parking or a reduction in the required number of parking spaces may be approved by the JDA as a Permitted Adjustment with the provision of a parking demand study (See Section 3.0).</li> <li>Landscaping within surface parking lots shall meet standards in Section 10.0 of this Code.</li> </ol>
Residential – Senior Independent Living, Assisted, Memory Care, or Skilled Nursing Uses	1.0 space/unit for Senior Independent Living units; 0.75 space/unit for Assisted Living, Memory Care and Skilled Nursing units.	N/A	1.0 space/unit for Senior Independent Living units; 0.75 spaces/unit for Assisted Living, Memory Care and Skilled Nursing units.	
Lodging Uses (Hotels and Motels)	0.5 spaces per guest room; all other areas shall be parked at the non-residential rate above	0.75 spaces per guest room; all other areas shall be parked at the non-residential rate above	N/A	
<b>Min. Bicycle Parking Requirement (# of Bicycles)</b>				
All Uses	10% of all provided off-street automobile spaces	5% of all provided off-street automobile spaces	N/A	<ol style="list-style-type: none"> <li>Location of Bicycle Parking: For retail buildings, 25% of all provided bicycle parking shall be located within 50 feet of a primary building entrance.</li> <li>See Section 1325.045 of the Arden Hills Code for additional criteria for multi-family uses.</li> </ol>

1 Includes Liquor Store.

2 Includes Business Services; Dog Kennel; Dry Cleaning; Library; Municipal Building; Personal Services; Pet Services; Research and Development Facility; and Vehicle – Motorized, Leasing and Rental.

3 Includes Automotive Washing; Service Station; and Vehicle – Motorized, Service

4 Includes Brewpub; Club or Lodge (non-profit); Cocktail Lounge; Community Center; House of Worship; Microbrewery; Mortuary, Funeral Home; Restaurant and Restaurant Fast-Food; Studio; Theater, Indoor; and Theater, Performing Arts Center.

5 Includes Club, Sports & Fitness and Commercial Recreation – Indoor.

iii. Driveways and Service Access:

- Unless otherwise specified in the specific Zoning District standards in Sections 6.2 through 6.8, driveway access and off-street loading and unloading may be along General Frontages only.

2. Unless otherwise specified in the specific Zoning District standards in Sections 6.2 through 6.8 or through permitted adjustments, driveway and off-street loading and unloading may be located with access along a Pedestrian-Friendly Frontage street only if the property has no access to either a General Frontage street or joint use easement to an adjoining property with direct driveway access to any other street.
3. Unless otherwise specified in the specific Zoning District standards in Sections 6.2 through 6.8 or through permitted adjustments, driveways and off-street loading and unloading may be located with access along a Pedestrian Priority Frontage street only if the property has no access to either a Pedestrian-Friendly or General Frontage Street or joint use easement to an adjoining property with direct access to any other street.
4. Along Pedestrian Priority and Pedestrian-Friendly Frontages, driveway spacing shall be limited to one driveway per each block face or per 200 feet of block face for blocks greater than 400 feet in length.
5. Shared driveways, joint use easements or joint access easements shall be required to adjoining properties when driveway and service access is off a Pedestrian Priority Frontage or Pedestrian-Friendly Frontage.
6. Service and loading/unloading areas shall be screened per standards in Section 10.0.
7. Unless required to meet minimum fire access or service access standards all commercial, mixed-use and multi-family residential driveways shall be a maximum of twenty feet (20') in width. Driveways used for service access (trash, fire, deliveries, etc.) shall be a maximum of thirty feet (30') in width. Driveways wider than twenty-four feet (24') in width shall only be located off of General Frontage Streets. Driveways along County controlled roadways shall meet Ramsey County Standards or the City's adopted standards.
8. Additional easements may be required if shared driveways or access agreements are established.
9. Residential Driveways and Garages:
  - a. Unless required to meet minimum fire access or service access standards, driveways for Single-Family Residential Use Buildings shall be a maximum of twelve feet (12') in width at the curb cut.
  - b. Garages for Residential Buildings shall be located on streets with General Frontage or at the rear of residential buildings.
  - c. If front-loaded garages are utilized on residential uses, each bay of the garage shall be no greater than twenty-four feet (24') wide and set back at least three feet (3') behind the front façade line, unless a front porch meets the requirements of Section 6.1(c)(iii)(9)(d) below. Front-loaded garages on residential lots less than fifty feet (50') wide shall not be allowed. Townhomes and courtyard apartments shall utilize garages at the rear of the lot with access from streets with General Frontage or from Alleys.
    - i. Lots less than sixty-five feet (65') in width shall not have more than twenty-four feet (24') of garage facing the street.
    - ii. Lots sixty-five to seventy feet (65'-70') in width shall permit up to three (3) car front-loaded garages provided the homes meet the following requirements:

1. Each bay of the garage shall not be greater than twenty-four feet (24') wide and setback at least three feet (3') from the front façade line, unless a front porch meets the requirements of Section 6.1 (c) (iii) (9) (d) below.
  2. The garage portion of the home facing the street shall not exceed fifty-five percent (55%) of the total front façade of the home.
- iii. Lots greater than seventy feet (70') in width shall permit up to three (3) car front-loaded garages provided the homes meet the following requirements:
1. Each bay of the garage shall not be greater than twenty-four feet (24') wide and setback at least three feet (3') from the front façade line, unless a front porch meets the requirements of Section 6.1 (c) (iii) (9) (d) below.
  2. The garage portion of the home facing the street shall not exceed fifty percent (50%) of the total front façade of the home.
- d. If garage is flush with the front façade, a porch shall be added to the front façade measuring fifty percent (50%) of the main floor living space portion of the front façade and a minimum of six (6) feet in depth.
- e. Front driveways shall be a minimum of twenty feet (20') long and designed to fit at least two (2) parked vehicles and ensure that vehicles are parked outside of the public right-of-way.
- (d) Street Screen Required:**
- i. Any non-residential parking lot frontage along a public right-of-way with surface parking shall be defined by a Street Screen. This required Street Screen shall be located at the right-of-way edge. Refer to Section 10.0: Streetscape and Landscape Standards of this Code for more specifications.
- (e) Loading Dock Standards:**
- i. Facilities that include a loading dock shall have a maximum clear height of twenty-four feet (24') as measured from the surface of the ground floor to the lowest point on the ceiling.
  - ii. No more than one loading dock shall be allowed per 10,000 square feet of building area.
  - iii. Cross docks, where loading docks are situated along two (2) walls of the same building, shall not be permitted.
  - iv. Loading docks shall be located in the side or rear yard and shall be screened from view of the public right-of-way.
- (f) Fire Separation Requirement:** Side and rear setbacks shall be based on minimum fire separation required between buildings, if applicable.
- (g) Recessed Entry Setbacks:** Building façade lines on recessed entries and arcade buildings shall be measured from the front of façade with the recessed entry or arcade (see Section 4.0 Definitions for illustration).

**(h) Measuring Heights:**

- i. Elevator and stair enclosures; public flagpoles and monuments; and chimneys are exempt from the height limit.
- ii. Spires, belfries, cupolas, and domes of churches shall not exceed a height of sixty-five feet (65') as measured from the ground level.
- iii. Vents, tanks, solar energy systems, HVAC equipment, and other mechanical enclosures shall be exempted from the height limits so long as they do not extend more than fifteen feet (15') above the roof upon which they are located.
- iv. Internal building height shall be measured from finished floor to bottom of the structural members of the ceiling.
- v. Floor to ceiling heights shall not apply to parking structures or civic buildings.

**(i) Encroachments:**

- i. Encroachments into the public right-of-way shall not be permitted.
- ii. Encroachments over Required Setbacks: Canopies, awnings, galleries, and balconies may encroach over any required setback areas per standards established in each zoning district as long as the vertical clearance is a minimum of ten feet (10') from the finished sidewalk elevation.
  1. Maximum of fifty percent (50% of the depth of the sidewalk or ten feet (10') (whichever is less) (except blade signs which shall encroach no more than six feet (6') from the building façade line).
  2. In no case shall an encroachment be located over an on-street parking or travel lane.
  3. Additional license agreements are required for all encroachments over public right-of-way.

**(i) Phased Developments:** Due to the long-term development vision within the TRC, certain building form and site development standards may be deferred for phased development projects meeting the following criteria:

- i. Submission of a site plan that illustrates how development and any related private improvements will be phased over time. Each phase of the site plan shall independently comply with all applicable standards of the TRC unless a Permitted Adjustment is granted.
- ii. Required private landscaping and open space amenities may also be phased with the building.
- iii. If a full block is being phased in development, design and development standards may be measured at the full block level in order to accommodate the various phases of the development.

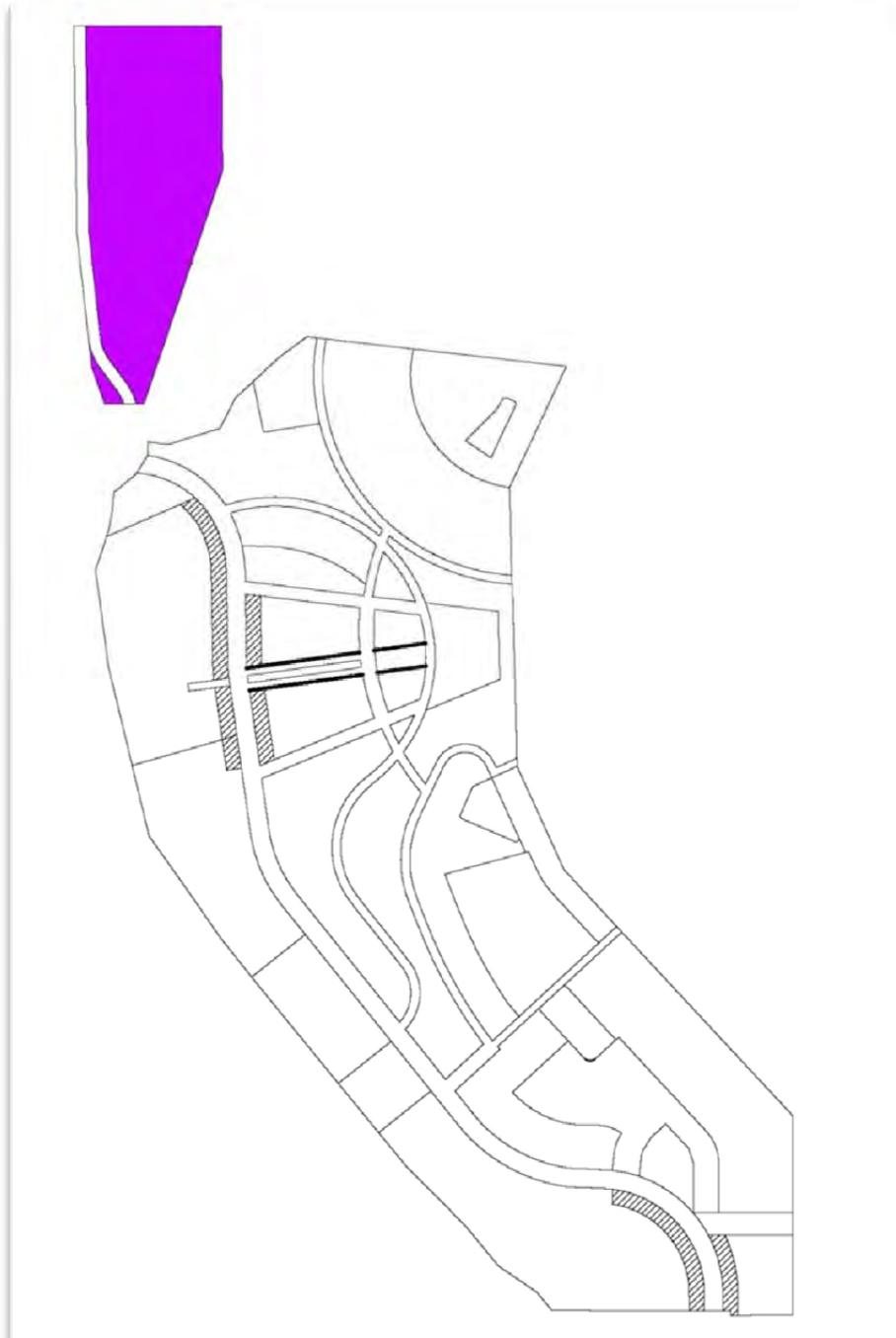
**(k) Required Public Improvements:** All site plans that require public improvements such as sidewalk and streetscape improvements may be deferred through the payment of a proportional fee-in-lieu when the entire length of that block is not within the site plan.

**6.2 Campus Commercial (CC)**

**(a) Illustrations and Intent**

The Campus Commercial Zoning District facilitates a building format that allows multiple, single tenant buildings or campuses within the northern “Thumb” site of the Plan Area. The goal is to allow for an individual plan approach for each campus or building, based on user preferences within a range of requirements.

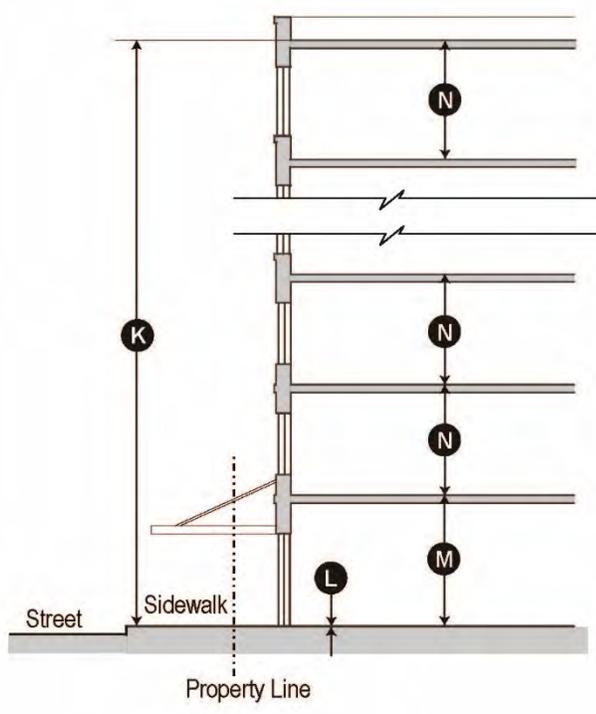
*TCAAP Master Plan Vision for Campus Commercial Zone*



**(b) Building Placement**

Public Open Space	<ul style="list-style-type: none"> <li>• 50' min. setback</li> <li>• Setback must be screened with vegetation and landscaping.</li> <li>• If loading or service is oriented towards Rice Creek Regional Park or public trails, appropriate screening shall be required</li> </ul>
General Frontage	10' min. setback; no max. setback
Side	No min.; no max.
Rear	No min; no max.

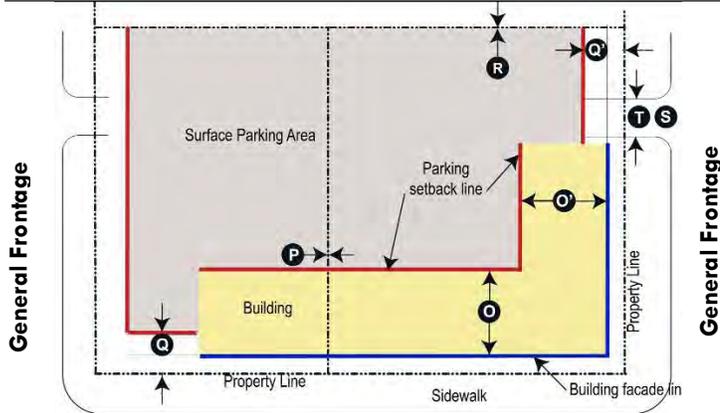
**(c) Building Height**



<b>(i) Principal Building Standards</b>		
Building maximum	<ul style="list-style-type: none"> <li>▪ 15 stories or maximum height of 210 feet</li> </ul>	<b>K</b>
First floor to ceiling height (fin. floor to ceiling structure)	<ul style="list-style-type: none"> <li>▪ Minimum height of 10 feet for all frontages</li> </ul>	<b>M</b>
Ground floor finish level	<ul style="list-style-type: none"> <li>▪ Maximum of 12 inches. above sidewalk for all buildings with Pedestrian Priority designation</li> <li>▪ ADA Code applies</li> </ul>	<b>L</b>
Upper floor(s) height (fin. floor to ceiling structure)	<ul style="list-style-type: none"> <li>▪ Minimum height of 9 feet.</li> </ul>	<b>N</b>
<b>(ii) Accessory Building Standards</b>		
Accessory buildings shall meet the standards for Principal Building standards in the CC Zone.		

**(d) Parking & Service Access**

**(i) Surface Parking Setbacks (with new building)**

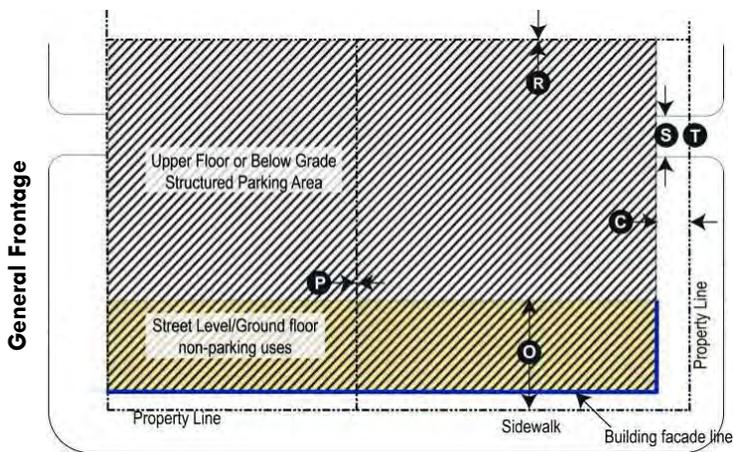


**Public Open Space**

Standards for S and T in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Public Open Space	<ul style="list-style-type: none"> <li>50' min. setback</li> <li>Setback must be screened with vegetation and landscaping</li> <li>If loading or service is oriented towards Public Open Space or public trails, appropriate screening shall be required</li> </ul>	<b>Q</b>
General Frontages	<ul style="list-style-type: none"> <li>10' min.</li> </ul>	<b>Q'</b>
Side	<ul style="list-style-type: none"> <li>0' min.</li> </ul>	<b>P</b>
Rear	<ul style="list-style-type: none"> <li>0' min.</li> </ul>	<b>R</b>

**(ii) Structured Parking or Below Grade Parking Setbacks**



**Public Open Space**

Standards for S and T in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Public Open Space	<ul style="list-style-type: none"> <li>50' min. setback</li> <li>Setback must be screened with vegetation and landscaping</li> <li>If loading or service is oriented towards Public Open Space or public trails, appropriate screening shall be required</li> </ul>	<b>O</b>
General Frontages	<ul style="list-style-type: none"> <li>10' min.</li> </ul>	<b>C</b>
Side	<ul style="list-style-type: none"> <li>0' min.</li> </ul>	<b>P</b>
Rear	<ul style="list-style-type: none"> <li>0' min.</li> </ul>	<b>R</b>

**(iii) Below Grade Parking**

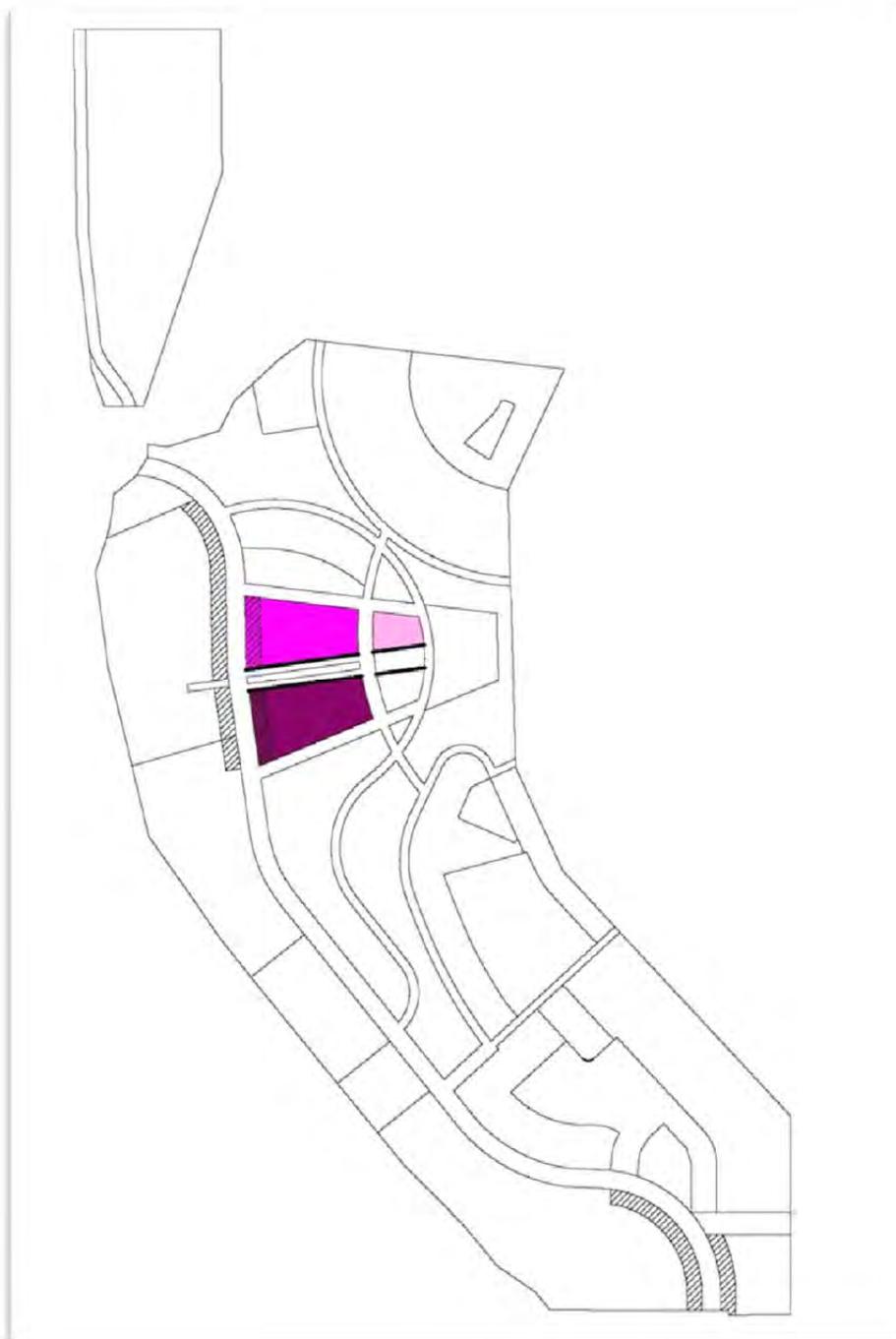
May be built up to the property line.

**6.3 Town Center (TC) Zone**

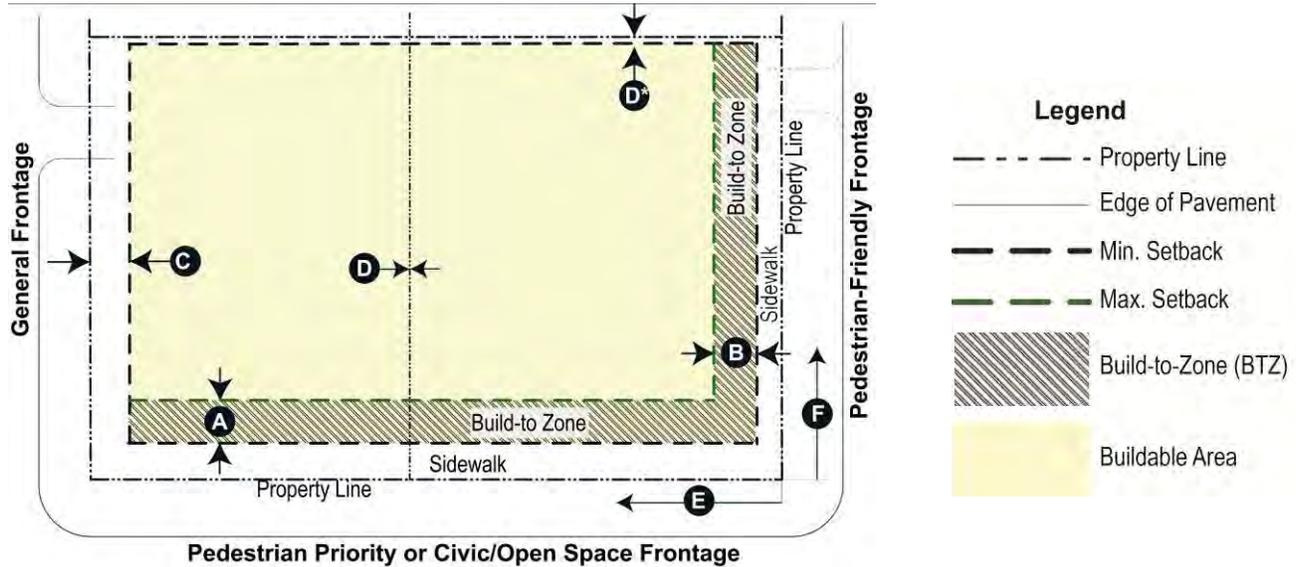
(a) Illustrations and Intent

The Town Center Zoning District creates a vibrant commercial and residential environment that maximizes the potential for an outdoor experience. This district promotes walkability through allowing for housing, office, retail, restaurant and civic use, all within close proximity of each other.

*TCAAP Master Plan Vision for Town Center Zone*

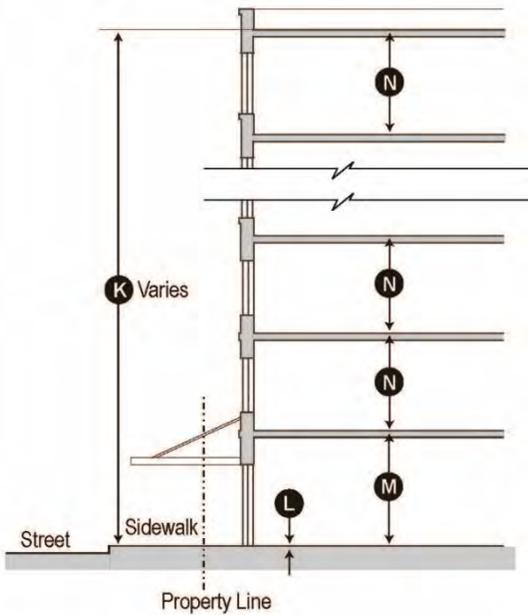


**b) Building Placement**



<b>(i) Build-to Zones (BTZs) and Setbacks (Distance from property line to edge of the zone)</b>		
Pedestrian Priority/Open Space Frontage BTZ	10' min. setback – 15' max. setback	<b>A</b>
Pedestrian-Friendly Frontage BTZ	10' min. setback – 25' max. setback	<b>B</b>
General Frontage BTZ	10' min. setback; no max. setback	<b>C</b>
Side – Adjacent to Neighborhood District	10' min. setback; no max. setback	<b>D</b>
Side – All other adjacencies	0' min. setback; no max. setback	<b>D</b>
Rear – Adjacent to Neighborhood District	10' min. setback; no max. setback	<b>D*</b>
Rear – All other adjacencies	0' min. setback; no max. setback	<b>D*</b>
<b>(ii) Building Frontage (Percentage of building façade built within the BTZ)</b>		
Pedestrian Priority Frontage	60% min.	<b>E</b>
Pedestrian-Friendly Frontage	50% min.	<b>F</b>
General Frontage	None Required	
<b>(iii) Gross Density</b>		
Town Center Sub-District 1 (TC-1)	Maximum density of 67 dwelling units/acre	
Town Center Sub-District 2 (TC-2)	Maximum density of 67 dwelling units/acre	
Town Center Sub-District 3 (TC-3)	Maximum density of 42 units/acre	
<b>(vi) Minimum Multi-Family Unit Sizes<sup>1</sup></b>		
Alcove Units	475 square feet*	1 Assisted Living, Memory Care and Skilled Nursing Units are Exempt.
Efficiency Units	550 square feet**	
One-Bedroom Units	635 square feet	*No more than 10% of the total units per building shall be Alcove Units.
Two-Bedroom Units	950 square feet	
Three-Bedroom Units	1,200 square feet	
Each Additional Bedroom	+150 square feet	**No more than 15% of the total units per building shall be Efficiency Units.

**(c) Building Height**



**(i) Principal Building Standards**

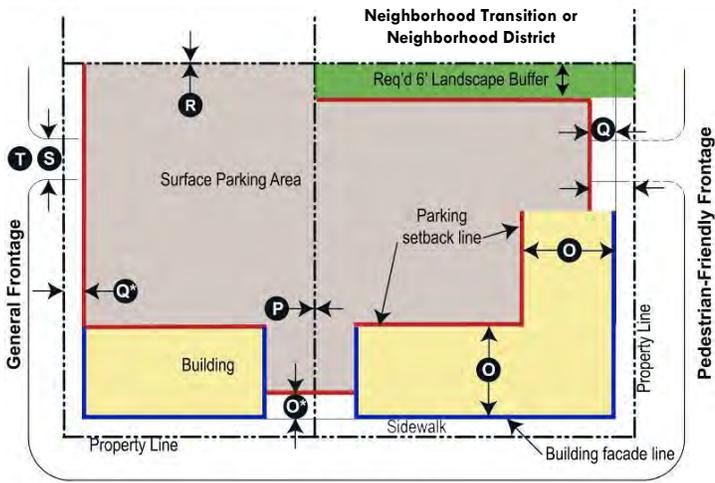
Building maximum	<b>Town Center Sub-District 1 (TC-1)</b>	<ul style="list-style-type: none"> <li>10 stories or a maximum height of 130 feet: up to 25 percent of total lot area.</li> <li>5 stories or a maximum height of 65 feet: remaining portion of lot area (up to 100 percent)</li> </ul>	K
	<b>Town Center Sub-District 2 (TC-2)</b>	<ul style="list-style-type: none"> <li>10 stories or a maximum height of 130 feet; up to 25 percent of the total lot area for properties with a Pedestrian Priority or Pedestrian Friendly Frontage, but not to exceed 60 percent of the public street frontage as measured in linear feet. Intersecting private streets shall be excluded from the total frontage.</li> <li>5 stories or a maximum height of 65 feet: remaining portion of lot area (up to 100 percent)</li> </ul>	
	<b>Town Center Sub-District 3 (TC-3)</b>	<ul style="list-style-type: none"> <li>5 stories or a maximum height of 65 feet: properties with Pedestrian Priority or Pedestrian Friendly Frontage</li> <li>4 stories or a maximum height of 52 feet: all other properties.</li> </ul>	
First floor to ceiling height (fin. floor to ceiling structure)		<ul style="list-style-type: none"> <li>Minimum height of 10 feet for all frontages.</li> </ul>	M
Ground floor finish level		<ul style="list-style-type: none"> <li>Maximum of 12 inches above sidewalk for all buildings with Pedestrian Priority Frontage</li> <li>ADA Code applies</li> <li>Concrete podium construction shall be used for ground floor of all building along Pedestrian Priority of Pedestrian Friendly Frontage</li> </ul>	L
Upper floor(s) height (fin. floor to ceiling structure)		<ul style="list-style-type: none"> <li>Minimum height of 9 feet</li> </ul>	N

**(ii) Accessory Building Standards**

Accessory buildings shall meet the standards for Principal Building standards in the TC Zone.

**(d) Parking & Service Access**

**(i) Surface Parking Setbacks**

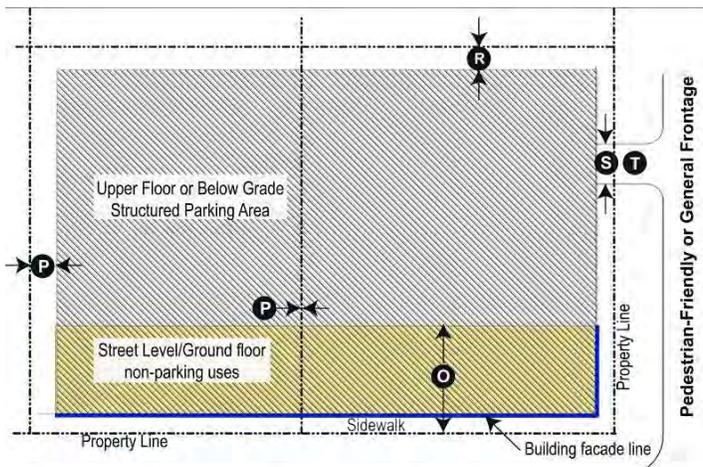


**Pedestrian Priority or Open Space Frontage**

Standards for S and T in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Pedestrian Priority or Open Space Frontage	<ul style="list-style-type: none"> <li>Shall be located behind the principal building along that street frontage; or</li> <li>Min. 3' behind the building façade line along that street</li> </ul>	O
Pedestrian-Friendly Frontage	<ul style="list-style-type: none"> <li>Min. 3' behind the building façade line along that street</li> </ul>	Q
General Frontage	<ul style="list-style-type: none"> <li>Min. 3' behind the property line along that street</li> </ul>	Q*
Side	<ul style="list-style-type: none"> <li>6' (min) only if adjacent to Neighborhood District;</li> <li>0' min. for all other adjacencies</li> </ul>	P
Rear	<ul style="list-style-type: none"> <li>6' (min) only if adjacent to Neighborhood District;</li> <li>0' min. for all other adjacencies</li> </ul>	R

**(ii) Structured Parking**



**Pedestrian Priority or Open Space Frontage**

Standards for S and T in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Pedestrian Priority or Open Space Frontage	<ul style="list-style-type: none"> <li>Ground floor - Shall be min. of 30' from the property line</li> <li>Upper Floors – may be built to the façade line along that street</li> </ul>	O
Pedestrian-Friendly Frontage or General Frontage	<ul style="list-style-type: none"> <li>May be built up to the building façade line along a that street; or</li> <li>If no building is located along the street frontage; then the structured parking shall meet the setback standards along that specific frontage.</li> </ul>	
Side	<ul style="list-style-type: none"> <li>10' (min) only if adjacent to Neighborhood District;</li> <li>0' for all other adjacencies</li> </ul>	P
Rear	<ul style="list-style-type: none"> <li>10' (min) only if adjacent to Neighborhood District;</li> <li>0' min. for all other adjacencies</li> </ul>	R

**(iii) Below Grade Parking**

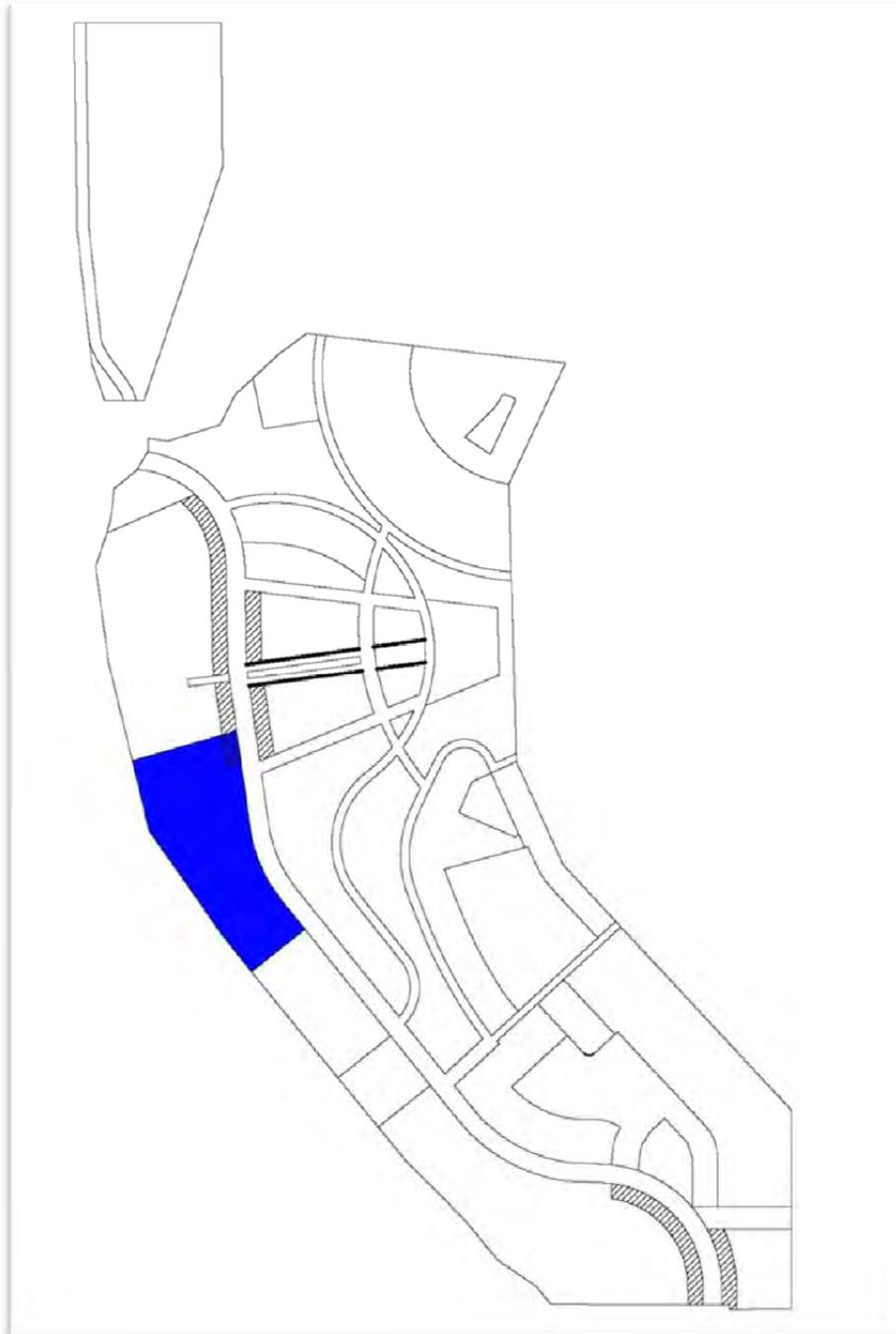
May be built up to the property lines along all streets

**6.4 Office Mixed-Use (OMU)**

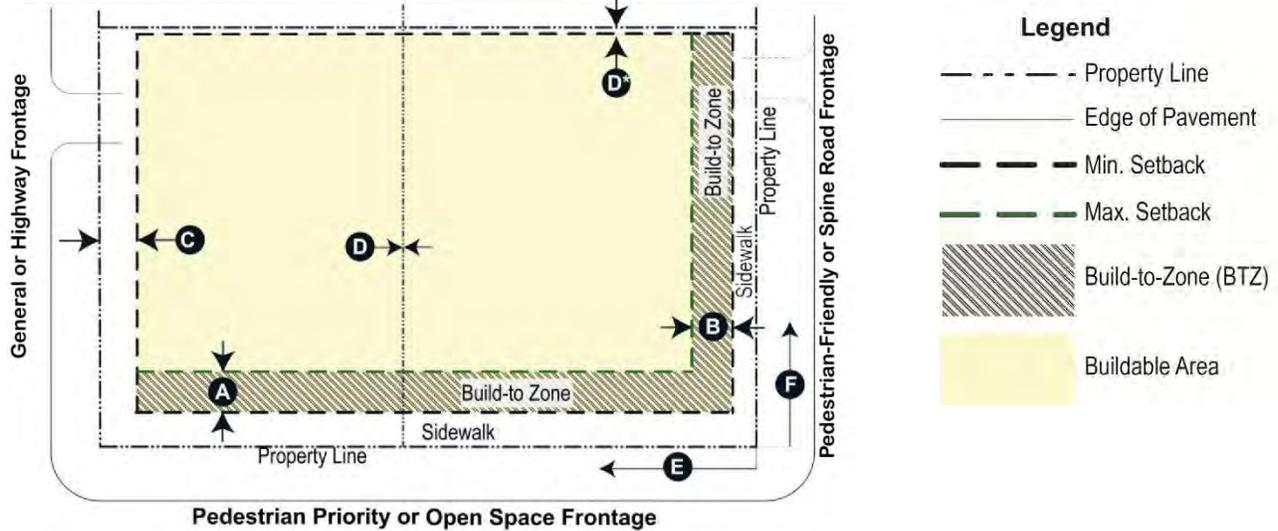
(a) Illustrations and Intent

The Office Mixed-Use Zoning District creates a flexible zone that allows and promotes a seamless transition from Retail Mixed-Use but focuses on employment and compatible uses. This district promotes employment as a primary use, but allows for other commercial and up to ten percent (10%) retail uses.

*TCAAP Master Plan Vision for Office Mixed-Use Zone*



**(b) Building Placement**



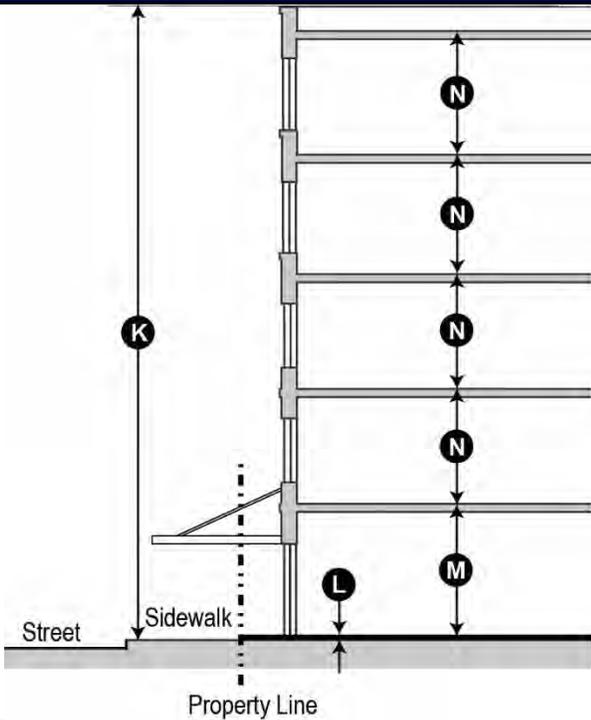
**(i) Build-to Zones (BTZs) and Setbacks  
(Distance from property line to edge of the zone)**

Pedestrian-Priority/Open Space Frontage (BTZ)	10' min. setback – 25' max. setback	<b>A</b>
Pedestrian-Friendly/Spine Road Frontage (BTZ)	10' min. setback – 95' max. setback	<b>B</b>
General or Highway Frontage	10' min. setback; no max. setback	<b>C</b>
Side	0' min. setback; no max. setback	<b>D</b>
Rear	0' min. setback; no max. setback	<b>D*</b>

**(ii) Building Frontage  
(Percentage of building façade built within the BTZ)**

Pedestrian-Priority/Open Space Frontage	50% min.	<b>E</b>
Pedestrian-Friendly	40% min.	<b>F</b>
General Frontage	None Required	<b>C</b>

**(c) Building Height**



**(i) Principal Building Standards**

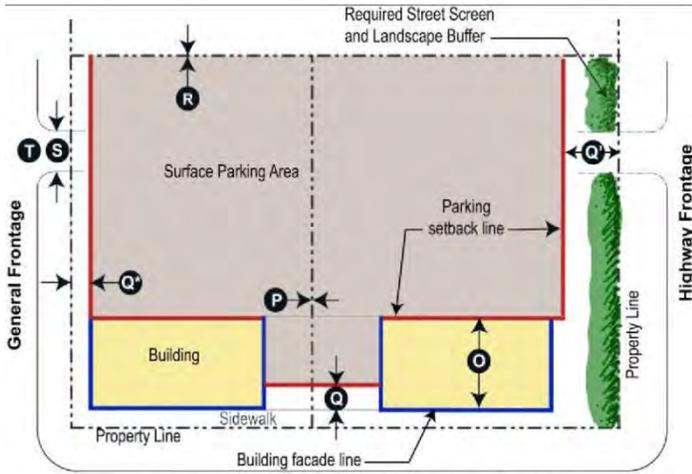
Building maximum	▪ 65' max.	<b>K</b>
First floor to ceiling height (fin. floor to ceiling structure)	▪ 10' min. for all frontages	<b>M</b>
Ground floor finish level	▪ 12" max. above sidewalk for all buildings with Pedestrian Priority Frontage ▪ ADA code applies.	<b>L</b>
Upper floor(s) height (fin. floor to ceiling structure)	▪ 9' min.	<b>N</b>

**(ii) Accessory Building Standards**

Accessory buildings shall meet the standards for Principal Building standards in the OMU Zone.

**(d) Parking & Service Access**

**(i) Surface Parking Setbacks**



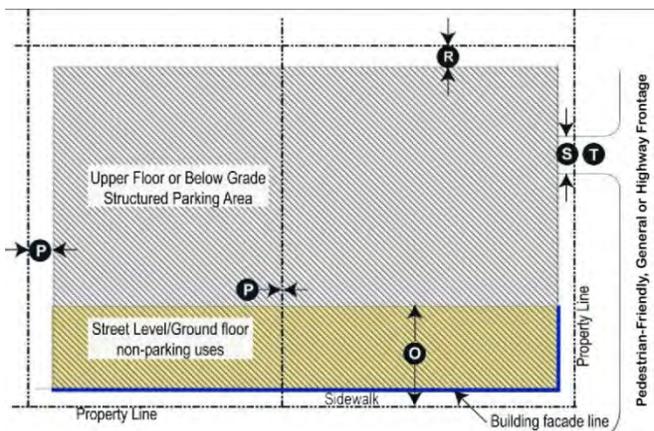
**Pedestrian-Friendly or Civic/Open Space Frontage**

**Pedestrian Priority, Pedestrian-Friendly, Open Space or Spine Road Frontage**

Standards for **S** and **T** in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Pedestrian-Priority or Open Space Frontage	<ul style="list-style-type: none"> <li>Shall be located behind the principal building along that street frontage; or</li> <li>Min. 3' behind the building façade line along that street;</li> <li>If no building is located along the street frontage; then surface parking shall be setback a minimum of 6' from the property line.</li> </ul>	<b>O</b>
Pedestrian Friendly Frontage	<ul style="list-style-type: none"> <li>Min. 3' behind the building façade line along that street.</li> <li>If no building is located along the street frontage; then surface parking shall be setback a minimum of 6' from the property line</li> </ul>	<b>Q</b>
General Frontage	<ul style="list-style-type: none"> <li>Min. 10' behind the property line; and</li> <li>Maximum of two rows of parking in front of building.</li> </ul>	<b>Q+</b>
Highway Frontage	<ul style="list-style-type: none"> <li>Min. 15' from the property line and include a street screen and landscape buffer</li> </ul>	<b>Q'</b>
Side	<ul style="list-style-type: none"> <li>0'</li> </ul>	<b>P</b>
Rear	<ul style="list-style-type: none"> <li>0'</li> </ul>	<b>R</b>

**(ii) Structured Parking or Below Grade Parking Setbacks**



**Pedestrian Priority or Open Space Frontage**

Standards for **S** and **T** in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Pedestrian-Priority or Open Space Frontage	<ul style="list-style-type: none"> <li>Ground floor - Shall be min. of 30' from the property line</li> <li>Upper Floors – may be built to the façade line along that street</li> </ul>	<b>O</b>
Pedestrian Friendly, General or Highway Frontage	<ul style="list-style-type: none"> <li>May be built up to the building façade line along that street frontage; or</li> <li>If no building is located along the street frontage; then the structured parking shall meet the setback standards along that street.</li> </ul>	
Side	<ul style="list-style-type: none"> <li>0'</li> </ul>	<b>P</b>
Rear	<ul style="list-style-type: none"> <li>0'</li> </ul>	

**(iii) Below Grade Parking**

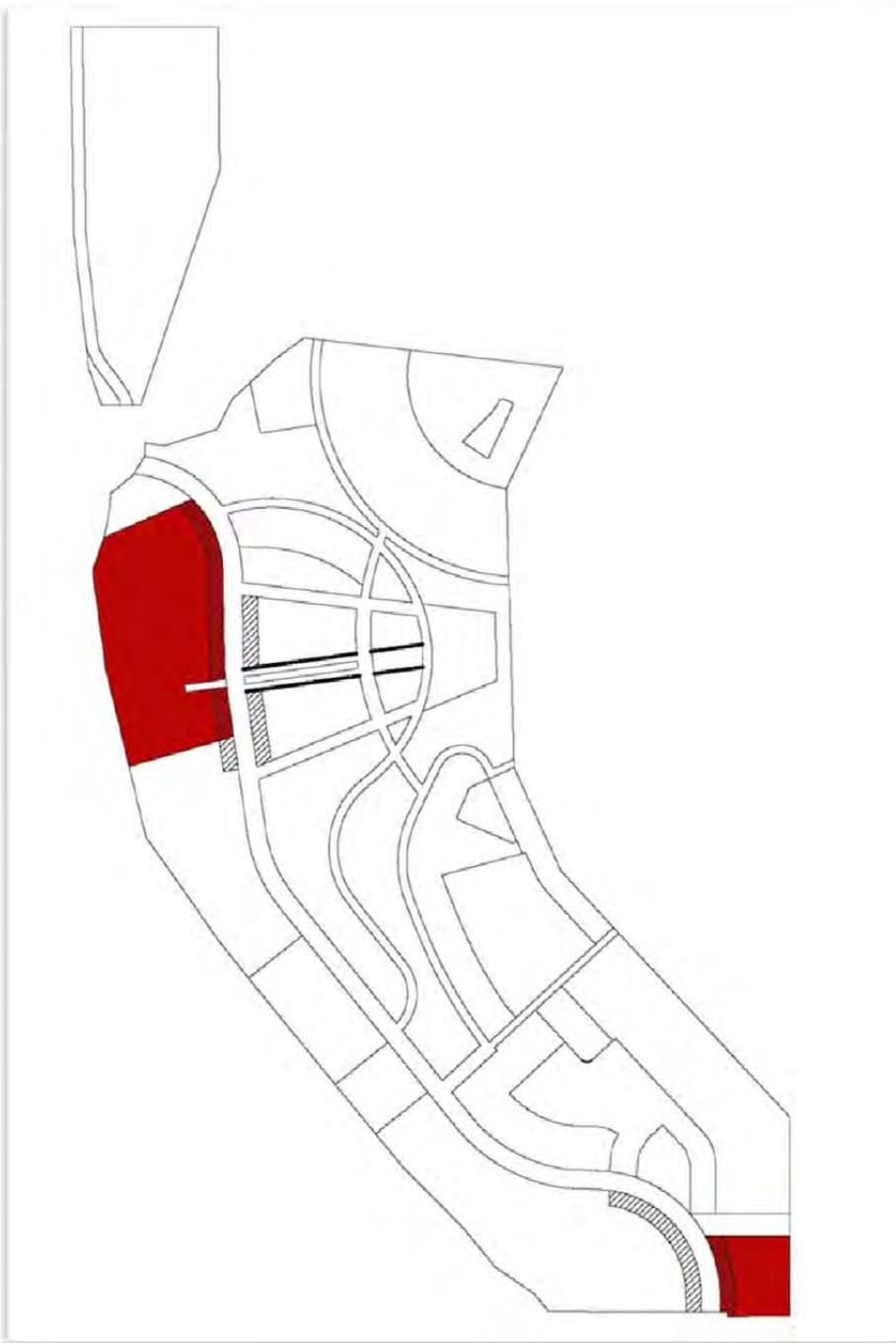
May be built up to the property line along all streets.

**6.5 Retail Mixed-Use (RMU)**

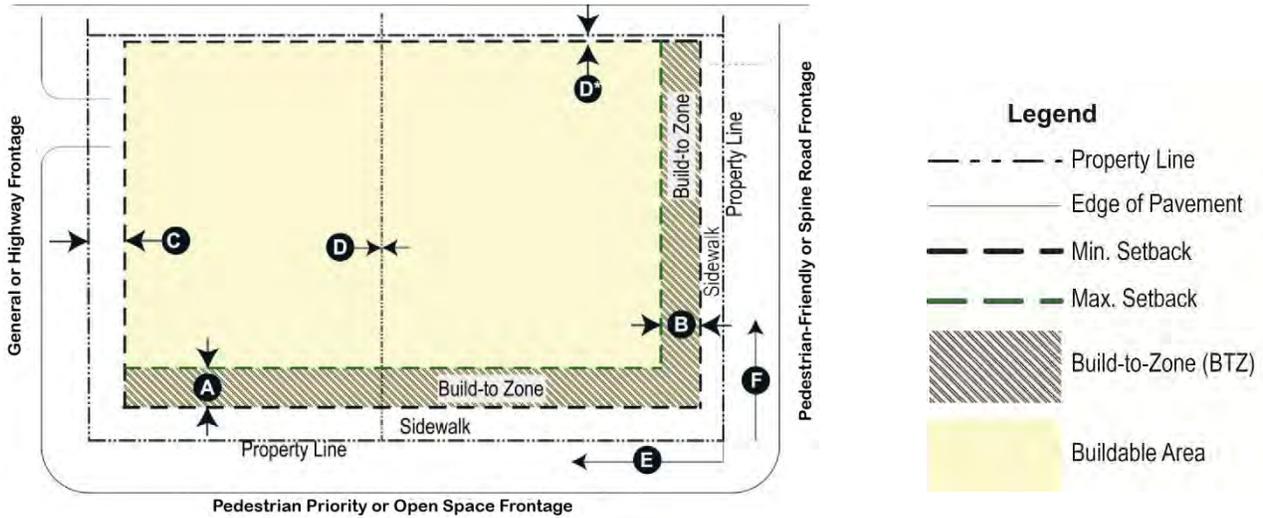
(a) Illustrations and Intent

*TCAAP Master Plan Vision for Retail Mixed-Use Zone*

The Retail Mixed-Use Zoning District creates a flexible zone that allows and promotes a seamless transition from Office Mixed-Use, but focuses on retail and compatible uses. This district promotes retail as a primary use, but allows for other commercial uses.

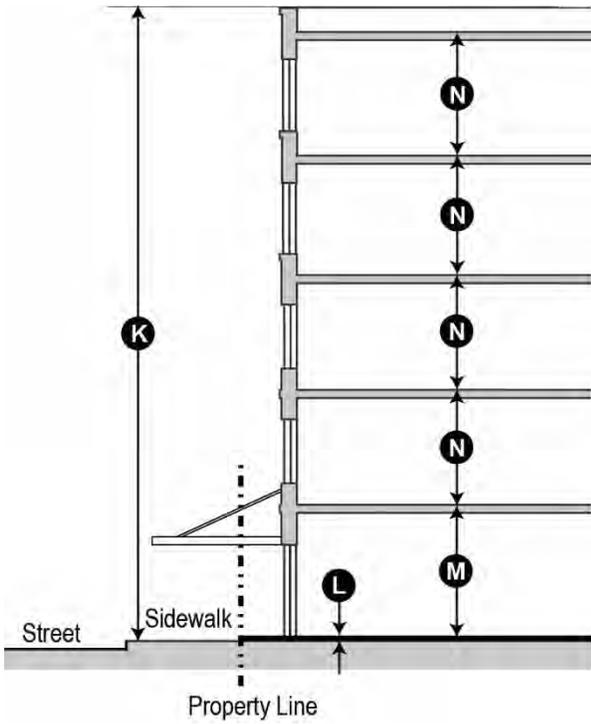


**(b) Building Placement**



<b>(i) Build-to Zones (BTZs) and Setbacks (Distance from property line to edge of the zone)</b>		
Pedestrian Priority /Open Space Frontage (BTZ)	10' min. setback – 25' max. setback	<b>A</b>
Pedestrian-Friendly /Spine Road Frontage (BTZ)	10' min. setback – 75' max. setback	<b>B</b>
General or Highway Frontage	10' min. setback; no max. setback	<b>C</b>
Side – Adjacent to Neighborhood District Side – All other adjacencies	10' min. setback; no max. setback 0' min. setback; no max. setback	<b>D</b>
Rear – Adjacent to Neighborhood District Rear – All other adjacencies	10' min. setback; no max. setback 0' min. setback; no max. setback	<b>D*</b>
<b>(ii) Building Frontage (Percentage of building façade built within the BTZ)</b>		
Pedestrian Priority /Open Space Frontage	60% min.	<b>E</b>
Pedestrian-Friendly Frontage	50% min.	<b>F</b>
General Frontage	None Required	

**(c) Building Height**



**(i) Principal Building Standards**

Building maximum ▪ 65' max. **K**

First floor to floor height (fin. floor to ceiling structure) ▪ 10' min. for all frontages. **M**

Ground floor finish level ▪ 12" max. above sidewalk for all buildings with Pedestrian Priority Frontage **L**  
▪ ADA Code Applies

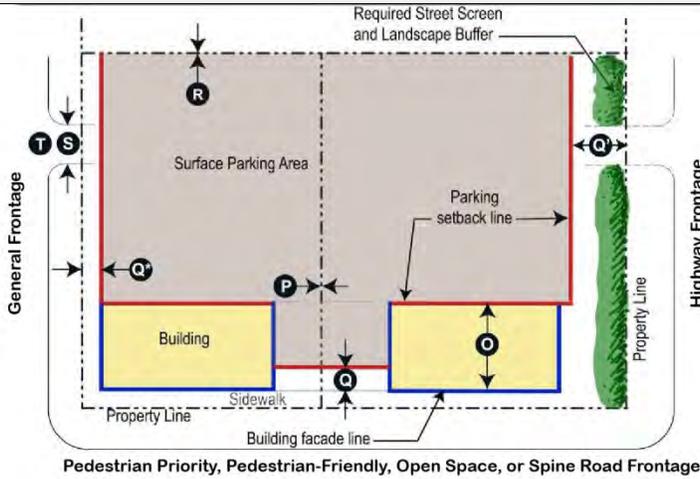
Upper floor(s) height (fin. floor to ceiling structure) ▪ 9' min. **N**

**(ii) Accessory Building Standards**

Accessory buildings shall meet the standards for Principal Building standards in the Retail Mixed-Use Zone.

**(d) Parking & Service Access**

**(i) Surface Parking Setbacks**

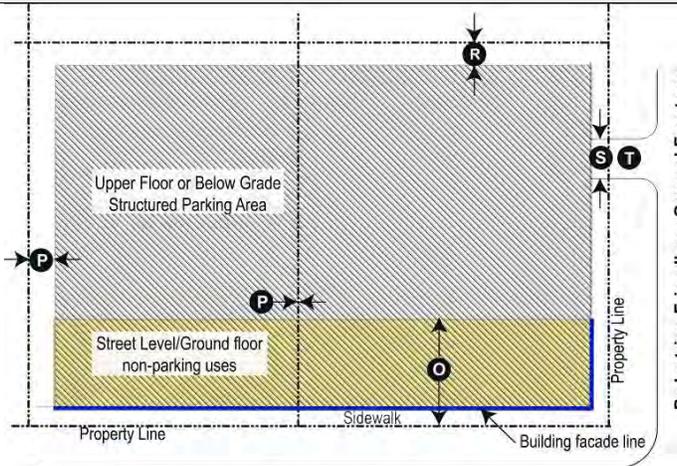


Pedestrian Priority, Pedestrian-Friendly, Open Space, or Spine Road Frontage

Standards for S and T in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Pedestrian Priority, Pedestrian Friendly, Open Space or Spine Road Frontage	<ul style="list-style-type: none"> <li>Shall be located behind the principal building along that street frontage; or</li> <li>Min. 3' behind the building façade line along that street</li> </ul>	O Q
Highway Frontage	<ul style="list-style-type: none"> <li>Min. 15' from the property line and include Street Screen and landscape buffer</li> </ul>	Q'
General Frontage	<ul style="list-style-type: none"> <li>Min. 3' behind the property line along that street</li> </ul>	Q*
Side	<ul style="list-style-type: none"> <li>6' (min) only if adjacent to Neighborhood District;</li> <li>0' min. for all other adjacencies</li> </ul>	P
Rear	<ul style="list-style-type: none"> <li>6' (min) only if adjacent to Neighborhood District</li> <li>0' min. for all other adjacencies.</li> </ul>	R

**(ii) Structured Parking or Below Grade Parking Setbacks**



Pedestrian Priority or Open Space Frontage

Standards for S and T in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Pedestrian Priority or Open Space Frontage	<ul style="list-style-type: none"> <li>Ground floor - Shall be min. of 30' from the property line</li> <li>Upper Floors – may be built to the façade line along that street</li> </ul>	O
Pedestrian-Friendly, General or Highway Frontage	<ul style="list-style-type: none"> <li>May be built up to the building façade line along a that street; or</li> <li>If no building is located along the street frontage; then the structured parking shall meet the setback standards along that specific frontage.</li> </ul>	
Side	<ul style="list-style-type: none"> <li>10' min. (adjacent to Neighborhood District )</li> <li>0' min. (all other adjacencies)</li> </ul>	P
Rear	<ul style="list-style-type: none"> <li>10' min. (adjacent to Neighborhood District )</li> <li>0' min. (all other adjacencies)</li> </ul>	R

**(iii) Below Grade Parking**

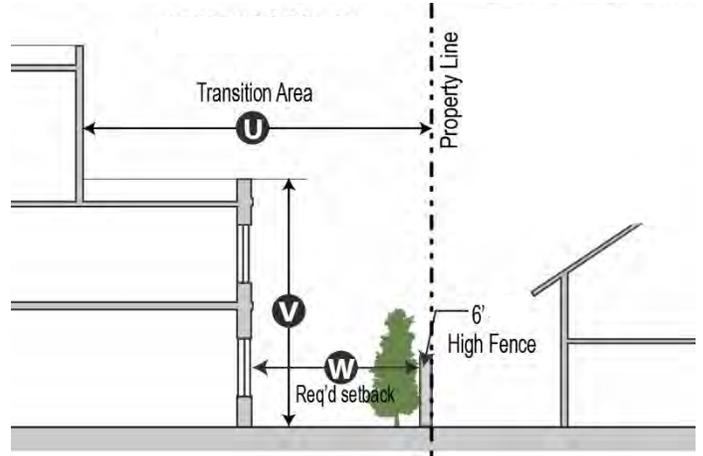
May be built up to the property line along all streets.

**(e) Residential Transition Standards**

The following transition standards shall apply to all new building construction and all upper story additions to existing buildings located adjacent to the Neighborhood District. This requirement shall NOT apply if an alley or other similar right-of-way separates the subject lot and the Neighborhood District.

i.	Transition Area	25' min.	<b>U</b>
ii.	Max. Building Height within Transition Area	2 stories or 30'	<b>V</b>
iii.	Required setback	Min. 10'	<b>W</b>

A Residential Transition Area fence (6 feet high) shall be required when adjacent to the Neighborhood District and shall be optional for all other adjacencies. The required fence shall NOT be chain link or vinyl. A 6-foot wide landscape buffer with evergreen shrubs planted at 3-foot on center and 6 feet min. in height at maturity shall also be required to be planted within the landscape buffer parallel to the Neighborhood District border. (see surface parking setbacks illustration).

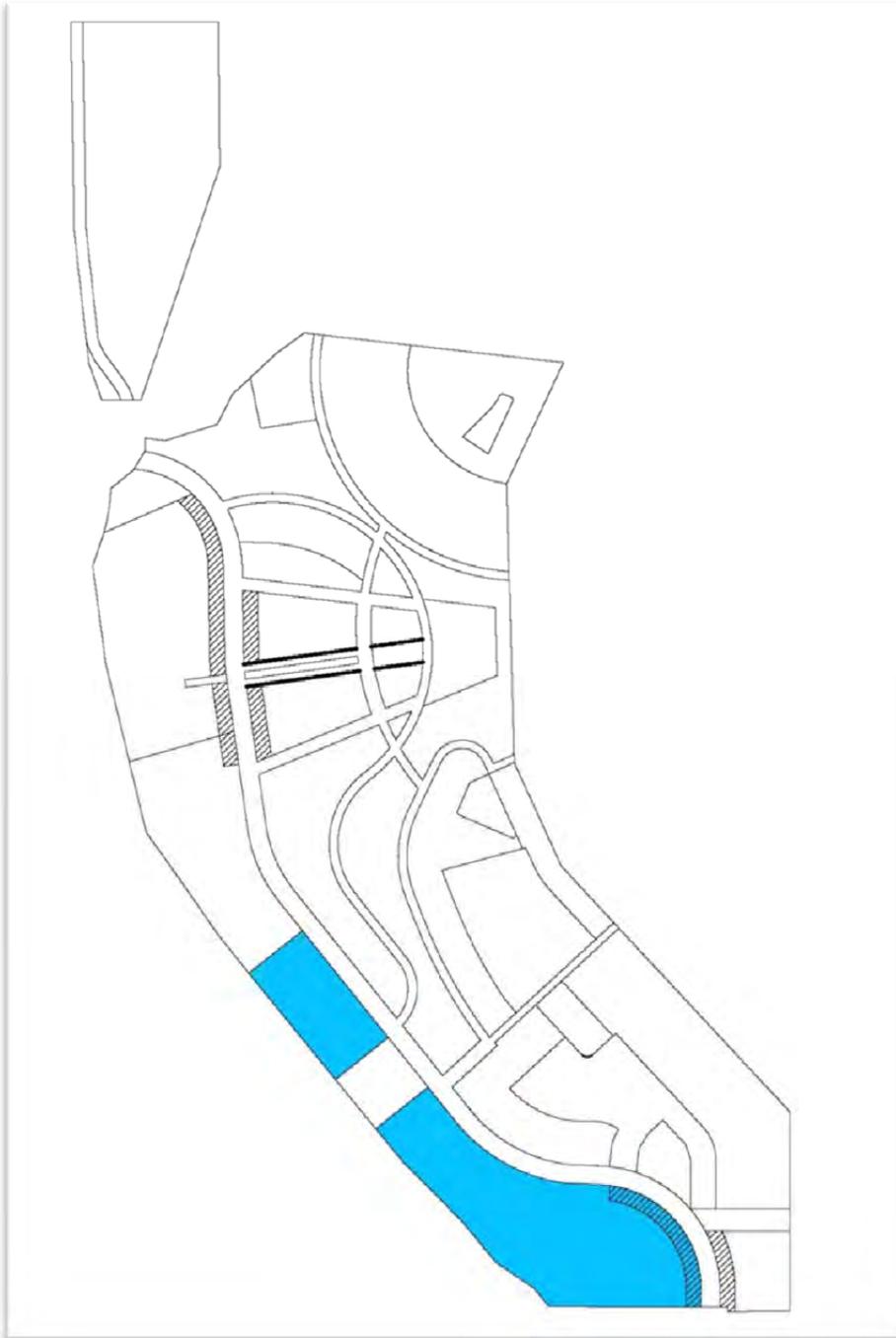


6.6 Flex Office (FO) Zone

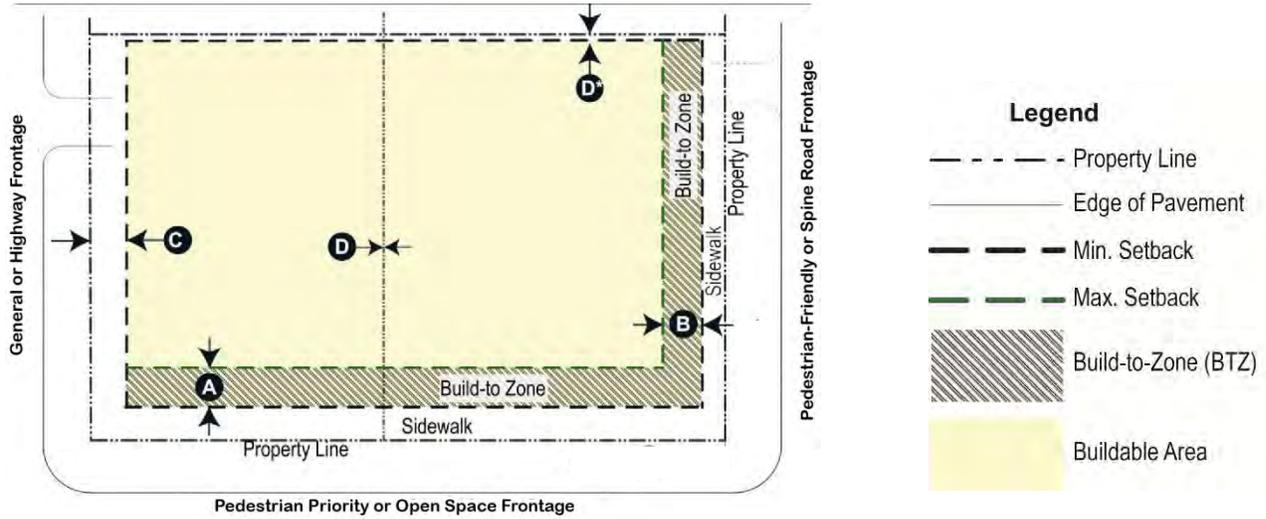
(a) Illustrations and Intent

*TCAAP Master Plan Vision for Flex Office Zone*

The Flex Office Zoning District creates an opportunity for large scale development for employment, and manufacturing uses that take advantage of the highway frontage and automobile access.



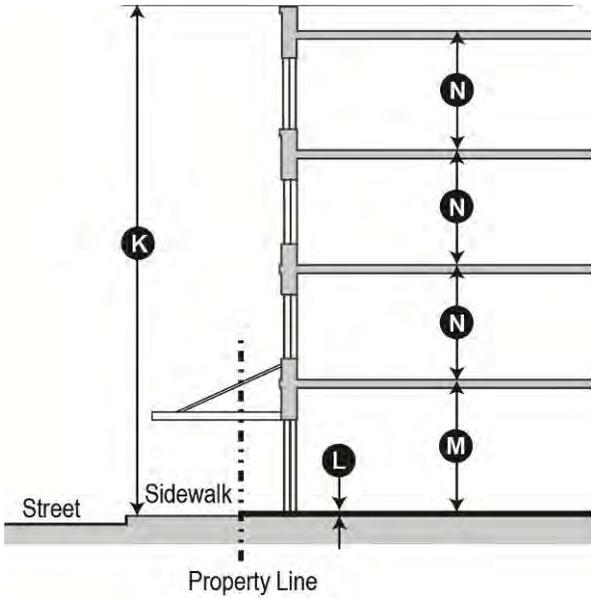
**(b) Building Placement**



**(i) Build-to Zones (BTZs) and Setbacks  
(Distance from property line to edge of the zone)**

Pedestrian Priority / Open Space Frontage (BTZ)	10' min. setback – 25' max. setback	<b>A</b>
Pedestrian-Friendly /Spine Road Frontage (BTZ)	10' min. setback – 95' max. setback	<b>B</b>
General or Highway Frontage	10' min. setback; no max. setback	<b>C</b>
Side	0' min. setback; no max setback	<b>D</b>
Rear	15' min. setback; no max. setback	<b>D*</b>

**(c) Building Height**



**(i) Principal Building Standards**

Building maximum
 

- 45' max.
- 65' max. for buildings with at least 75% office use.

K

First floor to floor height (fin. floor to ceiling structure)
 

- 10' min. for all frontages

M

Ground floor finish level
 

- 12" max. above sidewalk for all buildings with Pedestrian Priority Frontage designation
- ADA Code Applies

L

Upper floor(s) height (fin. floor to ceiling structure)
 

- 9' min.

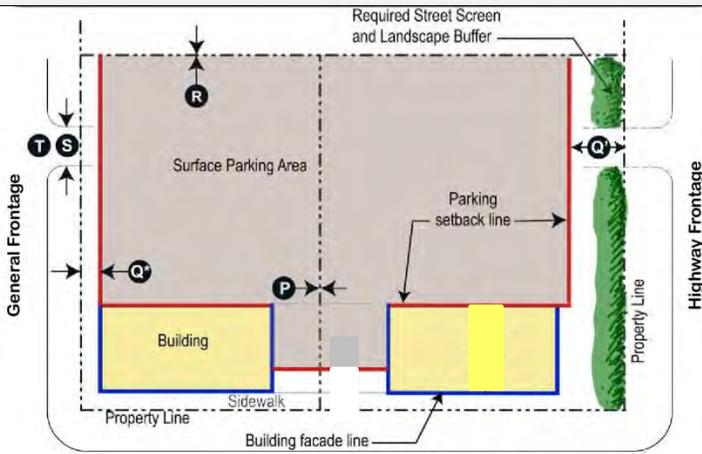
N

**(ii) Accessory Building Standards**

Accessory buildings shall meet the standards for Principal Building standards in the Flex Office Zone.

**(d) Parking & Service Access**

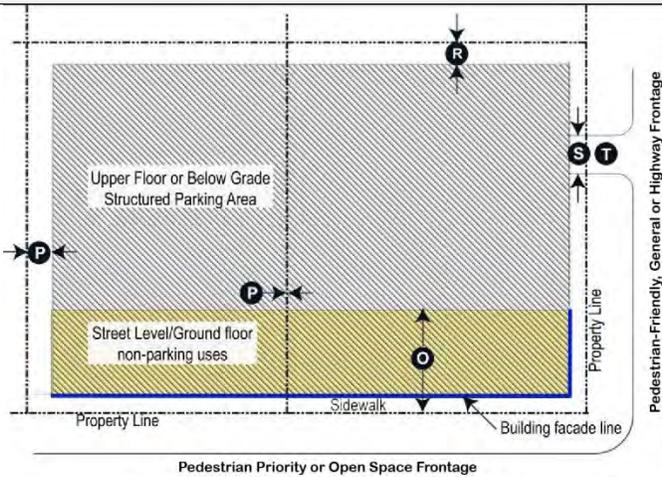
**(i) Surface Parking Setbacks**



Standards for S and T in the illustrations above are referenced in standards for Driveways and Service Access section below.

Highway Frontage	<ul style="list-style-type: none"> <li>15' min. from the property line and include a street screen and landscape buffer</li> </ul>	Q
General Frontage	<ul style="list-style-type: none"> <li>10' min. behind the property line along that street; and</li> <li>Maximum of two rows of parking in front of building.</li> </ul>	Q*
Side	<ul style="list-style-type: none"> <li>0' min.</li> </ul>	P
Rear	<ul style="list-style-type: none"> <li>0' min</li> </ul>	R

**(ii) Structured Parking or Below Grade Parking Setbacks**



Standards for S and T in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Pedestrian Priority / Open Space Frontage	<ul style="list-style-type: none"> <li>Ground floor - Shall be min. of 30' from the property line</li> <li>Upper Floors – may be built to the façade line along that street</li> </ul>	O
Pedestrian-Friendly, General or Highway Frontage	<ul style="list-style-type: none"> <li>Shall be min. of 10' from the property line;</li> <li>If no building is located along the street frontage; then the structured parking shall meet the setback standards along that specific frontage.</li> </ul>	
Side	<ul style="list-style-type: none"> <li>0' min</li> </ul>	P
Rear	<ul style="list-style-type: none"> <li>0' min</li> </ul>	R

**(iii) Below Grade Parking**

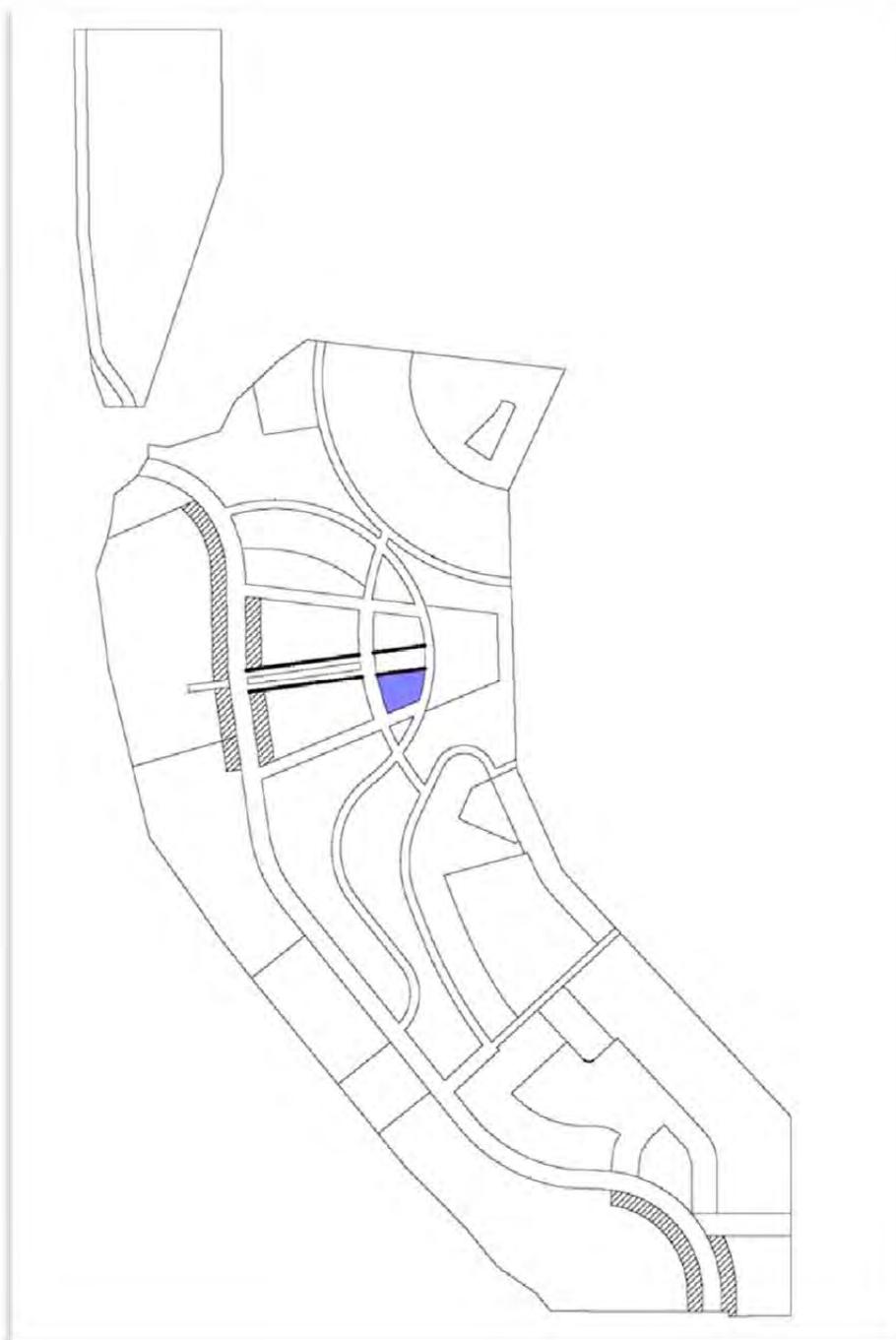
May be built up to the property line along all streets.

**6.7 Civic District (D) Zone**

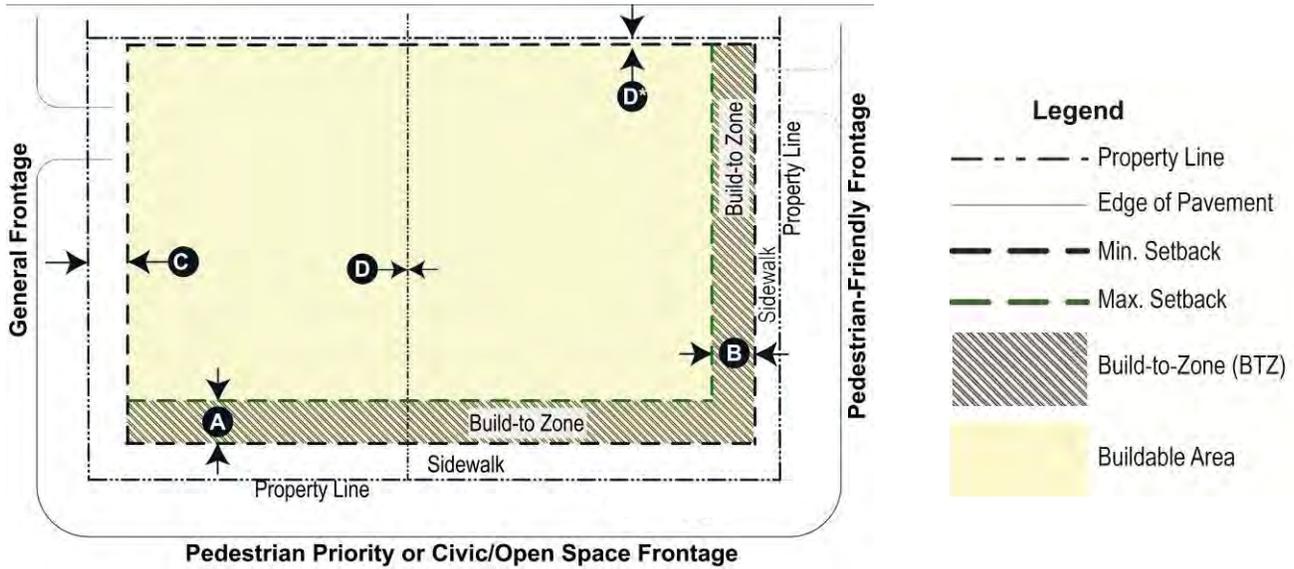
**(a) Illustrations and Intent**

The Civic District is intended to allow civic and community uses.

*TCAAP Master Plan Vision for Civic District Zone*



**(b) Building Placement**



**Legend**

- Property Line
- Edge of Pavement
- Min. Setback
- Max. Setback
- ▨ Build-to-Zone (BTZ)
- Buildable Area

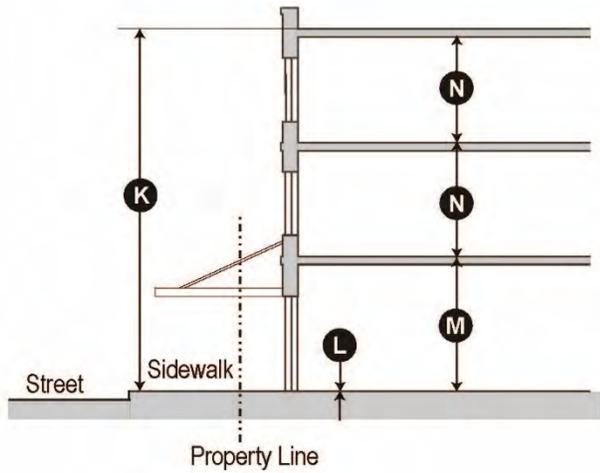
**(i) Build-to Zones (BTZs) and Setbacks  
(Distance from property line to edge of the zone)**

Pedestrian Priority/Open Space Frontage BTZ	10' min. setback – 15' max. setback	<b>A</b>
Pedestrian-Friendly Frontage BTZ	10' min. setback – 25' max. setback	<b>B</b>
General Frontage BTZ	10' min. setback; no max. setback	<b>C</b>
Side – Adjacent to Neighborhood District	10' min.; no max. setback	<b>D</b>
Side – All other adjacencies	0' min.; no max. setback	<b>D</b>
Rear – Adjacent to Neighborhood District	10' min.; no max. setback	<b>D*</b>
Rear – All other adjacencies	0' min.; no max. setback	<b>D*</b>

**(ii) Building Frontage  
(Percentage of building façade built within the BTZ)**

Pedestrian Priority Frontage	60% min.	<b>E</b>
Pedestrian-Friendly Frontage	50% min.	<b>F</b>
General Frontage	None Required	

**(c) Building Height**



**(iii) Principal Building Standards**

Building maximum ▪ 52' max **K**

First floor to ceiling height (fin. floor to ceiling structure) ▪ 10' min. for all frontages **M**

Ground floor finish level ▪ 12" max. above sidewalk for all buildings with Pedestrian Priority Frontage **L**  
▪ ADA Code applies

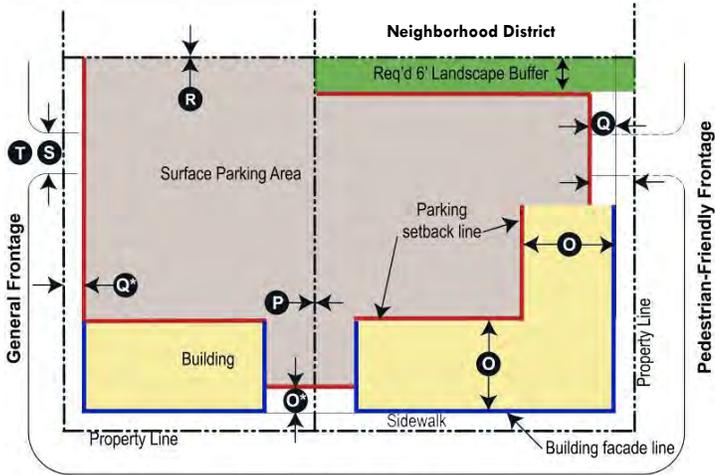
Upper floor(s) height (fin. floor to ceiling structure) ▪ 9' min. **N**

**(iv) Accessory Building Standards**

Accessory buildings shall meet the standards for Principal Building standards in the TC Zone.

**(d) Parking & Service Access**

**(iv) Surface Parking Setbacks**

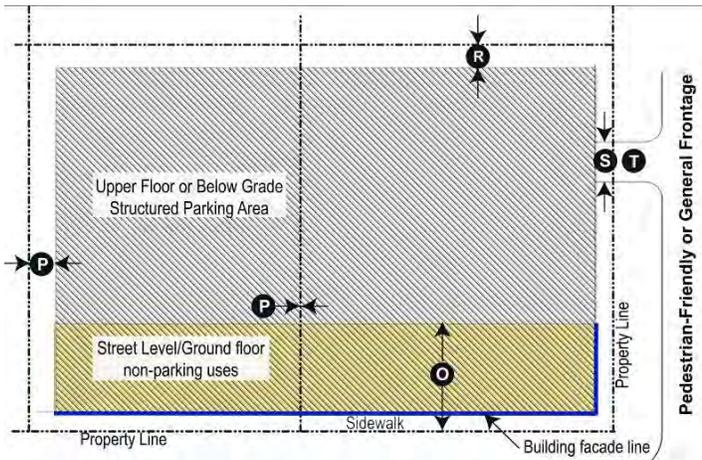


**Pedestrian Priority or Open Space Frontage**

Standards for **S** and **T** in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Pedestrian Priority or Open Space Frontage	<ul style="list-style-type: none"> <li>Shall be located behind the principal building along that street frontage; or</li> <li>Min. 3' behind the building façade line along that street</li> </ul>	<p><b>O</b></p> <p><b>O*</b></p>
Pedestrian-Friendly Frontage	<ul style="list-style-type: none"> <li>Min. 3' behind the building façade line along that street</li> </ul>	<b>Q</b>
General Frontage	<ul style="list-style-type: none"> <li>Min. 3' behind the property line along that street</li> </ul>	<b>Q*</b>
Side	<ul style="list-style-type: none"> <li>6' (min) only if adjacent to Neighborhood District;</li> <li>0' min. for all other adjacencies</li> </ul>	<b>P</b>
Rear	<ul style="list-style-type: none"> <li>6' (min) only if adjacent to Neighborhood District;</li> <li>0' min. for all other adjacencies</li> </ul>	<b>R</b>

**(v) Structured Parking**



**Pedestrian Priority or Open Space Frontage**

Standards for **S** and **T** in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

Pedestrian Priority or Open Space Frontage	<ul style="list-style-type: none"> <li>Ground floor - Shall be min. of 30' from the property line</li> <li>Upper Floors – may be built to the façade line along that street</li> </ul>	<b>O</b>
Pedestrian-Friendly Frontage or General Frontage	<ul style="list-style-type: none"> <li>May be built up to the building façade line along a that street; or</li> <li>If no building is located along the street frontage; then the structured parking shall meet the setback standards along that specific frontage.</li> </ul>	
Side	<ul style="list-style-type: none"> <li>10' (min) only if adjacent to Neighborhood District;</li> <li>0' for all other adjacencies</li> </ul>	<b>P</b>
Rear	<ul style="list-style-type: none"> <li>10' (min) only if adjacent to Neighborhood District;</li> <li>0' min. for all other adjacencies</li> </ul>	<b>R</b>

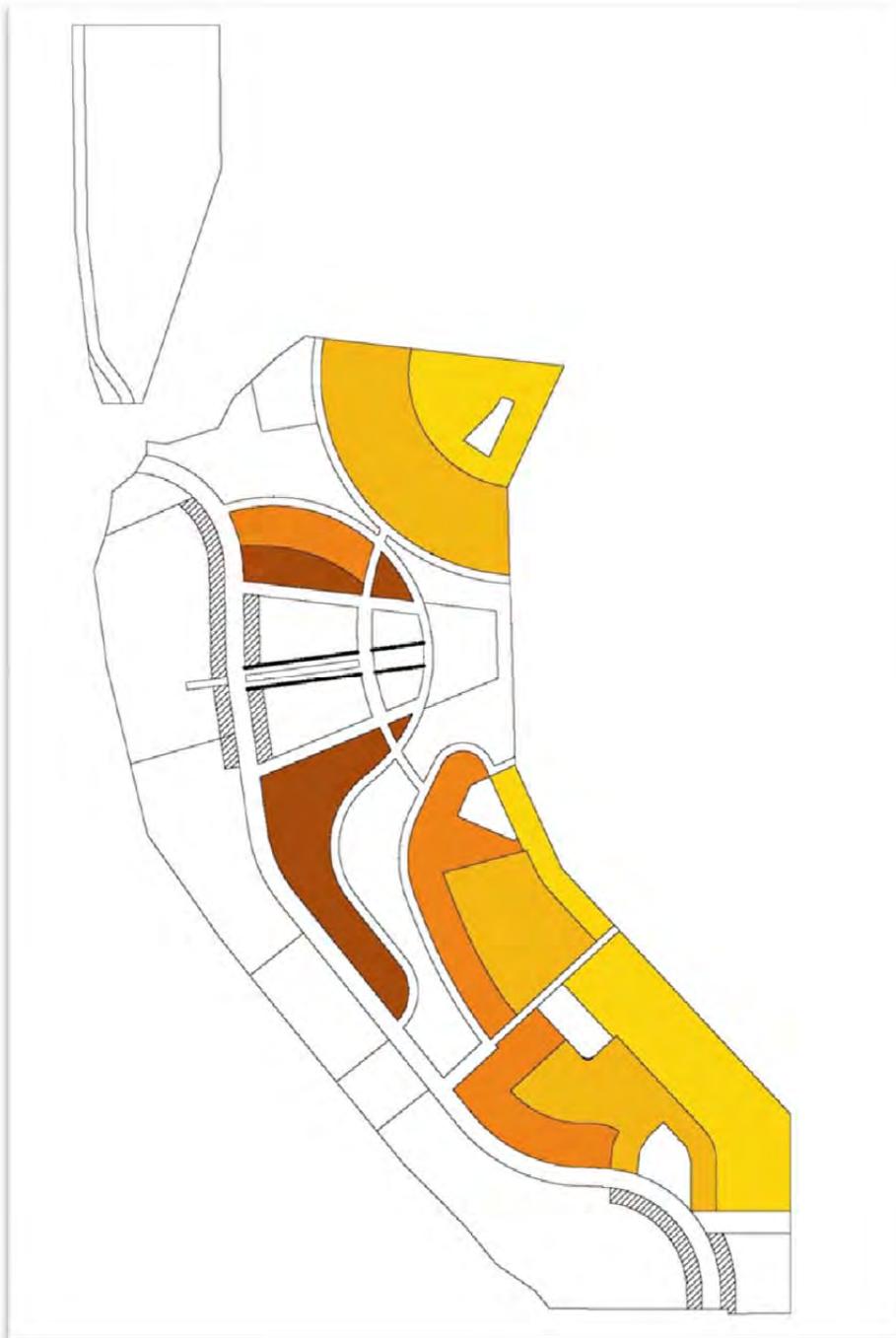
**(vi) Below Grade Parking**

May be built up to the property lines along all streets

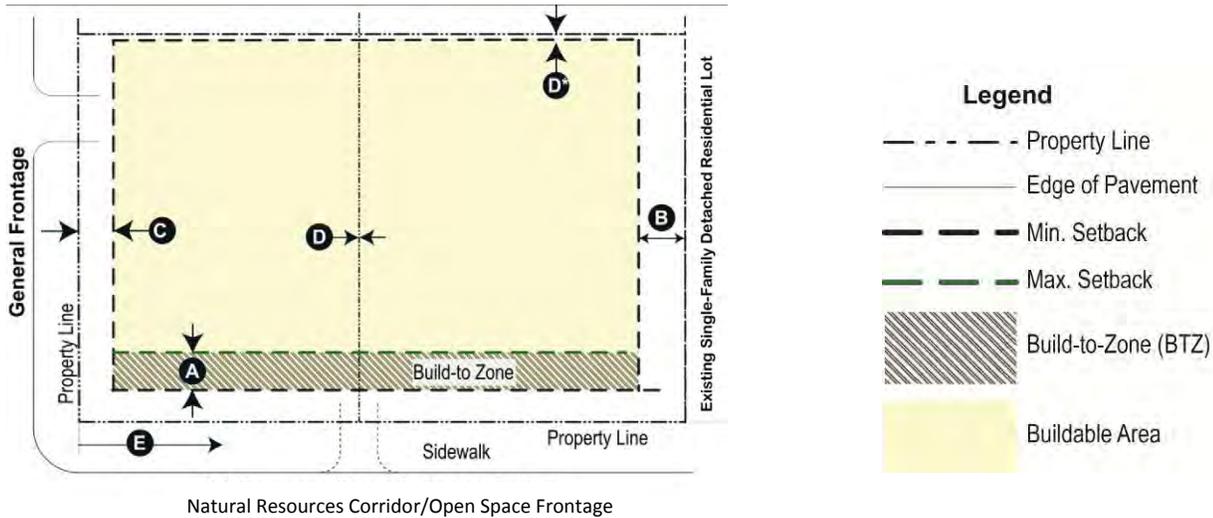
**6.8 Neighborhood (NR) Zone**

(a) Illustrations and Intent

The Neighborhood Zoning District provides for a range of attached and detached single-family residential uses.



**(b) Building Placement**



**(i) Build-to Zones (BTZs) and Setbacks**

Natural Resources Corridor/Open Space Frontage (BTZ)	10' min. setback – no max. setback	<b>A</b>
General Frontage	10' min. setback; no max. setback	<b>C</b>
Side – Adjacent to SF-detached residential lot	5' min. setback; no max. setback	<b>B</b>
Side – All other adjacencies	0' min. setback; no max. setback	<b>D</b>
Rear – Adjacent to SF-detached residential lot	10' min. setback; no max. setback	<b>D*</b>
Rear – All other adjacencies	0' min. setback; no max. setback	

**(ii) Building Frontage (Percentage of building façade built within the BTZ)**

Pedestrian-Friendly Frontage	50% min.	<b>E</b>
General Frontage	None Required	

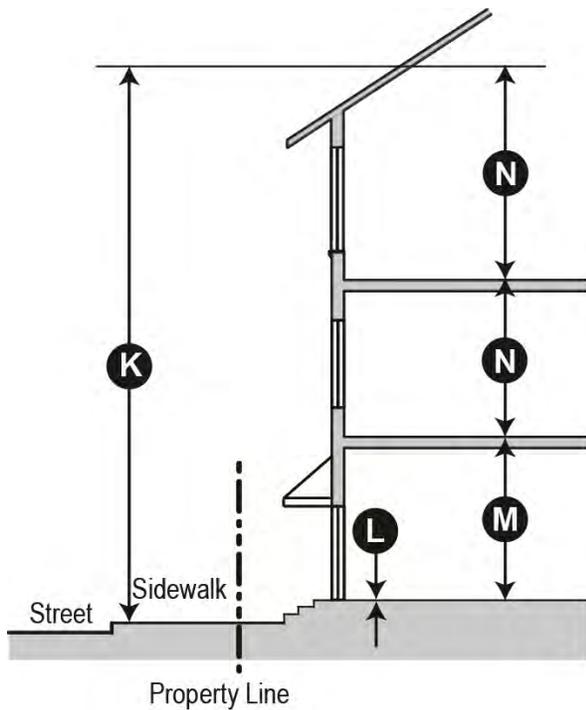
**(iii) Gross Density**

Neighborhood Sub-District 1 (NR-1)	Maximum density of 2.5 dwelling units/acre
Neighborhood Sub-District 2 (NR-2)	Minimum density of 2.5 dwelling units/acre Maximum density of 4 dwelling units/acre
Neighborhood Sub-District 3 (NR-3)	Minimum density of 4 dwelling units/acre Maximum density of 6.75 dwelling units/acre
Neighborhood Sub-District 4 (NR-4)	Minimum density of 4 dwelling units/acre Maximum density of 8 dwelling units/acre

**(c) Lot Standards**

Lot Width	<ul style="list-style-type: none"> <li>▪ Min. 20' for single-family attached/duplex/townhome buildings</li> <li>▪ Min. 40' for single-family detached buildings</li> <li>▪ Min. 50' for front-loaded or J-swing units. See Section 6.1 (c) iii 9. For driveway and garage size requirements</li> <li>▪ Less than 50' wide lots shall be alley-loaded lots.</li> </ul>
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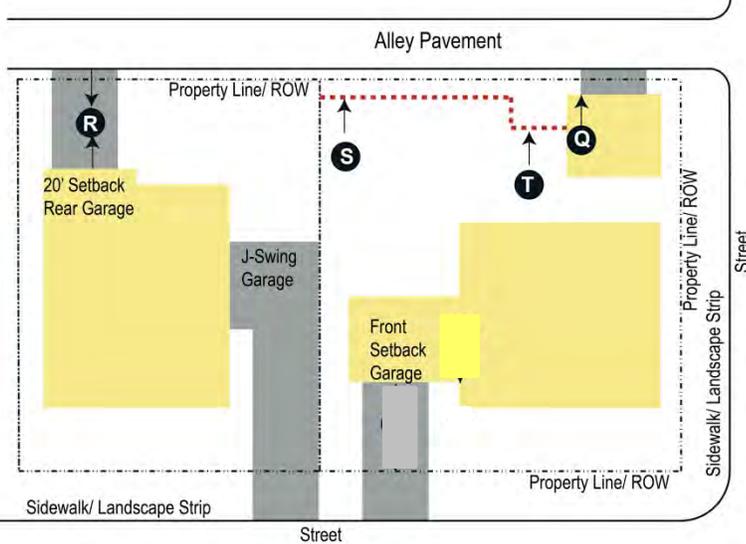
**(d) Building Height**



<b>(i) Principal Building Standards</b>		
Building maximum	▪ 35' max.	<b>K</b>
First floor to floor height (fin. floor to fin. floor)	▪ 8' min for single-family uses (all frontages) ▪ 9' min. for all other uses (all frontages)	<b>M</b>
Ground floor finish level	▪ 18" min. above sidewalk for ground floor residential uses along Pedestrian-Friendly Frontages that are also setback less than 10' from the front property line ▪ ADA Code applies on buildings with public access	<b>L</b>
Upper floor(s) height (fin. floor to fin. floor)	▪ 8' min.	<b>N</b>
<b>(ii) Accessory Building Standards</b>		
Building Height	15' maximum	
BTZ/Setbacks	Shall be placed behind the front façade of the principal building along all frontages.	
Building Footprint	Shall be limited to no more than 50% of the principal building footprint or 728 square feet, whichever is less.	

**(e) Parking & Service Access**

**i. Residential Parking Setbacks**



Standards for **S** and **T** in the illustrations above are referenced in standards for Driveways and Service Access section 6.1(c) iii.

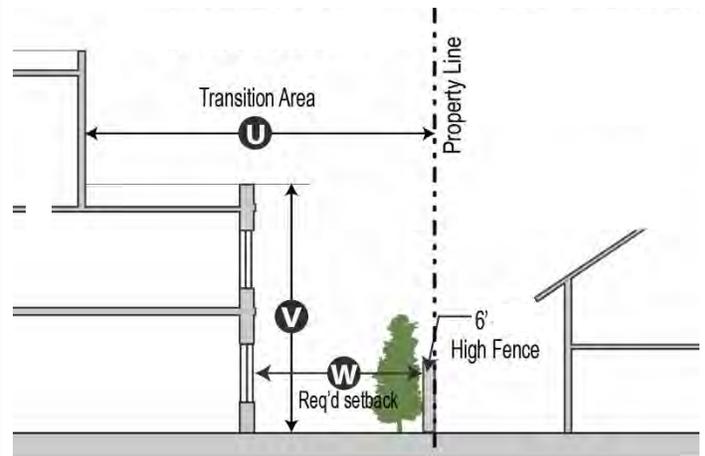
Natural Resources Corridor Frontage	<ul style="list-style-type: none"> <li>Shall be located behind the principal building along that street frontage</li> </ul>	<b>R</b>
General Frontage	<ul style="list-style-type: none"> <li>See Section 6.1 (c)(iii)(9)(d) for residential parking standards.</li> </ul>	<b>Q</b>
Side / Rear	<ul style="list-style-type: none"> <li>4' min; no parking permitted on driveway, OR</li> <li>20' min; parking permitted on driveway</li> </ul>	<b>R</b>
Alley Fence	<ul style="list-style-type: none"> <li>4' min from edge of typical pavement or</li> <li>8' min from edge of typical paving where above ground franchise equipment exists</li> </ul>	<b>S</b> <b>T</b>

**(f) Residential Transition Standards**

The following transition standards shall apply to all new multi-family, mixed-use and non-residential building construction and all upper story additions to existing buildings located adjacent to existing single-family detached lot(s). This requirement shall NOT apply if an alley or other similar right-of-way separates the subject lot and the existing single-family detached residential lot(s).

i. Transition Area	20' min.	<b>U</b>
ii. Max. Building Height within Transition Area	2 stories or 25'	<b>V</b>
iii. Required setback	Min. 10'	<b>W</b>

A Residential Transition Area fence (6 feet high) shall be required when adjacent to an existing single-family detached residential lot and shall be optional for all other adjacencies. The required fence shall NOT be chain link or vinyl. A 6-foot wide landscape buffer with evergreen shrubs planted at 3' on center and 6' min. in height at maturity shall also be required to be planted within the landscape buffer parallel to the SF-residential lot line. (see surface parking setbacks illustration)



## 7.0 Building Design Standards

### 7.1 Purpose and Intent

The Building Design Standards for the TRC shall establish a coherent character and encourage enduring and attractive development. Site and/or building plans shall be reviewed by the JDA for compliance with the standards below (see Table 7-1 for more detail).

The key design principles establish essential goals for the redevelopment within the Plan Area to be consistent with the vision for a vibrant mixed-use development with a range of commercial, employment and residential uses serving the neighborhoods and the region. Buildings shall be located and designed so that they provide visual interest and create enjoyable, human-scaled spaces. The key design principles include:

- (a) New and redeveloped buildings and sites shall utilize building and site elements and details to achieve a pedestrian-oriented public realm with glazing, shading and shelter;
- (b) Design compatibility is not meant to be achieved through uniformity, but through the use of variations in building elements to achieve individual building identity;
- (c) Building facades shall include appropriate architectural details and ornament to create variety and interest;
- (d) Open space(s) shall be incorporated to provide usable public areas integral to the environment; and
- (e) Increase the quality, adaptability, energy efficiency, sustainability, and resilience in Arden Hills' building stock.

**Table 7-1: Review Process for Building Design Standards**

Applicable Subsection	7.2 Building Orientation & Entrances	7.3 Façade Composition	7.4 Building Materials	7.5 Shading Requirements	7.6 Gateway Overlay District	7.7 Design of Auto-Oriented Site Elements	7.8 Design of Parking Structures
Site Plan Review	●		●		●	●	●
Building Permit Review	●	●	●	●		●	●

### 7.2 Building Orientation and Entrances

- (a) Buildings shall be oriented towards Pedestrian Priority Frontages, where the lot has frontage along Pedestrian Priority Frontages. If a building has no frontage along a Pedestrian Priority Frontage, then it shall front a Pedestrian-Friendly Frontage. All other buildings may be oriented towards General Streets or Civic/Open Spaces.
- (b) Primary entrances to buildings shall be located on the street along which the building is oriented (See Figure 7-1). At intersections, corner buildings may have their primary entrances oriented at an angle to the intersection. Building entrances shall be provided for all separate ground floor commercial use tenant spaces that are located along a Pedestrian Priority or Pedestrian-Friendly frontage.

- (c) All primary entrances shall be oriented to the public sidewalk for ease of pedestrian access and entrances may be placed on the corner of the building in order to serve both the sidewalk and the parking lot. Secondary and service entrances may be oriented to parking areas or alleys.
- (d) Primary Entrance Design: Primary building entrances along Pedestrian Priority Frontages and Pedestrian-Friendly Frontages shall consist of at least two (2) of following design elements so that the main entrance is architecturally prominent and clearly visible from that street (see Figures 7-2):
  - i. Architectural details such as arches, friezes, awnings, canopies, arcades, tile work, murals, or moldings; or
  - ii. Integral planters or wing walls that incorporate landscape or seating elements; or
  - iii. Prominent three-dimensional, vertical features such as belfries, chimneys, clock towers, domes, spires, steeples, towers, or turrets.

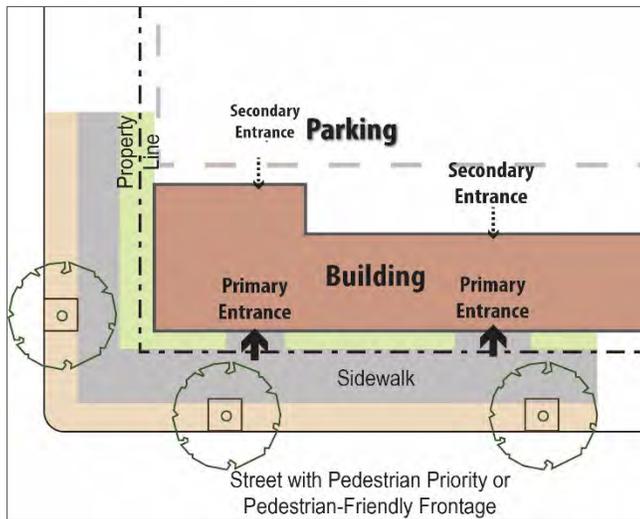


Figure 7-1 Figure showing required building orientation and location of primary entrances





Figures 7-2 Examples of Primary Entrance Designs

### 7.3 Façade Composition

(a) Commercial Use, Mixed-Use and Large and Medium Multi-Family Buildings:

(i) Facades greater than sixty feet (60') in length along all Pedestrian Priority Frontage, Pedestrian-Friendly Frontages and Civic/Open Spaces shall meet the following façade articulation standards:

1. Include facade modulation such that a portion of the facade steps back or extends forward with a depth of at least twenty-four inches (24") (see Figure 7-3).
2. The distance from the inside edge of a building projection to the nearest inside edge of an adjacent projection shall not be less than twenty feet (20') and not greater than sixty feet (60') (see Figure 7-3).

(ii) All other facades shall be articulated by at least one discernable architectural element every twenty feet (20'). Such architectural elements include, but are not limited to:

1. Changes in material, color, and/or texture either horizontally or vertically at intervals not less than twenty feet (20') and not more than sixty feet (60') (see Figure 7-3); or
2. The construction of building entrances, bay windows, display windows, storefronts, arcades, façade relief, panels, balconies, cornices, bases, pilasters, or columns (see Figures 7-4).

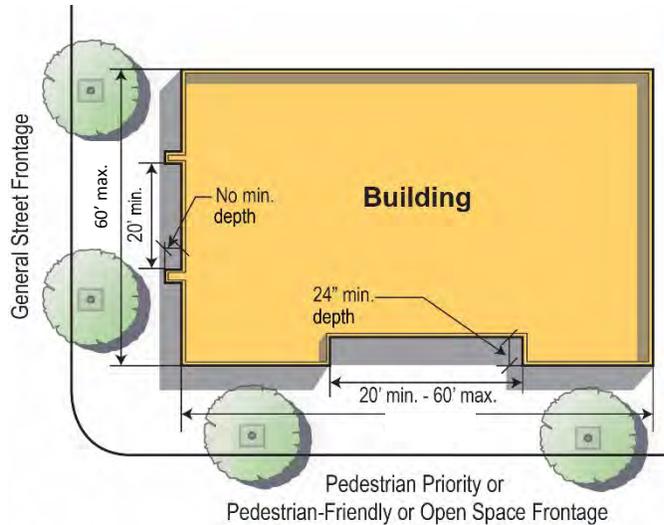


Figure 7-3 Illustration showing building articulation requirement



Figures 7-4 Images showing examples of appropriate building articulation

(iii) Façade Transparency Required:

1. All façades shall meet the minimum requirement for façade transparency (percentage of doors and windows) as established in Table 7-2 below.
2. In order to reduce building heat loss, a maximum of forty percent (40%) transparency coverage is recommended for the upper floors of northern facing façades.

**Table 7-2 Required Minimum Façade Transparency by Façade Frontage Type**

Façade Frontage Type →	Pedestrian Priority or Pedestrian-Friendly Frontage	General Frontage	All other façades
<b>Commercial Use or Mixed-Use Buildings</b>			
Ground Floor	50% (min.)	None	None
Upper Floor(s)	25% (min)	None	None
<b>Residential Use Buildings</b>			
Ground Floor	25% (min.)	None	None
Upper Floor(s)	20% (min.)	None	None



Images showing appropriate transparency required along Pedestrian Priority and Pedestrian-Friendly Frontages

(b) Single-Family and Small Multi-Family Use Buildings

(i) At least one (1) of the following shall be added along single-family building facades to add pedestrian interest along the street:

- porches,
- stoops,
- eaves, or
- balconies

(ii) Attached townhome facades shall have variation in architectural features and paint/siding between adjacent units. Variations of architectural features may include one of the following:

- porches,
- stoops,
- eaves,
- windows or doorway treatments or framing, or
- other architectural features acceptable as variation by community development staff.

(iii) Windows and Doors:

1. All building facades single family use buildings shall meet the transparency requirements established in Table 7-2
2. All residential garage doors shall be double clad solid core garage doors.

(iv) The decking of front porches shall be constructed of one of the following materials:

1. Grade #2 or better cedar
2. Composite
3. Concrete

(v) In a detached single-family development, along each block face a minimum of five (5) façade designs or styles shall be required. No home shall have the same design, style, or paint/siding as the homes immediately adjacent or across the street. The following design standards shall be met:

1. Variation to façade and roof designs or styles shall be required through changes to size and location of windows, doorways, or changes in eave lines and massing.

2. In an effort to decrease monotony of design, changing the paint color or material type will not be considered a different design or style.
- (vi) Single Family and Small Multi-Family buildings shall not have more than three materials used on the exterior of the structure. Of the three materials a primary material shall be used for a minimum of sixty percent (60%) of facades facing a public street. Primary materials shall be one of the following:
1. Masonry (individual brick, stone, cast stone, or other durable masonry material; any masonry product shall be mortared in place)
  2. Cementitious fiber
  3. Engineered wood
  4. Wood, or
- (vii) Secondary materials may be used up to forty percent (40%) of facades facing a public street. Secondary materials shall be one of the following:
1. A primary building material, or
  2. Architectural metal with matte finish, or
  3. Stucco utilizing a 3-step process of application.
- (c) A recommended palette for exterior building colors is included in Attachment 6. Fluorescent colors are prohibited. The colors of roofs, trim and siding, and accents shall work together to create a unified whole.
- (i) Accent colors shall be used on no more than ten percent (10%) of any façade. No large expanses such as panels shall be painted in accent colors.
- (ii) A darker value than façade colors is recommended for roofing materials. White roofs are prohibited on pitched roof buildings.
- (d) Best practices for bird safety are recommended as described in Attachment 7.



*Residential buildings with porches, fencing, balconies and stoops to add interest along the street.*

#### **7.4 Non-Residential, Mixed-Use, and Large and Medium Multi-Family Residential Building Materials**

- (a) On Pedestrian Priority and Pedestrian Friendly Frontages, primary building structures shall have a minimum of sixty percent (60%) of the following primary building materials:
  - (i) Masonry (individual brick, stone, cast stone, etc. that is mortared in place)
- (b) On General Frontages, primary building structures shall have a minimum of forty percent (40%) of the following primary building materials:
  - (i) Masonry (individual brick, stone, cast stone, etc. that is mortared in place)
- (c) Secondary materials shall only be used for up to forty percent (40%) of the primary building façade for Pedestrian Priority and Pedestrian Friendly frontages. On General Frontages, secondary materials may be used for up to sixty percent (60%) of the primary building façade.
  - (i) Secondary materials include:
    1. Architectural metal with matte finish
    2. Cementitious fiber
    3. Exterior Insulation Finish System (EIFS), on all frontages shall not be used on the ground floor level. Use of EIFS is limited to ten percent (10%) per total façade area.
    4. Stucco utilizing a 3-step process of application.
    5. Engineered wood
- (d) Accessory buildings shall maintain the same building materials as the primary building.
- (e) For tilt-up wall construction, a veneer system of materials shall be used to come into conformance with the above listed materials.
- (f) Canvas awnings are not permitted.

#### **7.5 Shading Requirement:** Shading of public and publicly accessible sidewalks, especially sidewalks located along Pedestrian Priority and Pedestrian-Friendly frontages shall be important to implementing the vision for walkable mixed-use in the Plan Area. Shading may be achieved through any combination of canopies, awnings, street trees and other similar devices. To this end, the following standards shall apply (see Figure 7-5):

- (a) Shaded sidewalks shall be provided alongside at least:
  - (i) Fifty percent (50%) of all building facades with Pedestrian Priority Frontage designation per the Regulating Plan (Attachment 1).
  - (ii) Fifty percent (50%) of all building facades with frontage along an off-street surface parking lot
- (b) When adjacent to a surface parking lot, the shaded sidewalk shall be raised above the level of the parking lot by way of a defined edge, such as a curb. ADA ramps along the building must also be shaded.
- (c) A shaded sidewalk must meet the following requirements:
  - (i) Along a street, a shaded sidewalk shall comply with the applicable sidewalk standards for its designated street type. If not otherwise required, the shaded sidewalk shall provide trees planted no more than fifty feet (50') on center.

- (ii) Along any surface parking adjacent to the building (both off-street or on street), the shaded sidewalk shall consist of a minimum five foot (5') clear zone and five foot (5') planting zone, planted with trees no more than fifty feet (50') on center, or a five foot (5') clear zone with a minimum five foot (5') wide over-head weather protection.
- (iii) Building entrances along Pedestrian Priority and Pedestrian-Friendly frontages shall be located under a shade device, such as an awning or portico.



Figure 7-5 Images showing examples of shading along sidewalks

**7.6 Gateway Overlay District:** Given the visual importance of certain entrances and gateways to the site, advanced architectural elements or landscaping features are required to be provided for properties within the Gateway Overlay District as identified on the Regulating Plan (Attachment 1).

- (a) Properties within the Town Center, Retail Mixed-Use, or Office Mixed-Use Districts shall meet the following standards for the Gateway Overlay District:
  - (i) Corner buildings located at a street intersection must incorporate a distinctive architectural feature as part of the building, such as a tower, cupola, turret, or rotunda (see Section 6.1(b)(ii) for specifications and restrictions).
  - (ii) Principal building structures shall have a minimum of seventy-five percent (75%) of the required primary building materials listed in Section 7.4(a)(i).
  - (iii) Commercial developments greater than ten (10) acres in size shall provide a prominent gateway monument at the entrance to the development with integrated landscaping.
- (b) Properties within the Flex Office or Neighborhood Districts shall meet the following standards for the Gateway Overlay District:
  - (i) A landscaped buffer with a minimum width of twenty feet (20') shall be provided along all frontages on public streets.
  - (ii) Landscaped buffers shall include a diversity of landscaping materials, including shade, evergreen, and/or ornamental trees, shrubs, and annual and perennial plants. Landscaping shall be a minimum of fifty percent (50%) opaque at maturity.

## 7.7 Design of Automobile Related Building and Site Elements

- (a) Where permitted under Section 5 of this Code, drive-through lanes, auto service bays, and gas station canopies for commercial uses shall not be located with frontage along any Pedestrian Priority Frontage. Drive-through lanes may be permitted along Pedestrian-Friendly or Spine Road frontages only if the property has no General or Alley frontage. Drive-through lanes, auto service bays, and gas station canopies shall be hidden behind a three foot (3') high Street Screen along both Pedestrian-Friendly and General frontages (see illustrations below). The Street Screen shall be made up of (i) a living screen or (ii) a combination living and primary building material screen (See Section 10.4 for details).
- (b) No more than sixty percent (60%) of a lot's frontage along a Pedestrian-Friendly or Spine Road frontage may be dedicated to drive through lanes, canopies, service bays, and other auto-related site elements. There shall be no such limitation along General or Alley frontages and along highway frontage roads.

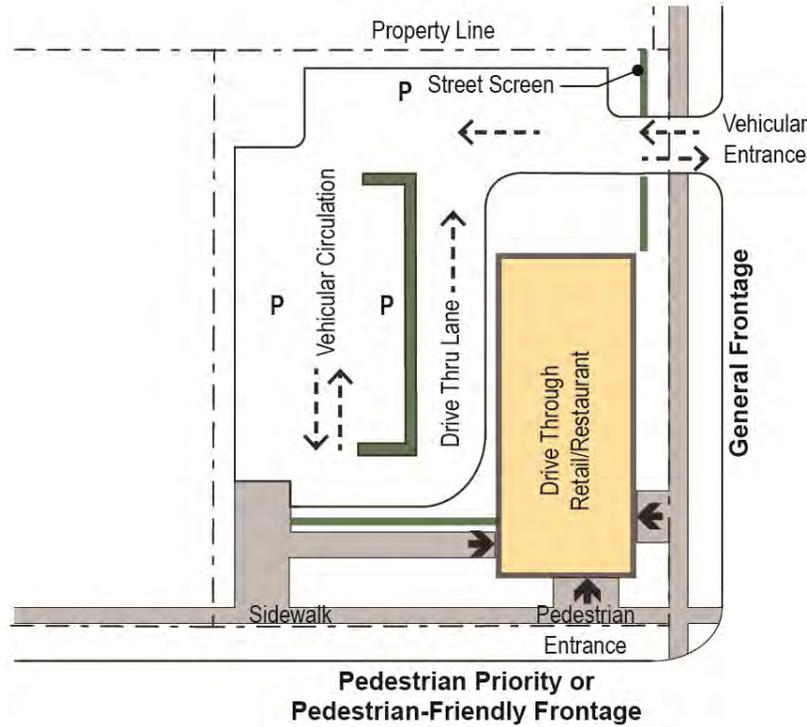
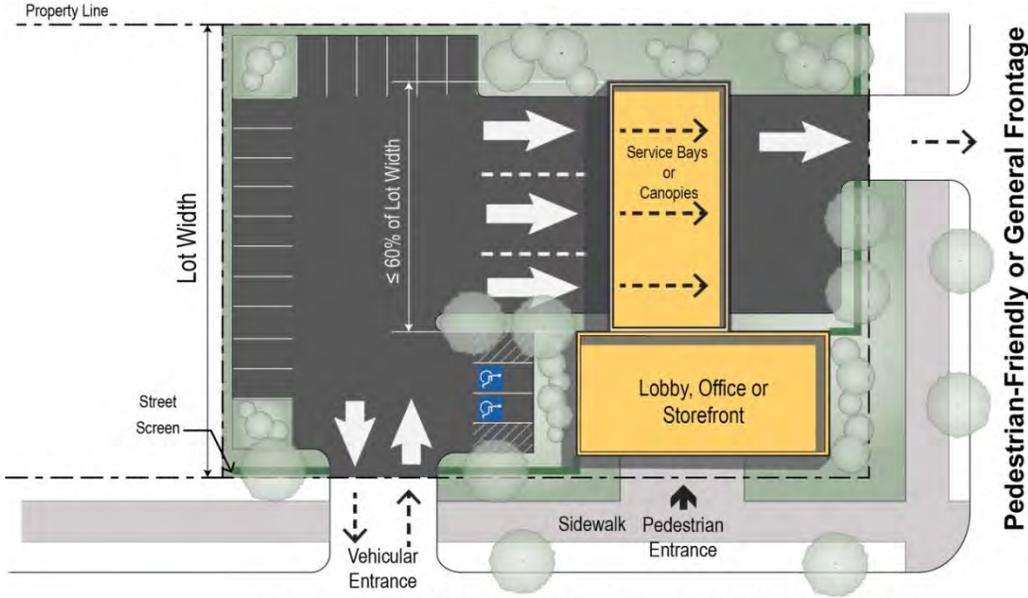


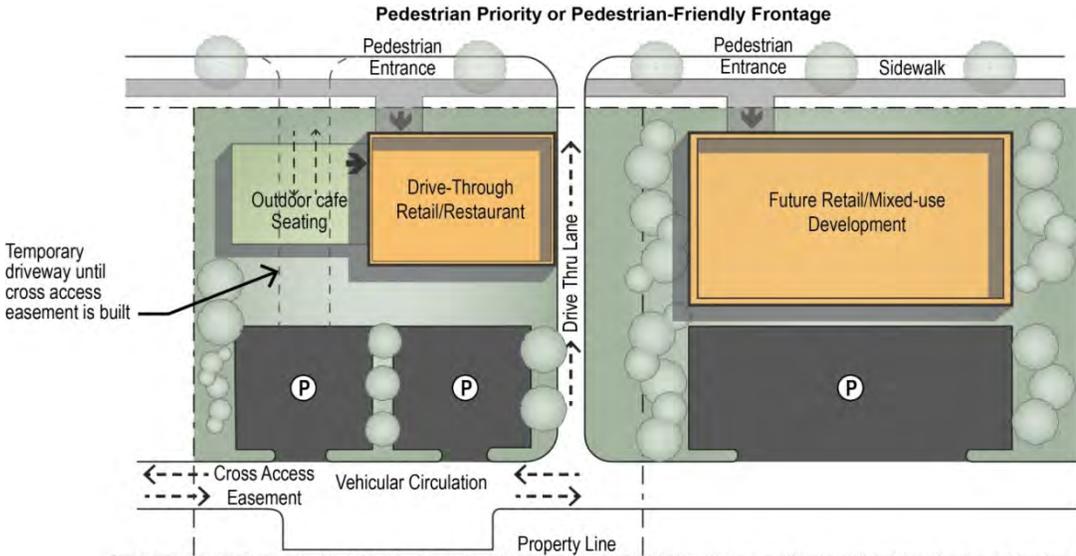
Image illustrating the appropriate design of retail/restaurant drive-throughs (Corner Lot)



**Pedestrian Priority or Pedestrian-Friendly Frontage**

*Image illustrating the appropriate design of auto-related site elements (Gas stations, auto-service uses, and bank drive-throughs)*

- (c) Any automobile related retail sales or service use of a site or property with Pedestrian Priority, Pedestrian-Friendly, or Spine Road frontage designation shall have a primary building entrance along its Pedestrian Priority Frontage. A primary building entrance may be along a building's Pedestrian-Friendly or Spine Road Frontage only if the site has no Pedestrian Priority frontage designation.
- (d) Drive through access (driveways only) may be from a Pedestrian Priority Frontage only if the lot has no access to any Pedestrian Friendly or General Frontage. Drive through access may be from a Pedestrian-Friendly or Spine Road Frontage only if the lot has no access to any General Frontage. In cases where drive through access is provided from a Pedestrian Priority Frontage, a joint access easement shall be required to adjoining properties providing alternative access to a Pedestrian-Friendly or General Frontage.

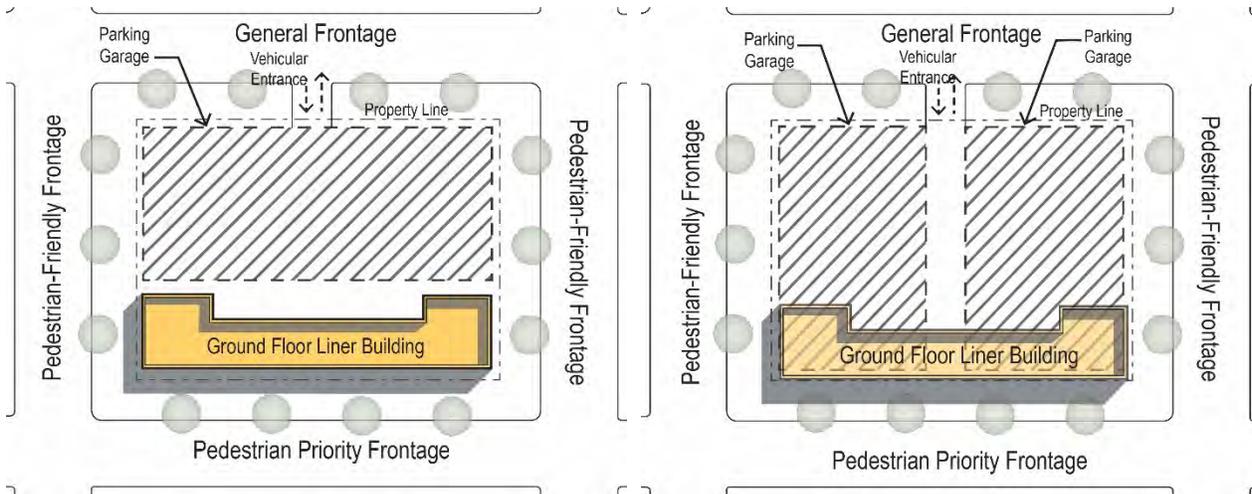


*Image illustrating the appropriate design of retail/restaurant drive throughs (Interior Lot)*

- (e) All off-street loading, unloading, and trash pick-up areas shall be located along alleys or General Frontages only unless permitted in the specific building form and development standards in Section 6 of this Code. If a site has no General Frontage or Alley access, off-street loading, unloading, and trash pick-up areas may be permitted along a Pedestrian-Friendly or Spine Road Frontage.
- (f) All off-street loading, unloading, or trash pick-up areas shall be screened using a Street Screen that is at least as tall as the trash containers and/or service equipment. The Street Screen shall be made up of (i) a living screen or (ii) a combination living and primary building material screen.

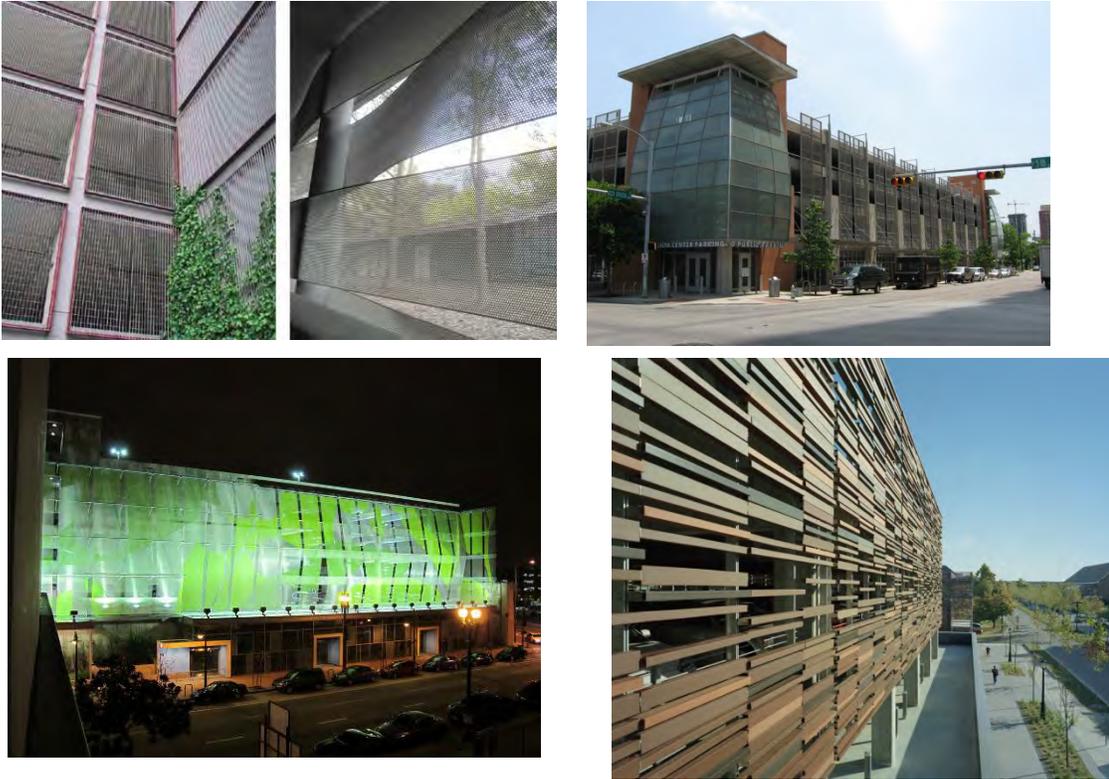
### 7.8 Design of Parking Structures

- (a) All ground floors of parking structures located on Pedestrian Priority frontages shall be constructed in order to accommodate ground floor retail/commercial uses to a minimum depth of twenty-four feet (24').
- (b) To the extent possible, the amount of Pedestrian Priority frontage devoted to a parking structure shall be minimized by placing the shortest dimension(s) of the parking structure along the Pedestrian Priority frontage edge(s) (see Figures 7-8 for illustrations below).



Figures 7-8 Allowed Parking Garage Configurations

- (c) Where above ground structured parking is located at the perimeter of a building with Pedestrian Priority Frontage, it shall be screened in such a way that cars on all parking levels are completely screened from view (see Figures 7-9 for illustrative images). Architectural screens shall be used to articulate the façade, hide parked vehicles, and shield lighting. Ramps within parking garages shall not be visible from any Pedestrian Priority Frontages. Ramps shall not be located along the exterior perimeter of the parking structure.



*Figures 7-9 Illustrative Examples of Parking Garage Screening*

- (d) Ground floor façade treatment (building materials, windows, and architectural detailing) shall be continued to the second floor of a parking structure along all Pedestrian Priority Frontages (see Figures 7-10).



*Figures 7-10 Images showing required façade treatment of parking garages along Pedestrian Priority Frontages*

- (e) When parking structures are located at street intersections, corner emphasizing elements (such as towers, pedestrian entrances, signage, glazing, etc.) shall be incorporated.
- (f) Parking structures and adjacent sidewalks shall be designed so pedestrians and bicyclists are clearly visible (through sight distance clearance, signage, and other warning signs) to entering and exiting automobiles.

## 8.0 Street Design Standards

- 8.1 Purpose and Intent:** The Master Plan Vision for the TRC recognizes the importance of providing adequate public infrastructure, which includes an ultimate Street Network that maximizes connectivity, and other needed infrastructure to serve the vision for redevelopment within the Plan Area.

Street design and connectivity is envisioned to support and balance automobile, bicycle, and walking trips in addition to becoming the “living” space for development. The “living” nature of streets will not only serve private redevelopment, but the community at large and the people who live in and use it. This section establishes context sensitive standards for Street Design and Connectivity.

- 8.2 Street Designation Categories:** In order to service multiple modes of transportation within an appropriate redevelopment context, streets within the TRC are designated under two (2) major categories:

- (a) **Street Classification:** The Street Classification designation establishes standards for the actual cross-section of the street itself. The Street Classification includes information on automobile, bicycle, pedestrian, and parking accommodation. It typically addresses the space allocation within the public right-of-way and its emphasis towards different modes of transportation. The TCAAP Street Type Plan (Attachment 5) identifies the Street Classification designations within the Plan Area and Attachment 4 provides cross sections for the different Street Classifications.
- (b) **Street Network:** In addition to Street Classification designations, streets in plan are identified as Required streets to implement the ultimate street network in the Master Plan Vision. The TCAAP Street Type Plan (Attachment 5) illustrates the Street Network within the TRC.
  - 1. Required Streets – these are mainly existing, improved or new streets that are needed to implement the ultimate street network envisioned in the Vision for the TRC. They shall be mandatory at the time of redevelopment including the requirement to dedicate right-of-way as identified in the Regulating Plan. The alignment of new Required Streets may be modified per Permitted Adjustments in Section 3.3 of this Code.

- 8.3 Project Circulation Plan:** A Project Circulation Plan must be submitted with a site plan or subdivision application (whichever comes first) for an area of four (4) acres or larger that is subject to the requirements of this section. The Project Circulation Plan shall be developed and reviewed for its consistency with this section and the Regulating Plan, which illustrates proposed locations for new and improved streets within the Plan Area. Required streets on the Regulating Plan shall be mandatory and their alignments may be adjusted per Section 3.3 Permitted Adjustments.

- (a) A Project Circulation Plan must demonstrate:
  - 1. How the proposed circulation meets the intent of the Master Plan Vision for redevelopment of TCAAP;
  - 2. How the on-site circulation system integrates with existing and planned streets, bicycle and pedestrian facilities, and trails in the surrounding area;
  - 3. How new street alignments conform with the Regulating Plan or how modifications from the Regulating Plan, in terms of street placement, alignment, and design are consistent with the intent of this Code;
  - 4. How new street design conforms with the street cross section standards in Attachment 4;

5. How the plan considers all modes of transportation including walking, biking, and automobiles; and
  6. How the plan provides adequate linkages between different destinations within the Plan Area.
- (b) For a subdivision, a private restrictive covenant depicting the Project Circulation Plan shall be recorded and referenced on the plat. The covenant may be amended if the JDA approves a revision to the Project Circulation Plan as authorized under this section.
- (c) **Approvals:** A Project Circulation Plan may only be approved by the JDA.
1. The Project Circulation Plan shall create interconnected blocks bounded by streets to the extent feasible. The JDA may approve a Project Circulation Plan containing blocks bounded by Highway right-of-way, subdivision boundary lines, or natural and infrastructure features if no reasonable alternatives are available.
  2. When required, revisions to the Project Circulation Plan may be approved by the JDA after considering the circulation characteristics of a proposed development plan, the need for access to adjoining properties, phasing of a larger-scaled project, and the context of surrounding development.
  3. The JDA, with the recommendation of the Arden Hills Public Works and Community Development Departments, may waive the requirement for a Project Circulation Plan through the Permitted Adjustment process. This is permitted if the JDA finds that a plan is not necessary due to the nature of the proposed development on the site, the existence of surrounding incompatible development, or other factors unique to the property which make strict compliance unfeasible.
  4. A subdivision or site plan may not be approved if the Project Circulation Plan is not approved.
  5. **Joint Access and Public Cross-Access Easements:** If necessary to ensure access management goals along the Spine Road and to meet the intent of the recommended alley/public cross-access easements as indicated on the Regulating Plan, the JDA may require joint use driveways or public cross-access easements within the site to adjacent properties and/or easements.
- 8.4 Street Standards:** Attachment 4 shall establish standards for all elements within the public right-of-way including travel lane(s), on-street parking, bicycle accommodation, streetscape/parkway standards, and sidewalk standards. The process and standards in the Arden Hills Public Works Design Manual shall apply to the extent that they do not conflict with the design and context standards in Attachment 4 and the Master Plan Vision for streets in TCAAP. Landscaping within the public right-of-way shall be per standards in Section 10 in the TRC. Attachment 4 provides recommended cross sections for public streets within the TRC based on available right-of-way and intended development context per the Master Plan Vision.

## 9.0 Open Space Standards

**9.1 Open Space Approach:** The Master Plan Vision for TCAAP recognizes the importance of providing a network of open spaces with a multitude of passive and active recreational opportunities. These opportunities are to be accommodated in a variety of spaces ranging from large scale open spaces to small scale pocket parks located within the Plan Area. The open space network will be serviced by an interconnected network of trails and paths for pedestrians and bicyclists alike, providing desired amenities for future residents and visitors alike.

The approach to Open Space facilitates the implementation of the Master Plan Vision for the TRC. This vision for redevelopment is based on the City of Arden Hills' goal to create a comprehensive, maintained and interconnected system of parks, pathways and open spaces, as well as a balanced program of recreational activities for residents of all ages, incomes and abilities. The Open Space approach recognizes that the development context, with varying density and building types, is required to ensure quality open spaces that serve both recreational and placemaking goals of the Master Plan.

**9.2 Required Open Space Designations:** This section establishes standards for Open Space within the TRC. The TRC Regulating Plan (Attachment 1) designates areas for required Open Spaces within the TRC. The detailed Open Space Standards for each type are included in Attachment 2. These standards include general character, design, typical size, frontage requirements, and typical uses.

(a) Required Open Spaces are the areas shown on the Regulating Plan with specific locations of future Open Spaces (including parks, plazas, greens, and squares). These spaces have been identified on the Regulating Plan due to the certainty of their location within the context of the overall Plan Area. Such required spaces shall be publicly accessible open spaces. The specific location of parks, particularly in the Hill and Creek neighborhoods, are likely to change based on developer input, but will need to include the amenities identified in the TCAAP Master Parks Plan.

**9.3 Water Infrastructure Designation:** The Natural Resources Corridor within the TCAAP Site Redevelopment will be designed with the goal of maximizing compatibility and functionality of regional storm water, wetland mitigation, the Rice Creek re-meander, floodplain restoration, and groundwater requirements. An additional goal is to provide visual and active and passive recreational features to support adjacent land uses. The Natural Resources Corridor is intended to be an amenity to the site's uses and users.

**9.4 Permeable Area Requirement:**

(a) All development is required to maintain a permeable ground area per Table 9-1. In limited areas, the JDA may grant flexibility on these requirements in accordance with MPCA guidelines.

**Table 9-1 Permeable Area Requirements**

<i>District</i>	<i>Min Pervious Lot Area</i>
Neighborhood	40%
TC, Retail, Office, Civic	10%
Flex Office, CC	25%

(b) Permeable ground area shall be on-site within the parcel limits of the development.

(c) Up to 100% of Private Common Open Space may count towards the permeable ground area requirements if the materials and ground cover for the Private Common Open Space meets the standards of permeability.

- (d) Street screening for parking lots that utilize vegetative screening may count towards the permeable ground area requirements.
- (e) Permeable materials include:
  - i. Any natural vegetation or landscaping that allows direct water infiltration
  - ii. Permeable paving materials designed and engineered to allow direct water infiltration. Any new material not listed in any best practice guides for permeable paving will be evaluated and considered by Community Development Staff and may be approved by the JDA. Permeable paving materials shall not count towards more than twenty percent (20%) of the total permeable area requirements.
  - iii. Any material that requires a sheet flow and collection system for water infiltration shall not be considered permeable cover.
- (f) Design and placement:
  - i. In Town Center, Civic, Retail Mixed-Use and Office Mixed-Use Zones, permeable area that is adjacent to or visible from the public right-of-way shall be designed in context with the public realm and not interrupt the walkable form of the public realm. An interruption may be considered any design that blocks pedestrian walkability and clear zones, blocks views of entryways and windows, or blocks access to any ingress/egress of a building.
  - ii. In the Neighborhood, Flex Office or Campus Commercial Zones, any yard or buffer space on site shall be designed in context with the primary building(s) and shall not block views or ingress/egress access to the buildings.

**9.5 Open Space Classification:** For the purposes of this Code, all open space shall fall into one of the following three major classes:

- (a) **Public Open Space:** Open air or unenclosed to semi-unenclosed areas intended for public access and use and located per the Regulating Plan (Attachment 1). These areas range in size and development and serve to compliment and connect surrounding land uses and Code requirements.
- (b) **Private Common Open Space:** A privately owned outdoor or unenclosed area, located on the ground or on a terrace, deck, porch, or roof, designed and accessible for outdoor gathering, recreation, and/or landscaping and intended for use by the residents, employees, and/or visitors to the development. This may or may not be accessible to the public, but shall be maintained privately.
- (c) **Private Personal Open Space:** A privately owned outdoor or unenclosed area, located on the ground or on a balcony, deck, porch, or terrace and intended solely for use by the individual residents of a condominium or multi-family dwelling unit.

**9.6 Open Space Requirements**

- (a) All non-residential development shall provide four (4.0) sq.ft. of Private Common Open Space for every 100 sq. ft. of non-residential building space or fraction thereof. This standard shall only apply to site plans two (2) acres in size or larger.
- (b) All residential development of five (5) attached dwelling units or more, on a single parcel, shall meet the Private Common Open Space standards established in this Section. Table 9-2 establishes the Private Common Open Space requirement based on the proposed intensity of residential development.

**Table 9-2 Private Common Open Space Requirements**

<b>Residential Density (dwelling units per acre)</b>	<b>Private Common Open Space Standard Proposed (area of private common space per dwelling unit)</b>
0 – 4 DU / acre	Not required
5 – 19 DU / acre	Provide minimum of 160 sf per dwelling unit
20 – 29 DU / acre	Provide minimum of 120 sf per dwelling unit
30 DU / acre or greater	Provide minimum of 80 sf per dwelling unit

- (c) All residential development with seven (7) or more attached units within the TRC shall also meet the Private Personal Open Space standards established in this Section. Table 9-3 establishes the Private Personal Open Space requirement based on the proposed intensity and type of residential development. Nursing Home and Assisted Living residential uses and Live-work units are exempted from Private Personal Open Space requirements.

**Table 9-3 Private Personal Open Space Requirements**

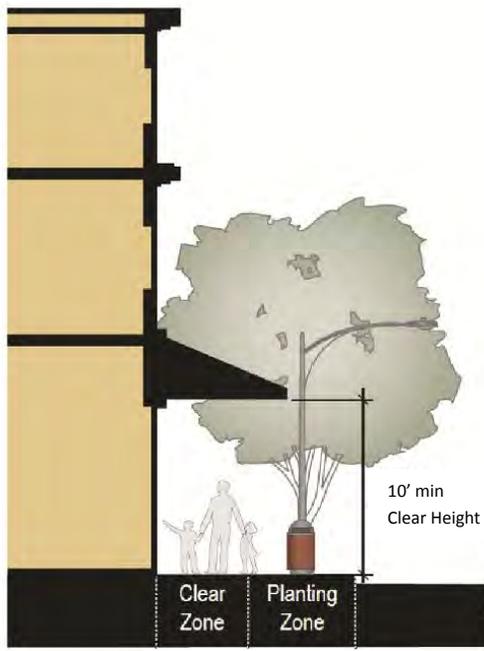
<b>Residential Density (dwellings per acre)</b>	<b>Private Personal Open Space Standard Proposed</b>
7 - 19 DU / acre	Ground floor units located on a Pedestrian Friendly or Pedestrian Priority Frontage: all dwelling units shall have private personal open space including one of the following: Porch, Stoop, Patio, or Deck or combination  Upper floor units: 60% of all dwelling units shall have a balcony.
20 – 29 DU / acre	Ground floor units located on a Pedestrian Friendly or Pedestrian Priority Frontage: all dwelling units shall have one of the following: Porch, Stoop, Patio, or Deck  Upper floor units: 60% of all dwelling units shall have a Balcony.
30 or greater DU / acre	Ground floor dwelling units located on a Pedestrian Friendly or Pedestrian Priority Frontage: All units shall include one of the following: Porch, Stoop, Patio, or Deck  Upper floor dwelling units: 50% of all upper dwelling units shall have a Balcony.

- (d) Attachment 2 shall provide the palette of open space types.

## 10.0 Streetscape and Landscape Standards

**10.1 Sidewalks:** Publicly accessible sidewalks are required for all development under this Code and shall meet the standards of Table 10-1 and shall be based on the Street Classification per Attachment 4. The minimum sidewalk width requirement shall apply regardless of the available right-of-way. If necessary to meet the required sidewalk width, the sidewalk shall extend onto private property to fulfill the minimum requirement, with a permanent public access easement provided. Sidewalks shall consist of two zones: a planting zone located adjacent to the curb, and a clear zone (see Figures 10-1).

- (a) **Planting Zone:** The planting zone is intended for the placement of street trees, if required, and street furniture including seating, street lights, waste receptacles, fire hydrants, traffic signs, newspaper vending boxes, bus shelters, bicycle racks, public utility equipment such as electric transformers and water meters, and similar elements in a manner that does not obstruct pedestrian access or motorist visibility (see Figure 10-1). This zone may be planted with vegetation along the street or paved to match the grade of the clear zone. Landscaping and streetscaping shall follow the City of Arden Hills Street Design Manual for details and process.
- (b) **Clear Zone:** The clear zone shall be hardscaped, shall be located adjacent to the planting zone, shall comply with ADA and Minnesota Accessibility Code and shall be unobstructed by any permanent or nonpermanent element for the required minimum width and a minimum height of ten (10) feet (see Figure 10-1). Accessibility is required to connect sidewalk clear zones on adjacent sites.
- (c) **Fee In-Lieu Option:** An applicant may opt to pay a proportional fee in-lieu for the required sidewalk if the development project is phased or the sidewalk improvements need to match the timing of a programmed City capital project affecting that street frontage.



Figures 10-1 Illustrations delineating the Streetscape Zone elements

**Table 10-1 Required Public and Publicly Accessible Sidewalk Standards**

Street Classification	Spine Road (Various)	Town Street	Collector Road (Various)	Neighborhood (Various)
<b>Standard</b>				
Min. Streetscape Zone width (includes planting zone and clear zone) (feet)	Varies	11' (two-sides)	11' (two-sides)	11' (two-sides) 6' (one-sided sidewalk; planting zone on side without sidewalk)
Min. Planting Zone width (feet)	Varies	6'	6'	6'
Min. Clear Zone (feet)	Varies	5' (within public access easement)	5' (within public access easement)	5' (one-side min.)
Street Trees Required (see Section 10.2 for standards)	Yes	Yes	Yes	Varies

**10.2 Street Trees and Streetscape:**

- (a) Street trees shall be required per Attachment 4 within the Planting/Furnishings Zone.
- (b) Street trees shall be centered within the Planting Zone and be planted a minimum of three feet (3') from the back of curb.
- (c) Spacing shall be an average of forty feet (40') on center (measured per block face) along all Streets as required by Attachment 4.
- (d) Requirements for minimum caliper size and height are included in the Arden Hills Public Works Design Manual. Each tree shall be planted in a planting area no less than thirty-six (36) square feet.
- (e) Preferred street tree species are identified in the Arden Hills Public Works Design Manual. Arrangement of species shall be interspersed in order to prevent wholesale loss of street trees in the case of disease.
- (f) Area between the building facade and property line or edge of existing sidewalk along Pedestrian Priority Frontages shall be such that the sidewalk width shall be a minimum of ten feet (10') (with public access easement if necessary) with the remainder of the setback area paved flush with the public sidewalk. Sidewalk cafes, landscaping within tree-wells or planters may be incorporated within this area. (see Illustration in Section 6.1)
- (g) Placement of trees shall not impede the clear vision area as required in Section 1325.05, Subsection 1 of the AHC.

**10.3 Single-Family Landscaping and Tree Requirements**

- (a) The following table sets the required trees and landscaping requirements for single-family residential uses per lot size:

**Table 10-2 Single-Family Landscaping and Tree Requirements**

Lot Size	Requirement
Less than 40 feet wide	40 percent of permeable area requirement shall be shrubbery or perennial; no on-site trees required.
40 feet wide to 75 feet wide	20 percent of permeable area requirement shall be shrubbery or perennial; 2 trees required on-site.
Over 75 feet wide	10 percent of permeable area requirement shall be shrubbery or perennial; 3 trees required on-site.

## 10.4 Screening Standards

- (a) **Street Screen Required:** Any surface parking lot with frontage along a public right of way shall be defined by a three-foot (3') high Street Screen (see Figure 10-2). Furthermore, along all streets (except alleys), service areas and ground-mounted utility equipment shall be screened in such a manner that the service area shall not be visible to a person standing on the property line on the far side of the adjoining street (see Figure 10-3). Required Street Screens shall be of one of the following:
- The same building material as the principal structure on the lot or
  - A vegetative screen composed of shrubs planted to be a minimum of seventy-five percent (75%) opaque at maturity, or
  - A combination of the two.
- i. Street Screens cannot block any required sight triangles along a cross street or driveway.
- ii. Street Screens may include breaks to provide pedestrian access from any surface parking or service area to the public sidewalk.

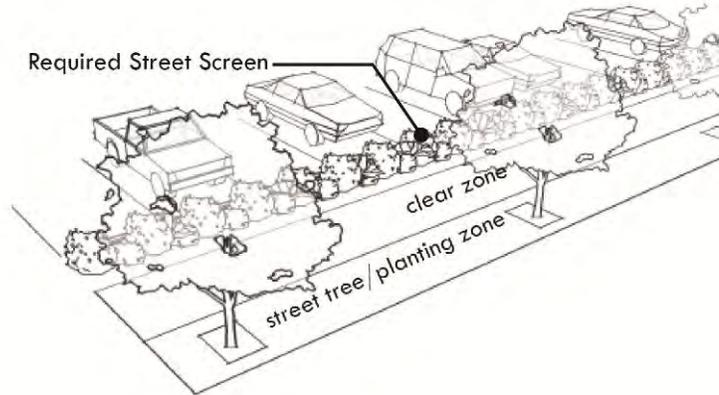


Figure 10-2 Illustration showing required Street Screen along all frontages without a Building within the BTZ

- (b) **Screening of Roof Mounted Equipment:** All roof mounted mechanical equipment (except solar panels) shall be screened from view of a person standing on the property line on the far side of the adjoining street (see Figure 10-3). The screening material used shall be the same as the primary exterior building material used.

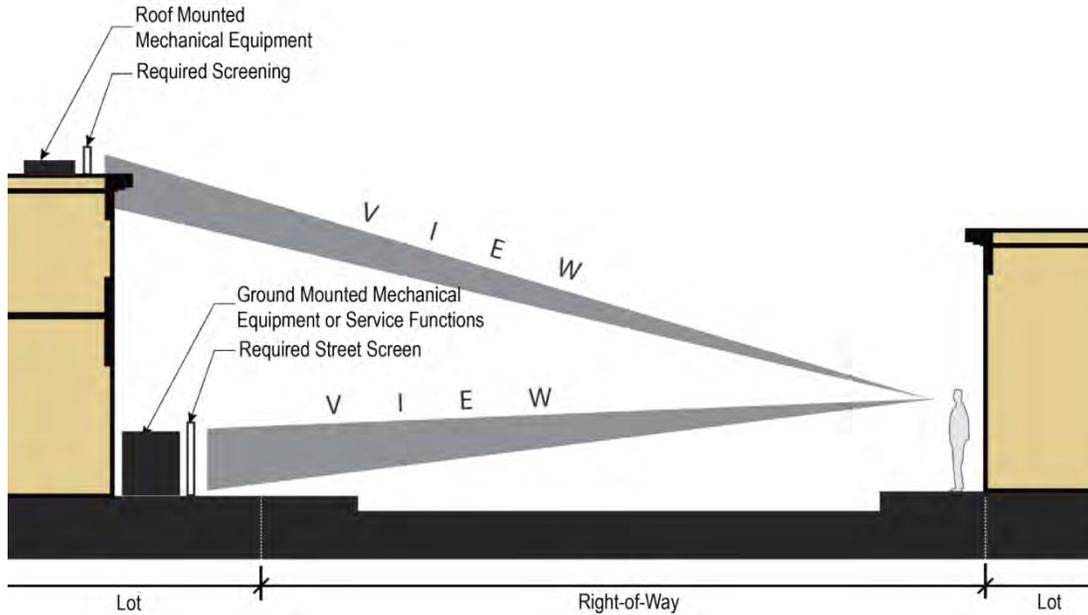


Figure 10-3 Illustration showing required screening of roof and ground mounted equipment

**10.5 Street Lighting:** Street lighting should be provided on Spine, Town, Collector and Collector with Trail roads. Refer to Arden Hills Public Works Design Manual for lighting palette. The following standards shall apply for pedestrian scale lighting:

- (a) Vehicular lighting shall be a maximum of thirty feet (30') in height and pedestrian-oriented lighting a maximum of eighteen feet (18') in height.
- (b) Street lights shall be placed at an average of forty feet (40') on center, approximately three (3) feet behind the back of curb, aligned with street trees, and where street trees are planted.
- (c) The light standard selected shall be compatible with the design of the street and buildings.
- (d) All other standards for street lighting shall direct light downward or properly shielded with three-quarter ( $\frac{3}{4}$ ) or fully shielded fixtures to prevent glare.
- (e) High efficiency lighting, such as LED lamps, is required.

**10.6 Exterior Lighting:** All development in the TRC (including surface parking lots) with the exception of Single-Family Attached, Single-Family detached, Townhouse, and Two-Family Residential Uses shall comply with the Exterior Lighting regulations in AHC Section 1325.

**10.7 Street Furniture**

- (a) Street Furniture shall be placed within the Plantings/Furnishings Zone or within the front setback area only. Benches and bike racks are recommended along all Pedestrian Priority Frontages and will be placed in alignment with light poles and street trees.
- (b) Trash receptacles shall be required for all development along Pedestrian Priority Frontages. Trash receptacles should be placed at street corners. If development is located mid-block, place the trash can near front entry.

- (c) All street furniture shall be located in such a manner as to allow a Clear Zone of a minimum of six (6) feet in width. Placement of street furniture and fixtures shall be coordinated with organization of sidewalks, landscaping, street trees, building entries, curb cuts, signage, and other street fixtures.
- (d) Materials selected for paving and street furniture shall be of durable quality and require minimal maintenance.

**10.8 Utilities**

- (a) All utility lines shall be underground.
- (b) Locations on private property must be found for switchgear and transformer pads needed to serve that property. Such locations shall be either along General Frontages or at the side or rear of the property and screened from view of a person standing on the property line on the far side of any adjoining street (see Figure 10-3).

**10.9 Parking Lot Landscaping:** All surface parking shall meet the standards for parking lot landscaping in the AHC Section 1325.

## 11.0 Sign Standards

**11.1 Applicability:** Except for sign types, sign dimensional standards, and as specifically listed below, all other signage and sign standards shall comply with the AHC Chapter 12.

**11.2 Prohibited Signs:** The following types of Signs shall be prohibited in the TRC:

- (a) Any sign that flashes, blinks, revolves, or is put into motion will not be permitted except as allowed in TRC Section 11.16;
- (b) Streaming or video signs or screens;
- (c) Non-shielded LED or flood lights;
- (d) Streamers and inflatable mascots;
- (e) Portable or wheeled signs and advertising devices on the site other than sandwich board signs and mounted menu signs permitted in Table 11-1; and
- (f) Any additional prohibited signage in AHC Section 1230.02.

**11.3 Sign Types Permitted:** All development to which this Section is applicable shall comply with the Sign Regulations in Table 11-1 below.

**Table 11-1 Permitted Sign Types by Character Zone**

LEGEND				
				
Campus Commercial	Town Center	Retail Mixed-Use	Office Mixed-Use	
				
Civic	Flex Office	Neighborhood		
Sign Type	Zoning District Allowed	Description	Image	Standard
<b>Permanent Signs</b>				
<b>HIGHWAY MONUMENT SIGN</b>	   	A sign not attached to a building, but permanently supported by a structure extending from the ground and permanently attached to the ground.		11.4
<b>CORRIDOR MONUMENT SIGNS</b>	    	A sign not attached to a building, but permanently supported by a structure extending from the ground and permanently attached to the ground. A Corridor Monument sign shall be smaller than a Highway Monument Sign.		11.5

**LEGEND**



Campus Commercial



Town Center



Retail Mixed-Use



Office Mixed-Use



Civic



Flex Office



Neighborhood

Sign Type	Zoning District Allowed	Description	Image	Standard
<b>BUILDING IDENTITY SIGN</b>	     	A Wall Sign attached to the upper floor of a multiple story building or parapet of single tenant one-story building that provides identification of the entire building. (May be used instead of the Building Projecting Sign)		11.6
<b>STOREFRONT/ TENANT WALL SIGNS</b>	    	Wall Sign attached to a retail storefront or sign band area directly adjacent to the retail storefront within a multi-tenant building. (May be used instead of a Tenant Canopy Sign)		11.7
<b>BUILDING PROJECTING SIGNS</b>	   	Wall Sign that extends a distance of more than 18" perpendicular from the building façade. Sign is placed on the upper floors of a multiple story building. (May be used instead of the Building Identity Sign)		11.8

**LEGEND**



Campus Commercial



Town Center



Retail Mixed-Use



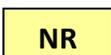
Office Mixed-Use



Civic



Flex Office



Neighborhood

Sign Type	Zoning District Allowed	Description	Image	Standard
<p><b>ROOF SIGNS</b></p>	<p>Not permitted</p>	<p>A sign installed over or on the roof of a building.</p>		
<p><b>TENANT CANOPY SIGNS</b></p>		<p>A sign mounted to a canopy or awning that is within or directly adjacent to a retail storefront. (May be used instead of a Storefront/Tenant Wall Sign)</p>		<p>11.9</p>
<p><b>TENANT BLADE SIGNS</b></p>		<p>Wall Sign that extends a distance more than 18” perpendicular from the building façade and is oriented towards the sidewalk. Sign is mounted to a retail storefront or may be mounted under a canopy.</p>		<p>11.10</p>

**LEGEND**



Campus Commercial



Town Center



Retail Mixed-Use



Office Mixed-Use



Civic



Flex Office



Neighborhood

Sign Type	Zoning District Allowed	Description	Image	Standard
<b>WINDOW SIGNS</b>	     	A sign mounted to or intended to be seen through a window.		11.11
<b>DIRECTIONAL SIGNS</b>	     	A vehicular sign with directional information intended to direct visitors to various destinations within a larger development with multiple buildings.		11.12

**LEGEND**



Campus Commercial



Town Center



Retail Mixed-Use



Office Mixed-Use



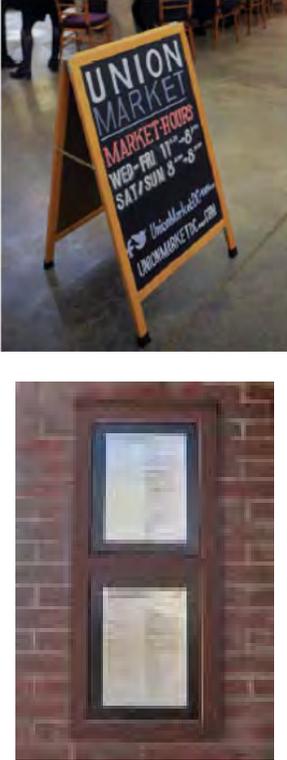
Civic



Flex Office



Neighborhood

Sign Type	Zoning District Allowed	Description	Image	Standard
<p><b>DIRECTORY SIGNS</b></p>	<p>CC                      TC                      RMU                      OMU                      FO                      C</p>	<p>A pedestrian oriented sign containing a listing and or map of the tenants and destinations within an area, block, building or development.</p>		<p>11.13</p>
<p><b>SANDWICH BOARD AND MOUNTED MENU SIGNS</b></p>	<p>CC                      TC                      RMU                      OMU                      C</p>	<p>A temporary sign with two connected faces usually arranged back to back.                       A temporary pole or wall mounted sign that displays a restaurant menu.</p>		<p>11.14</p>

**LEGEND**



Campus Commercial



Town Center



Retail Mixed-Use



Office Mixed-Use



Civic



Flex Office



Neighborhood

Sign Type	Zoning District Allowed	Description	Image	Standard
<p><b>ADDRESS SIGNS</b></p>	<p>All</p>	<p>A sign containing only the lot, building or retail tenant address.</p>		<p>11.15</p>
<p><b>MARQUEE SIGN</b></p>	<p>      </p>	<p>A sign placed over the entrance to a theatre or other public gathering venue. It has signage stating either the name of the establishment or, in the case of theatres or other public venues, the name of the event, artist, and other details of the event appearing at that venue. The marquee is often identifiable by a surrounding cache of light bulbs, usually yellow or white, that flash intermittently or as chasing lights. Marquee signs may often be combined with Building Projecting signs.</p>		<p>11.16</p>

**LEGEND**



Campus Commercial



Town Center



Retail Mixed-Use



Office Mixed-Use



Civic



Flex Office



Neighborhood

Sign Type	Zoning District Allowed	Description	Image	Standard
<b>Temporary Signs</b>				
<b>BANNERS</b>	     	A temporary fabric or vinyl sign hung from a building façade.		11.17
<b>TEMPORARY CONSTRUCTION SIGNS</b>	All	A temporary sign mounted to a construction fence that announces a new business or construction project.		11.18

### 11.4 Highway Monument Sign

	Location	Standards
(a)	I-35W and Hwy 10 Frontages only	<ul style="list-style-type: none"> <li>a. Located within 60 ft. of the edge of I-35W or Hwy 10.</li> <li>b. Maximum height of 30 ft. above the street pavement grade of the elevated portion of the highway.</li> <li>c. Maximum total sign face area of 400 sq. ft. (cumulative of all surfaces). Sign face may be divided into multiple segments. Area between segments does not count toward sign face area.</li> <li>d. One sign allowed for lots with at least 1,000 ft. of highway frontage. Two signs permitted for frontages greater than 1,000 ft. Signs to be a minimum of 1,000 ft. apart.</li> </ul>

### 11.5 Corridor Monument Sign

	Location	Standards
(a)	All per zoning district permitted	<ul style="list-style-type: none"> <li>i. Maximum area of 0.7 sq. ft. for each linear foot of street frontage with a maximum of 150 sq. ft. for multi-tenant signs.</li> <li>ii. Corridor Monument Sign not permitted for single-tenant buildings, instead multiple single tenants should be combined onto one (1) Corridor Monument Sign.</li> <li>iii. One per lot. For lots with a total street frontage greater than 700 ft., two (2) signs are permitted. Signs must be a minimum of 400 ft. apart.</li> <li>iv. For lots fronting two streets, one sign is permitted on each street.</li> <li>v. Maximum height of 12 ft. above frontage street pavement grade.</li> <li>vi. Monument structure shall include a base, frame, and cap around the sign area. Material shall be the same as the principal structure on the lot.</li> <li>vii. Maximum total area shall not exceed 1.5 times the permitted sign copy area of a sign.</li> </ul>

### 11.6 Building Identity Sign

	Location	Standards
(a)	I-35W, Hwy 10 and MN-96 Frontages only	<ul style="list-style-type: none"> <li>i. May be used for single tenant commercial, office or institutional buildings only (multiple tenant building shall be subject to 11.7 below).</li> <li>ii. May be used instead of a Building Projecting Sign</li> <li>iii. Maximum area of 200 sq. ft. or 15% of the façade area, whichever is less.</li> <li>iv. Mount in upper third of the facade.</li> </ul>
(b)	All frontages other than I-35W, Hwy 10 and MN-96	<ul style="list-style-type: none"> <li>i. May be used for single tenant commercial, office or institutional buildings only (multiple tenant building shall be subject to 11.7 below).</li> <li>ii. May be used instead of a Building Projecting Sign</li> <li>iii. Maximum area of 150 sq. ft. or 10% of the façade area, whichever is less.</li> <li>iv. Mount in the upper third of the facade</li> </ul>

**11.7 Storefront/Tenant Wall Sign**

	Location	Standards
<b>(a)</b>	IH-35W, Hwy 10 and MN-96 Frontages only	<ul style="list-style-type: none"> <li>i. May be used for multiple tenant commercial, office or institutional buildings only (single tenant building shall be subject to 11.6 above).</li> <li>ii. May be used instead of a Tenant Canopy Sign</li> <li>iii. May be located on the ground floor façade only (sign to be mounted below 25 feet as measured from finished grade outside the facade).</li> <li>iv. One sign per tenant space; area to be calculated at 2 sq.ft. per linear foot of tenant space façade along the building's frontage up to a maximum of 150 sq.ft.</li> <li>v. Sign to be located between demising walls of leased storefront.</li> <li>vi. Sign shall not overlap architectural features like window lintels, canopy support points, coping, etc.</li> <li>vii. Wall sign may encroach, a maximum of 12", on to a sidewalk while maintaining a vertical clearance of 8 ft. from the finished sidewalk if it is non-illuminated and 11 ft. from the finished sidewalk if it is illuminated.</li> <li>viii. Building signs may be internally or externally lit.</li> </ul>
<b>(b)</b>	All frontages other than IH-35W, Hwy 10 and MN-96	<ul style="list-style-type: none"> <li>i. May be used for multiple tenant commercial, office or institutional buildings only (single tenant building shall be subject to 11.6 above).</li> <li>ii. May be used instead of a Tenant Canopy Sign</li> <li>iii. May be located on the ground floor façade only (sign to be mounted below 25 feet as measured from finished grade outside the facade).</li> <li>iv. One sign per tenant space; area to be calculated at 1.5 sq.ft. per linear foot of tenant space façade along the building's frontage up to a maximum of 100 sq.ft.</li> <li>v. Sign to be located between demising walls of leased storefront.</li> <li>ix. Sign shall not overlap architectural features like window lintels, canopy support points, coping, etc.</li> <li>vi. Wall sign may encroach, a maximum of 12", on to a sidewalk while maintaining a vertical clearance of 8 ft. from the finished sidewalk if it is non-illuminated and 11 ft. from the finished sidewalk if it is illuminated.</li> <li>vii. Building signs may be internally or externally lit.</li> <li>viii. Live-Work and Home occupations: One sign limited to an area of 30 sq. ft. max.</li> </ul>

### 11.8 Building Projecting Signs

	Location	Standards
(a)	All per zoning district permitted	<ul style="list-style-type: none"> <li>i. Building Projecting sign may be permitted in place of a Building Identity Sign.</li> <li>ii. Maximum area of 200 sq. ft. or 15% of the façade area, whichever is less</li> <li>iii. Will not obstruct any pedestrian or vehicular way (vertical clearance of 10 ft. from the finished sidewalk if it is non-illuminated and 11 ft. from the finished sidewalk if it is illuminated).</li> <li>iv. Sign may project no more than 50% of the width of the sidewalk or six (6) ft. from building façade line (whichever is less).</li> <li>v. Sign may not extend above building parapet line or eaves line.</li> <li>vi. Maximum of one per façade</li> <li>vii. Signs must be constructed of durable materials. Impermanent materials, such as canvas or flexible vinyl, are not allowed.</li> </ul>

### 11.9 Tenant Canopy Sign

	Location	Standards
(a)	All per zoning district permitted	<ul style="list-style-type: none"> <li>i. May only be used instead of a Storefront/Tenant Wall Sign.</li> <li>ii. One sign per tenant space; area to be calculated at 1.5 sq.ft. per linear foot of tenant space façade along the building's frontage up to a maximum of 100 sq.ft.</li> <li>iii. Sign to be located between demising walls of leased storefront.</li> <li>iv. Sign shall not extend beyond outermost edges of canopy.</li> <li>v. Signs are to be mounted over the canopy, on the face of a canopy or over any awnings</li> </ul>

### 11.10 Tenant Blade Sign

	Location	Standards
(a)	All per zoning district permitted	<ul style="list-style-type: none"> <li>i. One Blade sign per tenant space</li> <li>ii. May be located on the ground floor façade only (sign to be mounted below 15 feet as measured from finished grade outside the facade)</li> <li>iii. Maximum area of 15 sq. ft.</li> <li>iv. Will not obstruct any pedestrian or vehicular way. Minimum vertical clearance of ten (10) ft. from the finished sidewalk if it is non-illuminated and eleven (11) ft. from the finished sidewalk if it is illuminated.</li> <li>v. Sign may project no more than three (3) ft. from building wall or a distance equal to 50% of the width of the abutting sidewalk (whichever is less).</li> </ul>

**11.11 Window Sign**

	Location	Standards
(a)	All per zoning district permitted	<ul style="list-style-type: none"> <li>i. No permit is required for small-scale (under 1.0 sq. ft. in total area) signs placed at the pedestrian eye level. These exempted signs include: tenant logo and name, website or other social media address store hours and address, and public safety decals as required by applicable codes or government regulations.</li> <li>ii. Window signs include any signage attached to the storefront glazing or located on storefront interior within three (3) ft. of the storefront and intended to be viewed from the storefront exterior.</li> <li>iii. Maximum area of 25% of overall glazed storefront, including doors.</li> </ul>

**11.12 Directional Signs**

	Location	Standards
(a)	All per zoning district permitted	<ul style="list-style-type: none"> <li>i. Permitted only for multi-tenant commercial and mixed-use developments with multiple building within one development.</li> <li>ii. Applies only to signs located at lot entrances accessible from public streets.</li> <li>iii. Maximum size of 60 sq. ft.</li> <li>iv. Maximum height of eight (8) ft. above frontage street pavement grade.</li> <li>v. One sign permitted per development entrance. Maximum of two (2) signs per street frontage.</li> <li>vi. Signs located on interior of site and not intended to be viewed or utilized by traffic on public streets do not require a permit.</li> <li>vii. In the Town Center, an electronic changeable copy sign is allowed for each parking structure entrance.</li> </ul>

**11.13 Directory Signs**

	Location	Standards
(a)	All per zoning district permitted	<ul style="list-style-type: none"> <li>i. Signs located on interior of lot and not intended to be viewed or utilized by traffic on public streets do not require a permit. In such cases, any sign lettering or logos used must be less than 2" (max.).</li> </ul>

**11.14 Sandwich Board and Mounted Menu Signs**

	Location	Standards
(a)	All per zoning district permitted	<ul style="list-style-type: none"> <li>i. Permitted only for retail, service, or restaurant tenants.</li> <li>ii. Maximum area of 8 sq. ft. per sign face</li> <li>iii. Maximum height of 4 ft.</li> <li>iv. One per storefront.</li> <li>v. Sign shall not interfere with any pedestrian way and a minimum of 5 ft. of sidewalk shall remain clear.</li> <li>vi. Chalkboards may be used for daily changing of messages. Reader boards (electronic and non-electronic) shall be prohibited.</li> <li>vii. Sandwich Board Signs and Pole-Mounted Menu Signs shall be removed every day after the business is closed.</li> </ul>

**11.15 Address Signs**

	Location	Standards
(a)	All per zoning district permitted	i. Allowed per AHC Section 1230.01 – Subsection 3.

**11.16 Marquee Signs**

	Location	Standards
(a)	All per zoning district permitted	i. Permitted for theatres, auditoriums, and other public gathering venues of 100 persons or more; ii. Marquee signs shall be attached to the building or located above or below a canopy only; iii. Area = 100 sq ft. maximum; iv. Message board may be changeable copy provided that the copy does not change more than once every 15 minutes.

**11.17 Banners**

	Location	Standards
(a)	All per zoning district permitted	i. Maximum area of 150 square feet or 10% of the façade area, whichever is less. ii. For multi-tenant buildings, individual tenant banners shall not exceed the width of the tenant bay. iii. Banners shall only be permitted on a temporary basis for a maximum period of 30 days per calendar year. Upon review of need by Community Development Department, an extension or additional time may be granted with submittal of a new application.

**11.18 Temporary Construction Signs**

	Location	Standards
(a)	All per zoning district permitted	i. Must be attached to a part of a temporary construction fence.

**11.19 For Sale/Lease Signs**

	Location	Standards
(a)	All per zoning district permitted	i. Allowed per AHC Section 1250.02 – Subsection 5.

**11.20 Additional Standards**

- a. Signs located on interior of a lot and not intended to be viewed or utilized by traffic on public streets do not require a permit.
- b. Retail, service, and restaurant business that wrap a building corner creating two or more storefronts will be permitted to place signs on each storefront.
- c. Encroachments into public right-of-way shall not be permitted. See section 6.1(i) for standards for encroachments over required setback areas.

# **TCAAP Redevelopment Code**

## **ATTACHMENTS**

**December 2016**

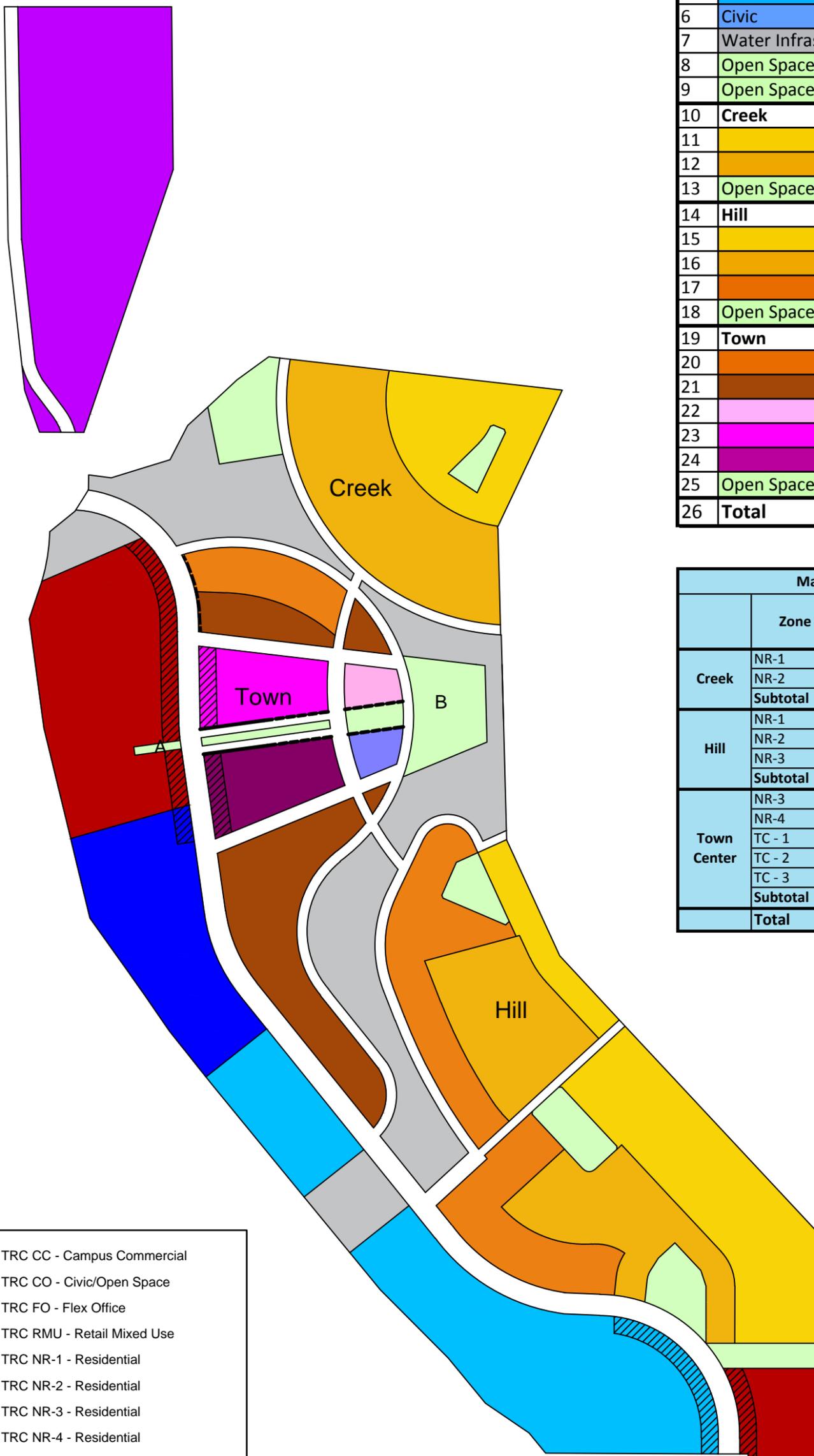
## **Table of Contents**

- 1: Regulating Plan
- 2: Palette of Open Space Types
- 3: Development Review Chart
- 4: Street Cross Sections
- 5: Street Type Plan
- 6: Recommended Color Palette
- 7: Audubon Minnesota Bird-Safe Building Guidelines
- 8: TCAAP Energy Integration Resiliency Framework

# TCAAP Proposed Regulating Plan

	Parcel	Acreage
1	Campus Commercial	40.0
2	Mixed Use Retail - West	28.4
3	Mixed Use Retail - East	6.0
4	Office Mixed Use	20.0
5	Flex Business	41.8
6	Civic	1.6
7	Water Infrastructure	45.6
8	Open Space A	0.3
9	Open Space B	5.9
10	<b>Creek</b>	<b>42.5</b>
11	NR -1	13.1
12	NR -2	23.7
13	Open Space	5.7
14	<b>Hill</b>	<b>92.5</b>
15	NR -1	29.8
16	NR -2	27.8
17	NR -3	24.5
18	Open Space	10.4
19	<b>Town</b>	<b>45.3</b>
20	NR -3	5.8
21	NR -4	21.6
22	TC-1	1.8
23	TC-2	6.9
24	TC-3	7.2
25	Open Space	2.0
26	<b>Total</b>	<b>369.9</b>

Maximum Residential Units				
	Zone	Gross Density Range	Acreage	Maximum Units
Creek	NR-1	0.00 - 1.98	13.1	26
	NR-2	2.50 - 4.05	23.7	96
	<b>Subtotal</b>		<b>36.8</b>	<b>122</b>
Hill	NR-1	0.00 - 2.52	29.8	75
	NR-2	2.50 - 3.45	27.8	96
	NR-3	4.00 - 5.60	24.5	137
	<b>Subtotal</b>		<b>82.1</b>	<b>308</b>
Town Center	NR-3	4.00 - 5.66	5.8	33
	NR-4	4.00 - 5.41	21.6	117
	TC - 1	0.00 - 68.16	1.8	120
	TC - 2	0.00 - 67.02	6.9	460
	TC - 3	0.00 - 41.64	7.2	300
	<b>Subtotal</b>		<b>43.3</b>	<b>1030</b>
	<b>Total</b>		<b>162.2</b>	<b>1460</b>



	TRC CC - Campus Commercial
	TRC CO - Civic/Open Space
	TRC FO - Flex Office
	TRC RMU - Retail Mixed Use
	TRC NR-1 - Residential
	TRC NR-2 - Residential
	TRC NR-3 - Residential
	TRC NR-4 - Residential
	TRC OMU - Office Mixed Use
	TRC OS - Open Space
	TRC TC-1 - Town Center
	TRC TC-2 - Town Center
	TRC TC-3 - Town Center
	TRC - Water Infrastructure
	Right of Way
	Gateway Overlay District
	Pedestrian Priority Frontage
	Pedestrian Friendly Frontage
	Property Boundary

## Attachment 2

### Palette of Open Space Types

The Open Space Types and Standards contained herein shall be used as a guide to fulfill the required and recommended Open Space requirements of Section 9 of the TRC. These open space types may be Public or Private Common Open Spaces. The following section provides a description of these open space types including the design context and criteria consistent with the Vision for TRC Neighborhoods.

#### 1. Public Open Space Types

##### (a) Pocket Park Standards



Pocket Parks are small scale public open spaces intended to provide recreational opportunities where (publicly accessible/park) space is limited. They are often located between buildings and developments; on single vacant lots; and on small irregular pieces of land. Low maintenance landscaping and facilities is recommended in order to support multiple pocket parks in a park system.

Development may include pavilions, picnic tables, small performance stage, seating areas, gathering areas, family play areas, gazebos, small game areas, small community gardens, dog parks, and interactive art. Shade and lighting is desired.

#### Typical Characteristics

##### General Character

Small open space responding to specific user groups and space available.

Range of character can be for intense use or aesthetic enjoyment. Low maintenance is essential.

##### Location and Size

0.25 – 1.99 acres  
 Within walking distance of either a few blocks or up to a 1/4 mile of residences

##### Typical Uses

Varies per user group

(b) Green Standards



A Green is a public open space available for civic purposes, commercial activity, unstructured recreation and other passive uses. Greens shall primarily be naturally landscaped with many shaded places to sit. Open lawn areas shall encourage civic gathering. Appropriate paths, civic elements, fountains or open shelters may be included and shall be formally placed within the Green.

A Green shall be adjacent to a public right of way and be spatially defined by buildings which shall front onto and activate this space.

**Typical Characteristics**

**General Character**

- Open space
- Spatially defined by street and building frontages and landscaping
- Lawns, trees and shrubs naturally disposed
- Open shelters and paths formally disposed

**Location and Size**

- 0.25 – 4 acres
- Minimum width – 25'
- Minimum pervious cover – 80%
- Minimum perimeter frontage on public right of way – 50%

**Typical Uses**

- Unstructured recreation
- Casual seating
- Commercial and civic uses
- No organized sports

(c) **Square Standards**



A square is a public open space available for civic purposes, commercial activity, unstructured recreation and other passive uses. The square should have an formal character and be defined by the surrounding building frontages and adjacent tree-lined streets. All buildings adjacent to the square shall front onto the square. Adjacent streets shall be lined with appropriately scaled trees that help to define the square.

The landscape shall consist of lawns, trees, and shrubs planted in formal patterns and furnished with paths and benches. Shaded areas for seating should be provided. A civic element or small structure such as an open shelter, pergola, or fountain may be provided within the square.

**Typical Characteristics**

**General Character**

- Formal open space
- Spatially defined by buildings and tree-lined streets.
- Open shelters, paths, lawns, and trees formally arranged
- Walkways and plantings at all edges
- Abundant seating opportunities

**Location and Size**

- 0.25 – 4 acres
- Minimum width – 25'
- Minimum pervious cover – 60%
- Minimum perimeter frontage on public right of way – 60%
- Located at important intersections

**Typical Uses**

- Unstructured and passive recreation – no organized sports.
- Community gathering
- Occasional commercial and civic uses

(d) Plaza Standards



A plaza is a public open space that offers abundant opportunities for civic gathering. Plazas add to the vibrancy of streets within the higher density zones and create formal open spaces available for civic purposes and commercial activity. Building frontages shall define these spaces.

The landscape should have a balance of hardscape and planting. Various types of seating should be provided from planter seat walls, to steps, to benches, to tables, and chairs. Trees should be provided for shade. They should be formally arranged and of appropriate scale. Plazas typically should be located at the intersection of important streets. A minimum of one public street frontage shall be required for plazas.

**Typical Characteristics**

**General Character**

Formal open space

A balance of hardscape and planting

Trees important for shade

Spatially defined by building frontages

**Location and Size**

0.1 – 1 acre

Minimum width – 30'

Minimum pervious cover – 20%

Minimum perimeter frontage on public right of way – 25%

Located at important intersections, at vista termini, or at entrances to public/civic buildings

**Typical Uses**

Commercial and civic uses

Formal and casual seating

Tables and chairs for outdoor dining

Retail and food kiosks

(e) **Pocket Plaza Standards**



A pocket plaza is a small scale public open space that serves as an impromptu gathering place for civic, social, and commercial purposes. The pocket plaza is designed as a well-defined area of refuge separate from the public sidewalk. It is frequently located in a building supplemental zone next to the streetscape.

These areas contain a lesser amount of pervious surface than other open space types. Outdoor dining with café tables and chairs, water features, public art and other shaded amenities are appropriate uses.

**Typical Characteristics**

**General Character**

- Formal open space for gathering
- Defined seating areas
- Refuge from the public sidewalk
- Spatially defined by the building configuration

**Location and Size**

- Min. 300 s.f.
- Min. width – 15' / Max. width 20'
- Minimum pervious cover – 10 %
- Minimum perimeter frontage on public right of way – 25%
- Located at important intersections, at vista termini, or at entrances to public/civic buildings

**Typical Uses**

- Civic and commercial uses
- Formal and casual seating

(f) **Pedestrian Passage (Paseo) Standards**



Pedestrian passages or paseos are linear public open spaces that connect one street to another at through-block locations. Pedestrian passages create intimate linkages through buildings at designated locations. These wide pathways provide direct pedestrian access to residential or other commercial addresses and create unique spaces for frontages to engage and enter off of. Pedestrian passages allow for social and commercial activity to spill into the public realm.

Pedestrian passages should consist of a hardscape pathway with pervious pavers activated by frequent entries and exterior stairways. The edges may simply be landscaped with minimal planting and potted plants. Shade is required for the success of the paseo.

**Typical Characteristics**

**General Character**

Hardscape pathway with pervious pavers

Defined by building frontages

Frequent side entries and frontages

Shade Required

Minimal planting and potted plants

Maintain the character of surrounding buildings

**Standards**

Min. Width 15 feet

**Typical Uses**

Pedestrian connection and access

Casual seating

**(g) Multi-Use Trail Standards**



A multi-use trail is a linear public open space that accommodates two or more users on the same, undivided trail. Trail users could include pedestrians, bicyclists, skaters, etc. A trail frequently provides an important place for active recreation and creates a connection to regional paths and biking trails.

Pedestrian amenities add to recreational opportunities. These include drinking fountains, scenic view posts, fitness stations, and directional signs, and may be spread along the trail or grouped in a trailhead area.

**Typical Characteristics**

**General Character**

**Multi-use trail in Neighborhood Park:**

Naturally disposed landscape

Trees lining trail for shade

Appropriately lit for safety

Formally disposed pedestrian furniture, landscaping and lighting

**Multi-use trail along Spine Road or through neighborhoods.:**

Paved trail with frequent gathering spaces and regular landscaping.

**Standards**

Min. Width            12 feet

**Typical Uses**

Active and passive recreation

(h) **Family-friendly Play Area Standards**



Family-friendly play areas are areas within open spaces that are conducive to the recreational needs of families with children. Family-friendly play areas range in style from pocket parks within mixed use developments to playscapes within neighborhood parks.

These play areas should serve as quiet, safe places -- protected from the street and typically located where children do not have to cross major streets to access. An open shelter, play structures or interactive art and fountains may be included with landscaping between. Shaded areas and seating shall be provided for ease of supervision.

Playscape equipment and design must be reviewed and approved by the City prior to installation. The need for fencing depends on the surrounding environment.

A larger playground may be incorporated into a neighborhood park, whereas a more intimate family oriented design may be incorporated into a pocket park.

**Typical Characteristics**

**General Character**

Focused toward family-friendly needs

Fencing depends on surroundings

Open shelter

Shade and seating provided

Play structure, interactive art or fountains

**Standards**

Min. Size 300 sq.ft.

Max. Size N/A

As described by open space type in which playground is located

Protected from traffic

No service or mechanical equipment

**Typical Uses**

Active and passive recreation

Unstructured recreation

Casual seating

## 2. Private Common Open Space Types

### (a) Forecourt Standards



Forecourt is a small scale private common open space surrounded on at least two sides by buildings. A forecourt is typically a building entry providing a transition space from the sidewalk to the building. The character serves as a visual announcement of the building to visitors with additional amenities such as signage, water features, seating, planting, etc.

Forecourts should be laid out proportionate to building height with a 1:4 (min.) ratio. In order to offset the impact of taller buildings, the detail of the forecourt level should seek to bring down the relative scale of the space with shade elements, trees, etc.

The hardscape should primarily accommodate circulation. Seating and shade are important for visitors. Trees and plantings are critical to create a minimum of 30% pervious cover and offset the effect of the urban heat island.

#### Typical Characteristics

##### General Character

- Small scale private common open space
- Defined by buildings on at least 2 sides with connection to public sidewalk
- Size of court should be proportionate to building height
- Hardscape should accommodate entry circulation
- Trees and plants are critical
- Enhance the character of surrounding buildings

##### Standards

- Min. Width 25'
- Minimum Size Depth: Based on building height ratio; Width: Max. of 50% of the building's frontage along that street
- Minimum pervious cover – 30%

##### Typical Uses

- Building Entry Circulation
- Visual building announcement

**(b) Courtyard Standards**



Courtyards are small scale private common open spaces surrounded on at least three sides by buildings with a pedestrian connection to a public sidewalk. Courtyards maintain the character and style of the surrounding buildings.

Courtyards should be laid out proportionate to building height between 1:1 and 2:1 ratio (width to height of building). In order to offset the impact of taller buildings, the detail of the courtyard level should seek to bring down the relative scale of the space with shade elements, trees, etc. Transition areas should be set up between the building face and the center of the court.

The hardscape should accommodate circulation, gathering, seating, and shade. Trees and plantings are critical to create a minimum of 30% pervious cover and offset the effect of the urban heat island.

**Typical Characteristics**

**General Character**

- Small scale private common open space
- Defined by buildings on at least 3 sides with connection to public sidewalk
- Size of court should be proportionate to building height
- Hardscape should accommodate circulation, gathering, and seating.
- Trees and plants are critical
- Maintain the character of surrounding buildings

**Standards**

Min. Width	25'
Minimum Area	650 s.f.
Minimum pervious cover	30%

**Typical Uses**

- Gathering
- Casual seating

**(c) Roof Terrace Standards**



A Roof Terrace is a private common open space serving as a gathering space for tenants and residents that might not be at grade.

Up to 50% of the required private common open space may be located on a roof if at least 30 % of the roof terrace is designed as a Vegetated or Green Roof. A Vegetated or Green roof is defined as an assembly or system over occupied space that supports an area of planted beds, built up on a waterproofed surface.

Private common open space on a roof must be screened from the view of the adjacent property. The hardscape should accommodate circulation, gathering, seating, and shade.

**Typical Characteristics**

**General Character**

Small scale private common open space on roof top

Screened from view of adjacent property

Vegetated portion critical

Hardscape should accommodate gathering, seating, shade

Provides common open space that might not be available at grade

**Standards**

Min. Area 50% of the roof top

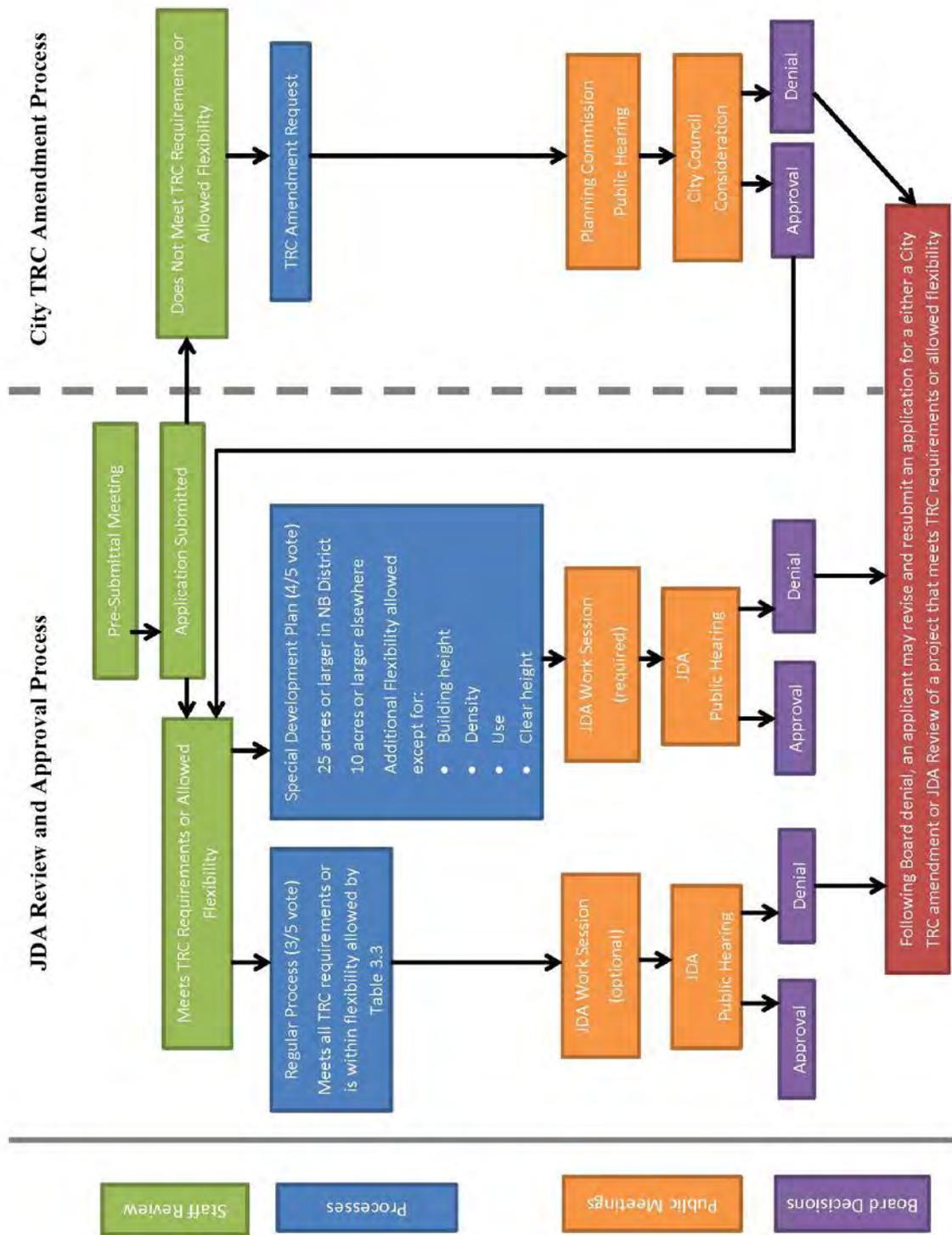
Planted area – 30% min.

**Typical Uses**

Gathering for tenants and residents

Green Roof

Attachment 3

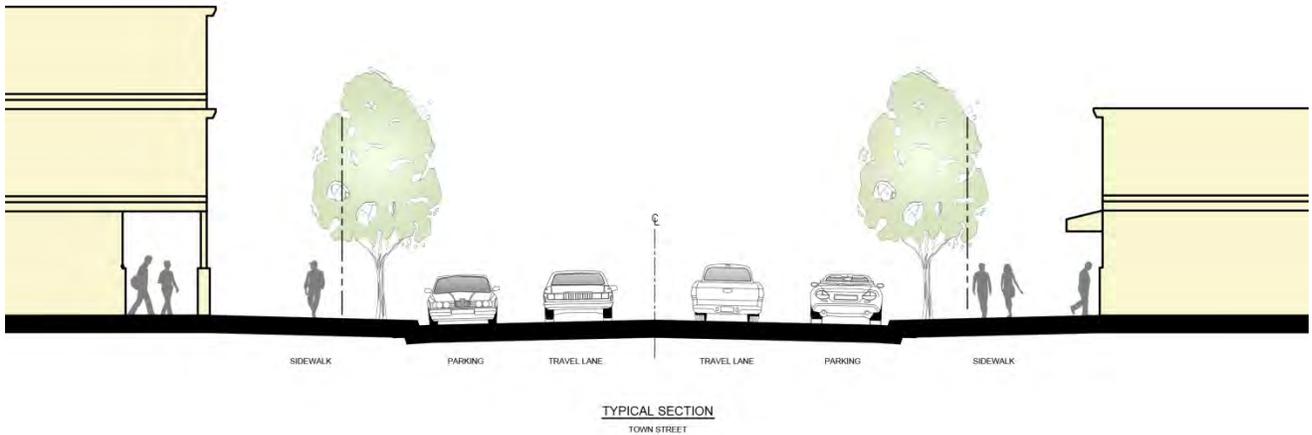
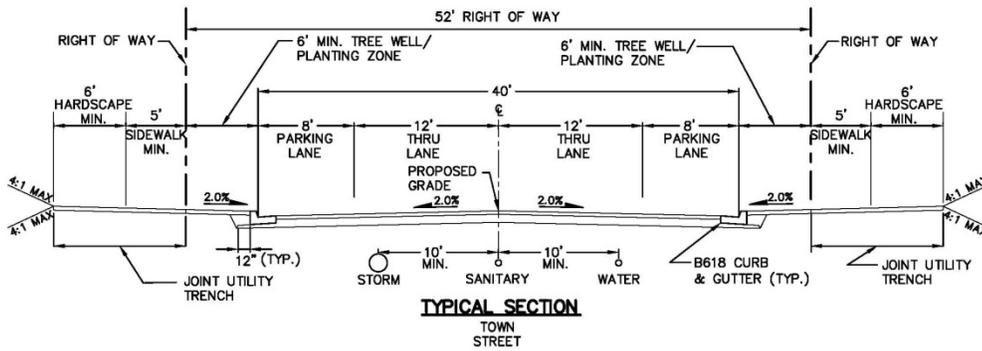


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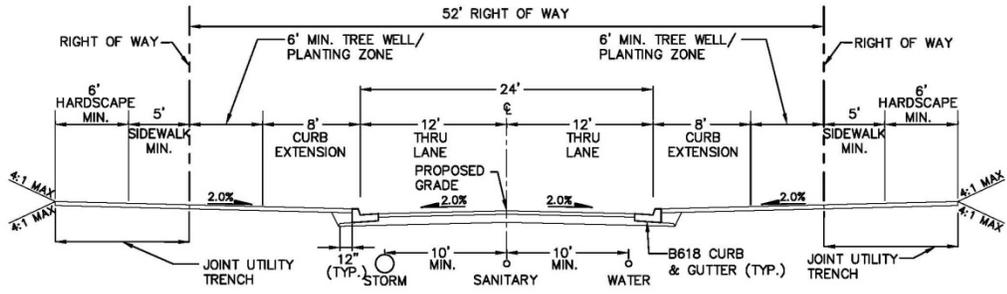
### Street Cross Sections

The following street cross sections are established for the Street Types as established in Regulating Plan for TRC. The cross sections (including vehicular lane and on-street parking configurations, street tree placement, etc.) may be adjusted to fit existing contexts or other development contexts consistent with the vision for the Neighborhood with the approval of the City Engineer. In addition, the proposed cross sections may be adjusted to meet the needs of the Uniform Fire Code as adopted by the City.

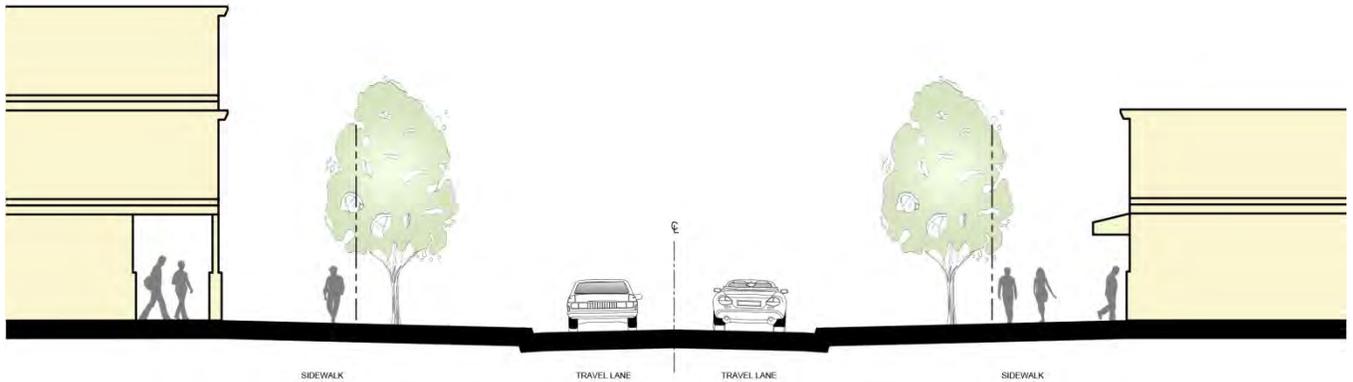
#### TOWN STREET



### TOWN STREET AT INTERSECTIONS

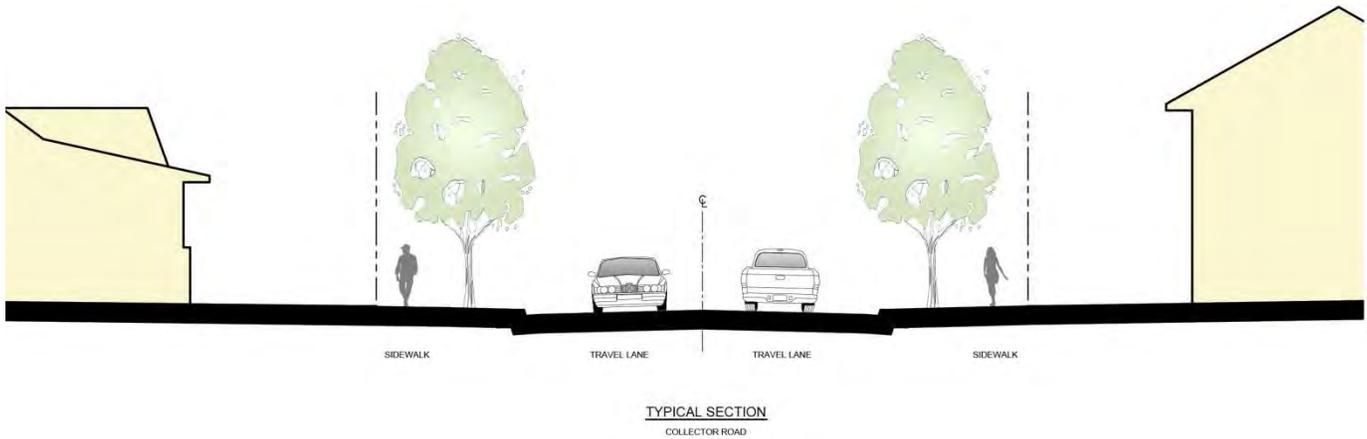
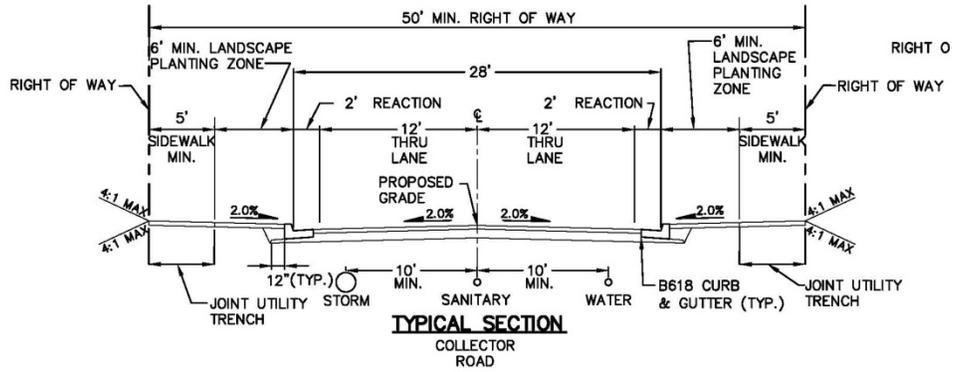


**TYPICAL SECTION**  
TOWN STREET AT INTERSECTIONS

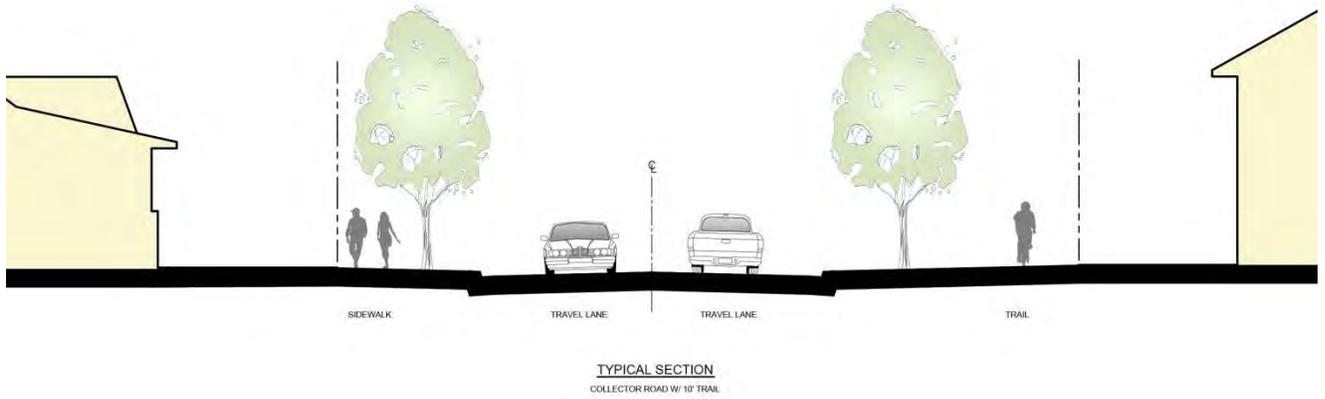
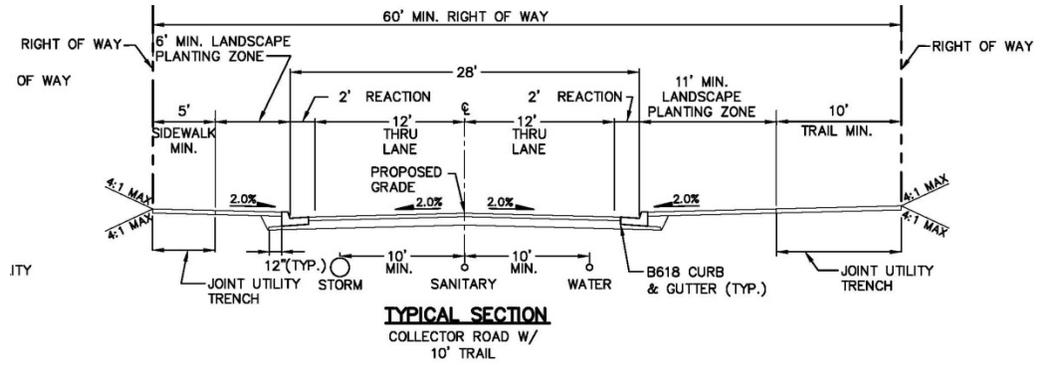


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TOWN STREET AT INTERSECTIONS

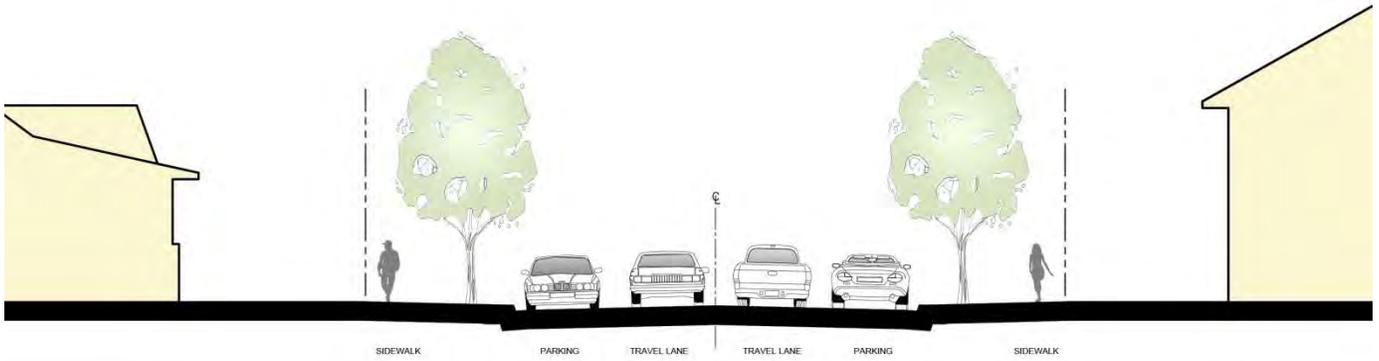
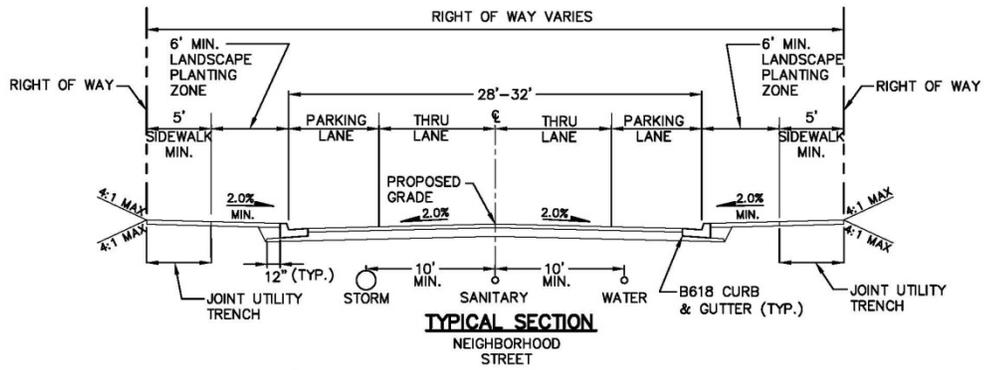
# COLLECTOR ROAD



### COLLECTOR ROAD WITH TRAIL

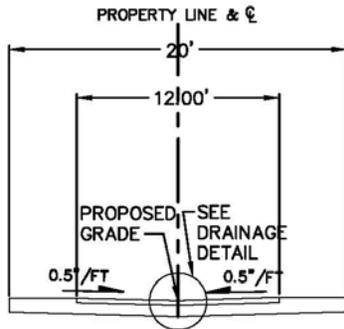


# NEIGHBORHOOD STREET

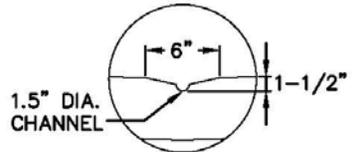


**TYPICAL SECTION**  
NEIGHBORHOOD STREET

### RESIDENTIAL ALLEY

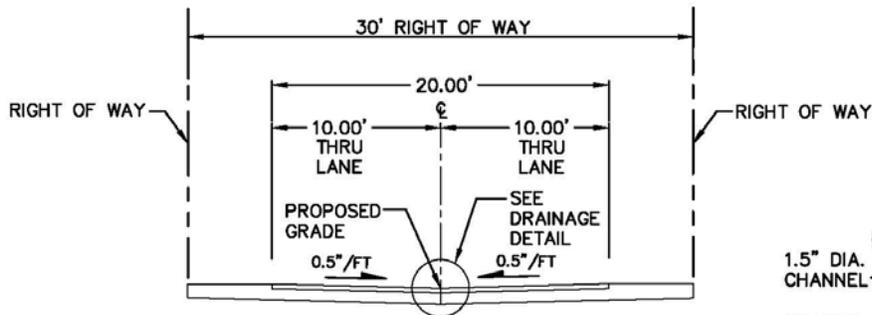


**TYPICAL SECTION**  
RESIDENTIAL ALLEY  
(PRIVATE)

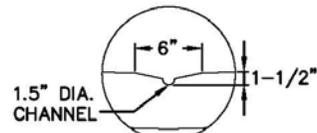


**ALLEY DRAINAGE DETAIL**

### COMMERCIAL ALLEY

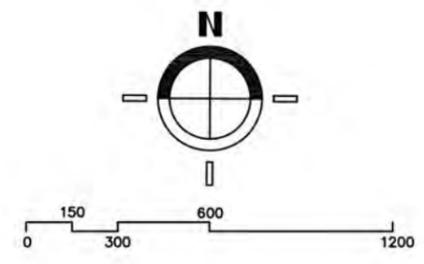
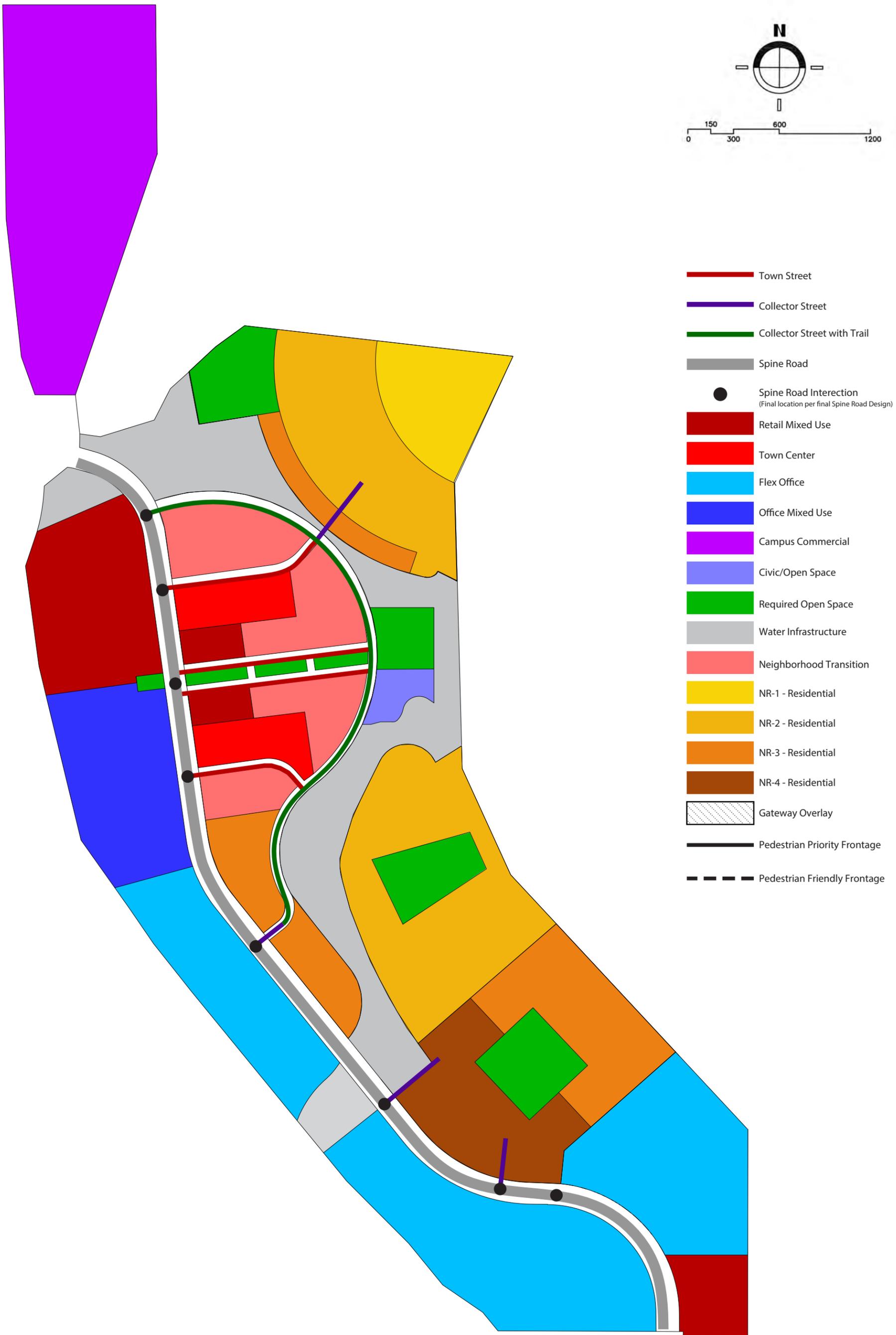


**TYPICAL SECTION**  
INDUSTRIAL OR  
COMMERCIAL ALLEY  
(PRIVATE)



**ALLEY DRAINAGE DETAIL**

# Attachment 5



- Town Street
- Collector Street
- Collector Street with Trail
- Spine Road
- Spine Road Intersection  
(Final location per final Spine Road Design)
- Retail Mixed Use
- Town Center
- Flex Office
- Office Mixed Use
- Campus Commercial
- Civic/Open Space
- Required Open Space
- Water Infrastructure
- Neighborhood Transition
- NR-1 - Residential
- NR-2 - Residential
- NR-3 - Residential
- NR-4 - Residential
- Gateway Overlay
- Pedestrian Priority Frontage
- - - Pedestrian Friendly Frontage

## TCAAP STREET TYPE PLAN

May 26, 2015

# Attachment 6

## Recommended Color Palette

## Attachment 6

### TCAAP Recommended Color Palette

The following recommended color palette is established for exterior building colors within TCAAP. This color palette is based on the Sherwin William paint palette. Other manufacturers may be used provided that the colors are similar in tone, shade, and intensity to the ones listed below.

Body/Wall	Trim/Accent
Renwick Rose Beige 2804	Renwick Beige 2805 Pewter Tankard 0023 Polished Mahogany 2838
Renwick Golden Oak 2824	Downing Straw 2813 Roycroft Vellum 2833 Deepest Mauve 0005
Downing Sand 2822	Rookwood Clay 2823 Rookwood Sash Green 2810 Rookwood Blue Green 2811
Sheraton Sage 0014	Downing Sand 2822 Rookwood Antique Gold 2814 Fairfax Brown 2856
Eastlake Gold 0009	Classical White 2829 Curio Gray 0024 Downing Slate 2819
Pearl Gray 0052	Classic Light Buff 0050 Colonial Revival Stone 2827 Mulberry Silk 0001
Downing Slate 2819	Downing Straw 2813 Rookwood Antique Gold 2814 Rookwood Medium Brown 2807
Downing Earth 2820	Renwick Beige 2805 Rookwood Terra Cotta 2803 Rookwood Dark Brown 2808
Renwick Olive 2815	Downing Sand 2822 Rookwood Dark Green 2816 Rookwood Amber 2817
Craftsman Brown 2835	Roycroft Vellum 2833 Rookwood Brown 2806 Naval 6244
Birdseye Maple 2834	Roycroft Brass 2843 Roycroft Bronze Green 2846 Aurora Brown 2837
Roycroft Pewter 2848	Weathered Shingle 2841 Roycroft Vellum 2833 Roycroft Copper Red 2839
Downing Stone 2821	Sage Green Light 2851 Roycroft Bronze Green 2846 Classic Light Buff 0050

Body/Wall	Trim/Accent
Rookwood Clay 2823	Pure White 7005 Downing Sand 2822 Teal Stencil 0018
Downing Straw 2813	Roycroft Vellum 2833 Roycroft Pewter 2848 Classic French Gray 0077
Antique White 6119	Roycroft Suede 2842 Creamy 7012 Bunglehouse Blue 0048
Peace Yellow 2857	Rookwood Antique Gold 2814 Classical White 2829 Roycroft Bottle Green 2847
Roycroft Mist Gray 2844	Downing Stone 2821 Extra White 7006 Rookwood Dark Red 2801
Needlepoint Navy 0032	Classic Light Buff 0050 New Colonial Yellow 2853 Antiquarian Brown 0045
Chelsea Gray 2850	Westchester Gray 2849 Decorous Amber 0007 Roycroft Pewter 2848
Downing Sand 2822	Classical White 2829 Toile Red 0006 Rookwood Dark Brown 2808
Colonial Revival Stone 2827	Classical White 2829 Tricorn Black 6258 Rookwood Red 2802
Colonial Revival Gray 2832	Pure White 7005 Downing Slate 2819 Harvester 6373
Colonial Revival Green Stone 2826	Classic Light Buff 0050 Polished Mahogany 2838 Roycroft Bronze Green 2846
Cardboard 6124	Believable Buff 6120 Urbane Bronze 7048
Wool Skein 6148	Hardware 6172 Fired Brick 6335
Universal Khaki 6150	Moderate White 6140 Naval 6244
Summit Gray 7669	Extra White 7006 Greenblack 6994
Restrained Gold 6129	Polar Bear 7564 Forestwood 7330
Virtual Taupe 7039	Accessible Beige 7036 Rustic Red 7593
Poolhouse 7603	City Loft 7631 Peppercorn 7674

Body/Wall	Trim/Accent
Whole Wheat 6121	Antique White 6119 Raisin 7630
Knitting Needles 7672	Pearly White 7009 Seaworthy 7620
Humble Gold 6380	Wool Skein 6148 Griffin 7026
Jubilee 6248	Extra White 7006 Salute 7582
Green Earth 7748	Nacre 6154 Fiery Brown 6055
Red Barn 7591	Alabaster 7008 Domino 6989
Dormer Brown 7521	Patience 7555 Cordovan 6027
Slate Tile 7624	Grecian Ivory 7541 Manor House 7505
Softer Tan 6141	Foothills 7514 Darkroom 7083
Maison Blanche 7526	Alabaster 7008 Dried Thyme 6186
Carriage Door 7594	Windsor Greige 7528 Thunder Gray 7645
Khaki Shade 7533	Tiki Hut 7509 Brandywine 7710
Burlap 6137	Rice Grain 6155 Bitter Chocolate 6013
Tree Branch 7525	Divine White 6105 Rustic Red 7593
Rare Gray 6199	Casa Blanca 7571 Pewter Green 6208
Dover White 6385	Gateway Gray 7644 Mediterranean 7617
Concord Buff 7684	Pure White 7005 Porpoise 7047
Wool Skein 6148	Artisan Tan 7540 Status Bronze 7034
Bamboo Shoot 7733	Alabaster 7008 Roycroft Pewter 2848
Breezy 7616	Extra White 7006 Rookwood Amber 2817
Tatami Tan 6116	Colony Buff 7723 Homburg Gray 7622
Fresco Cream 7719	Pottery Urn 7715 Carnelian 7580
Dry Dock 7502	Hot Cocoa 6047 Chateau Brown 7510

Body/Wall	Trim/Accent
Muslin 6133	Straw Harvest 7698 Rural Green 6418
Homestead Brown 7515	Keystone Gray 7504 Moderne White 6168
Outerbanks 7534	Rice Grain 6155 Rookwood Terra Cotta 2803
Extra White 7006	Rushing River 7746 Spiced Cider 7702
Uncertain Gray 6234	Evening Shadow 7662 Peppercorn 7674
Birdseye Maple 2834	Cocoon 6173 Olde Worlde Gold 7700
Retreat 6207	Netsuke 6134 Edgy Gold 6409
Perfect Greige 6073	Popular Gray 6071 Garret Gray 6075
Artifact 6138	Creamy 7012 Ramie 6156
Jogging Path 7638	Intellectual Gray 7045 Thunder Gray 7645
Shoji White 7042	Relaxed Khaki 6149 Hopsack 6109
Restrained Gold 6129	Burlap 6137 Pier 7545
Anjou Pear 6381	Jersey Cream 6379 Warm Stone 7032
Techno Gray 6170	Connected Gray 6165 Alchemy 6395
Rustic City 7699	Dover White 6385 Raisin 7630
Cork Wedge 7539	Smokehouse 7040 Rustic Red 7593
Silvermist 7621	Pure White 7005 Chamois 6131
Stone Lion 7507	Quiver Tan 6151 Incredible White 7028

**Attachment 7**  
**Audubon Minnesota Bird-Safe Building Guidelines**

# BIRD-SAFE BUILDING GUIDELINES



# Bird-Safe Building Guidelines



Over 100 bird species have been recovered from building collisions in Minnesota including Lincoln's Sparrow, Black-capped Chickadee, Indigo Bunting, Common Yellowthroat, and Nashville Warbler

Published by Audubon Minnesota, May 2010

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The mission of Audubon Minnesota is to conserve and restore natural ecosystems, focusing on birds and their habitats, for the benefit of humanity and the earth's biological diversity.

**AUDUBON MINNESOTA**

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Thank you to New York City Audubon and their original working group for permission to revise their Bird-Safe Building Guidelines (May 2007).

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NYC Reviewers: Karen Cotton, Bird-Safe Working Group; Randi Doeker, Birds & Buildings Forum; Bruce Fowle, FAIA, Daniel Piselli, FXFOWLE; Marcia Fowle; Yigal Gelb, Program Director, NYC Audubon; Mary Jane Kaplan; Daniel Klem, Jr., PhD., Muhlenberg College; Albert M. Manville, PhD., US Department of the Interior, Fish and Wildlife Service; E. J. McAdams, Former Executive Director NYC, Audubon; Glenn Phillips, Executive Director, NYC Audubon.

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# Site and Landscape Design

**OBJECTIVE:**

*Minimize the potential for bird collisions when siting buildings near existing landscape features and when planning new landscapes in close proximity to buildings.*

A WELL-INTEGRATED SUSTAINABLE DESIGN enhances open space and protects and restores habitat while enhancing the overall architectural and operational quality of a built facility. Efforts to integrate nature and attract wildlife should be balanced with specific considerations of a site’s impact on birds. Birds attracted to on-site habitat are vulnerable to collisions with glass. These guidelines encourage bird-safe design strategies early in the collaborative design process through consideration of site, existing habitat, and bird-safe landscaping.

**CONSIDER SITE ANALYSIS**



Urban parks attract birds

Analyze the site to determine potential attractions for bird populations.

- Consult with an ecologist or bird specialist to inventory the site.
- Document the location of nearby vegetated streetscapes and urban parks.
- Identify all sources of food and shelter for migratory and resident bird populations, including plants, water and other natural features.
- Identify human-made features that attract birds, including water sources, nesting and perching sites, and shelter from adverse weather.<sup>15</sup>

**LEED** Coordinate with LEED Credits  
SS 5.1 Site Development: Protect or Restore Habitat

**CONSIDER EXISTING HABITAT**



Treat windows near habitat

Site building(s) to reduce conflicts with existing and planned landscape features that may attract birds.

- Where buildings cannot be located away from bird sensitive areas, take special care in treating windows. See “Exterior Glass” pages 20-21.
- Where strategic reductions to building footprint have been made in order to enhance vegetated open space and habitat, assess site conflicts and include bird safe treatments.
- Use soil berms, furniture, landscaping, or architectural features to prevent reflection in glazed building facades.

**LEED** Coordinate with LEED Credits  
SS 5.2 Site Development: Maximize Open Space

WHILE BIRDS COLLIDE WITH BUILDINGS AT ALL LEVELS, ground-level stories are considered the most dangerous because this is where habitat reflections, glazing and internal planting are often all quite prominent. Analysis of bird collision data over 10 years in New York City showed that “most collisions were documented to occur during the day at the lower levels of buildings where large glass exteriors reflected abundant vegetation, or where transparent windows exposed indoor vegetation.”<sup>16</sup>

### CONSIDER LANDSCAPE PLACEMENT



Dangerous reflections

Birds are vulnerable to collisions nearly anywhere glass occurs. Habitat in proximity to glass exacerbates this threat unless reflections are avoided or eliminated or visual cues are incorporated in glazing.

- When planning new landscapes be aware of reflections and see-through effects created by habitat in relation to building features. Place plantings to minimize these effects.
- Alternatively, situate trees and shrubs immediately adjacent to the exterior glass walls, at a distance of less than three feet from the glass.<sup>17</sup> Close proximity will minimize habitat reflections. In addition, if a bird does try to fly to a reflection at this range, flight momentum will be minimal, thereby reducing fatal collisions. This planting strategy also provides beneficial summertime shading and reduces cooling loads.
- If any bird-attracting features (food, water, shelter) are in reflective range of the building(s), use fritting, shading devices or other techniques to make glass visible. See “Exterior Glass” pages 20-21.

### CONSIDER INTERIOR LANDSCAPING



Confusing interior plants

Birds will mistakenly seek shelter in landscaping located behind glass.

- Mask views of interior plantings from outside the building.
- Use screening, window films or treatments to make glass visible.

### CONSIDER ROOFTOP LANDSCAPING

With the increased use of green roof technology, impacts on birds must be considered.

- Treat glass to minimize the reflection of rooftop landscaping in adjacent building features.
- Consider foregoing green roof installation or eliminating access to birds if reflection in adjacent buildings will occur.

### CANOPY HEIGHT

Glass treatments should be applied to the height of the top of the surrounding tree canopy or the anticipated height of surrounding vegetation at maturity.<sup>13</sup>

LEED

Coordinate with LEED Credits  
SS 7.1 Heat Island Effect: Non-Roof  
SS 7.2 Heat Island Effect: Roof

# Building Layout and Massing

## OBJECTIVE:

*Include bird-safe strategies as part of an integrated design approach before construction rather than retrofitting a building that proves problematic.*

BIRD-SAFE STRATEGIES do not restrict the ability to design creatively. These guidelines encourage an integrated design approach, challenging building designers to include bird-safe strategies to enhance aesthetic, functional, and building performance goals. The layout of individual buildings and their relationship to other structures on the site can affect the number of bird collisions that occur. Building layout and massing can be planned along with landscaping to minimize the likelihood of bird collisions.

## CONSIDER SPECIFIC SITE FEATURES



These two birds were fooled by habitat reflections

**Ground level stories** are the most hazardous areas of all buildings and should be designed to minimize bird collisions.

- Minimize those hazards that bring birds close to buildings such as vegetation, water and other features.
- Provide uniform covering with bird-safe materials, especially adjacent to landscapes. See “Exterior Glass” pages 20-21.
- Use angled glass, between 20 and 40 degrees from vertical, to reflect the ground instead of adjacent habitat or sky.<sup>18</sup>



Clear barriers create a deadly hazard for birds

**Clear barriers** such as transparent bus-shelters, skyways, linkways, railings, windscreens and noise barriers create a serious hazard for birds because they are invisible, causing a deadly fly-through hazard.

- Avoid use of transparent materials in these structures in any location where birds may be present. Use translucent or decorative glazing as an alternative.
- If clear panels of any kind are in use, incorporate surface treatments to make glass visible. See “Exterior Glass” pages 20-21.



Confusing corners with multiple reflections

**Courtyards** may contain landscaping and confusing internal corners that limit bird escape routes. These areas often allow sudden access by people that flush birds into glass.

- Control access to enclosed areas so birds flush away from glass into open areas.
- Treat glass with bird-safe materials so birds see and avoid glass.

**Rooftop obstacles** such as antennas and media equipment can injure or kill birds and should be minimized. In poor weather and bright lighting conditions birds may congregate on and around rooftops.

- Co-locate antennas and tall rooftop media equipment to minimize conflicts with birds.
- Utilize self-supporting structures that do not require guy wire supports.
- Avoid up-lighting rooftop antennas and tall equipment, as well as decorative architectural spires. See “Lighting Design” pages 24-25.



Birds can fall through grates after hitting windows

**Site ventilation grates** also present a unexpected danger for birds. An injured bird that falls onto a ventilation grate with large pores can become trapped.

- Specify ventilation grates with a porosity no larger than 0.8 inches.<sup>13</sup> Cover larger grates with netting.
- Never up-light ventilation grates.

**Driveways** can also cause birds to flush from landscaping into reflective glazing as vehicles approach.

- Ensure routes of escape for birds that are using landscaping along driveways and access roads.
- Take care in routing driveways adjacent to landscaping and reflective glazing.

“BIRD SAFETY IS EASIER TO SELL WHEN IT OVERLAPS WITH OTHER GREEN STRATEGIES. SLANTED GLASS REDUCES SOLAR HEAT GAIN BUT ALSO WORKS TO EFFECTIVELY REDUCE BIRD INJURIES. FRITTED GLASS REDUCES HEAT GAIN, AND IF IT’S 50% YOU CAN STILL SEE THROUGH IT.”

Jeanne Gang, Studio Gang Architects, Chicago

# Exterior Glass

## OBJECTIVE:

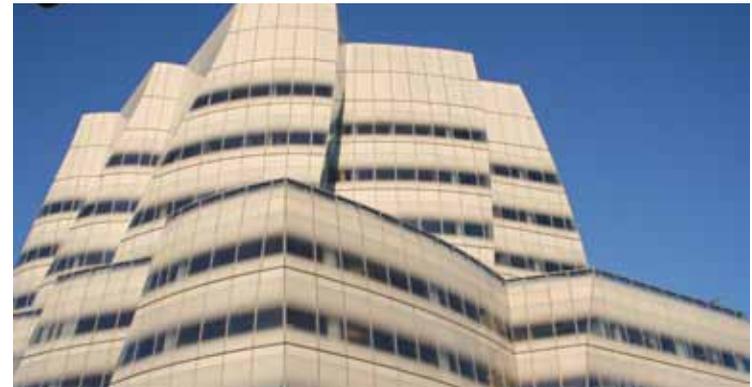
*Prevent bird collisions with glazed surfaces, while maintaining transparency for views, daylighting and passive environmental control.*

MOST BIRD COLLISIONS OCCUR at the glazed surfaces of buildings. While circumstances such as lighting and other obstacles do contribute, glass areas are the primary focus of bird-safe design and retrofit strategies regardless of the overall site, landscape, layout and massing features. Bird-friendly glass products can contribute to aesthetics, energy efficiency, and effective daylighting. For bird safety, efforts focus on creating visual markers to make glass visible to birds and minimize reflection of habitat and sky.

## CONSIDER VISUAL MARKERS



Interior shades and exterior film at the Minneapolis Central Library



White fritted pattern on glass facade at IAC Offices in New York City

NYC-AUDUBON

“Visual noise” is what allows us to see glass. It is created by varying materials, textures, colors, opacity, or other features and helps to break up glass reflections and reduce overall transparency.<sup>19</sup> Creating these visual markers can alert birds to the presence of glass as an obstacle. This is the most effective way to mitigate the danger that glass poses to birds.

- Utilize etching, fritting, translucent and opaque patterned glass to reduce transparency and reflection, while achieving solar shading. (Note: Although fritting is useful for creating visual noise, it is less effective at reducing reflectance since it is generally applied on the interior face of the glass.)
- Incorporate windows with real or applied divided lights to break up large window expanses into smaller subdivisions.
- Consider applying acid-etched or sandblasted patterns to glass on the outside surface to “read” in both transparent and reflective conditions.
- Create patterns that follow the “hand-print” rule (below).
- Use window films featuring artwork or custom patterns permanently or on a rotating basis.
- Low-reflectivity glass has not been sufficiently tested for bird safety but may prove beneficial in certain installations.



## DID YOU KNOW?

Studies show that small birds will attempt to fly through any opening larger than 4 inches wide or 2 inches tall or about the size of a child’s handprint oriented horizontally. When creating “visual noise” on or around a window, optimal openings are no larger than a small handprint.<sup>19</sup>

## CONSIDER INTERIOR AND EXTERIOR TREATMENT



An exterior ceramic framework provides shading and daylighting (New York Times)

**Exterior shading** or other architectural devices enhance bird safety.

- Utilize shading devices, screens, and other physical barriers to reduce reflectivity and birds' access to glass.
- Incorporate louvers, awnings, sunshades, light shelves or other exterior shading/shielding devices to reduce reflection and give birds a visual indication of a barrier.
- Consider other highly patterned shading/shielding devices that will provide visual cues and encourage bird safety.

**Interior window treatments** can provide visual cues for birds and reduce both transparency and reflections. They also help reduce light trespass from buildings. See "Building Operations" page 26.

- Design interior window treatments using light-colored solar reflective blinds or curtains. Partially open blinds during the day.
- Close curtains and blinds if evening lighting is utilized.
- For best results, consider photo-sensors, timers and other automatic controls to regulate shading devices, lighting and daylighting.

## CONSIDER INTEGRATED DAYLIGHTING



Translucent glass can help balance daylighting and prevent bird collisions

Large expanses of clear exterior glazing do not equate to effective daylighting for buildings. In fact, over-glazing can contribute to glare, veiling reflections, unwanted heat gain, and also bird collisions. Many strategies used to achieve effective daylighting are compatible with bird safety.

- Where appropriate, daylighting strategies such as exterior shading devices, fritted glass, and diffuse and translucent glass can also help to prevent bird collisions.
- In general, the more untreated glass you have, the greater the risk to birds, especially on sites that are in predictable migratory and resident bird areas.

### WINDOW AREA

Windows constitute about 25-40 percent of the wall area of effectively designed daylit buildings, an area very similar to the windowed area in non-daylit buildings.<sup>20</sup>

LEED

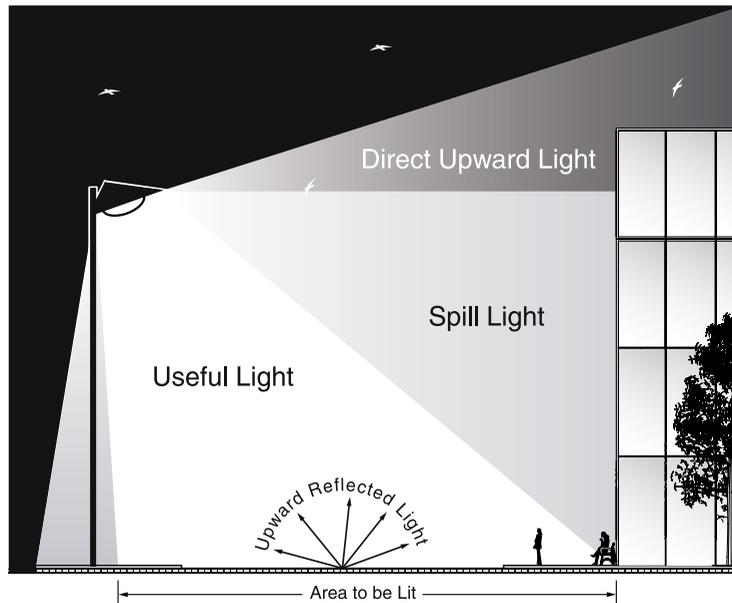
Coordinate with LEED Credits  
EQ 8.1 and 8.2 Daylight & Views  
EA 1 Optimize Energy Performance

# Lighting Design

**OBJECTIVE:**  
Undertake strategies to reduce light trespass from buildings, particularly during migration seasons.

REDUCING EXTERIOR BUILDING AND SITE LIGHTING has been proven effective at reducing nighttime migratory bird collisions and mortality. At the same time, such measures reduce building energy costs and decrease air and light pollution. These guidelines encourage efficient design of lighting systems as well as operational strategies to reduce light trespass from buildings, particularly during migration seasons.

## CONSIDER EXTERIOR LIGHT TRESPASS

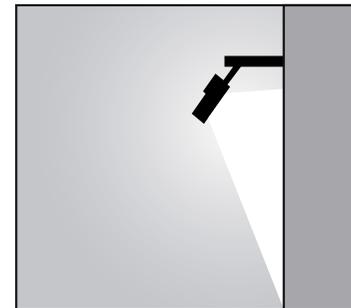


Lighting diagrams courtesy of the City of Toronto

Light pollution is largely a result of inefficient exterior lighting.

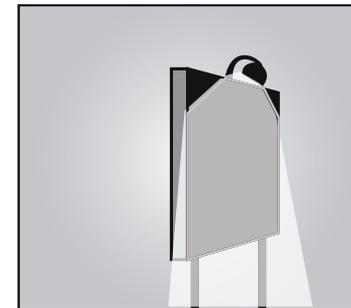
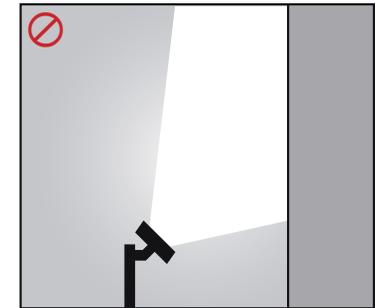
- Eliminate light directed upwards by attaching cutoff shields to streetlights and external lights.
- Highlight building features without up-lighting.
- Reduce the amount of light that spills outside areas where it is needed for safety and security.
- Maximize the useful light directed to targeted areas.
- Eliminate the use of spotlights and searchlights during bird migration.

## PREFERRED

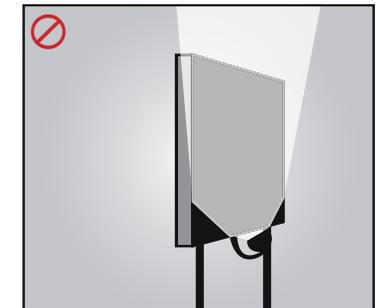


Direct exterior lighting downwards and adhere to Lights Out Guidelines

## DISCOURAGED



Light advertising from above to reduce the light projected skyward

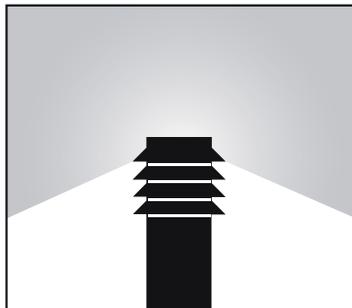
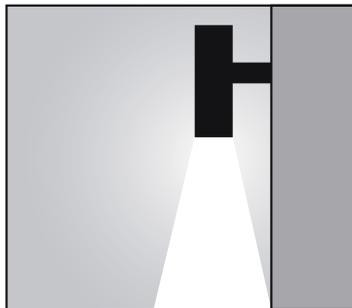
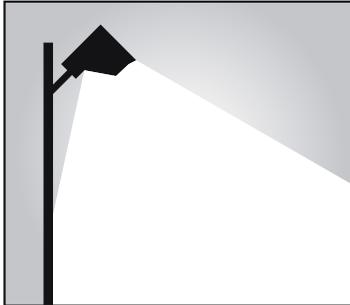


## DID YOU KNOW?

Red lights that don't flash are most attractive (and therefore deadly) to birds. Instead, use flashing white or non-flashing blue or green lights.<sup>24</sup>

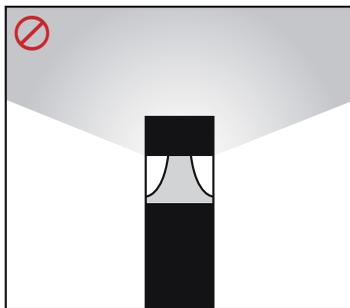
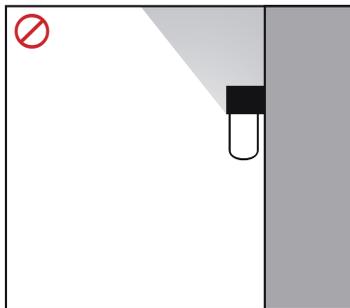
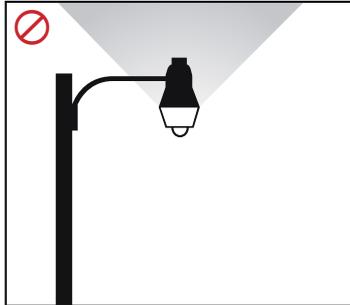


## PREFERRED



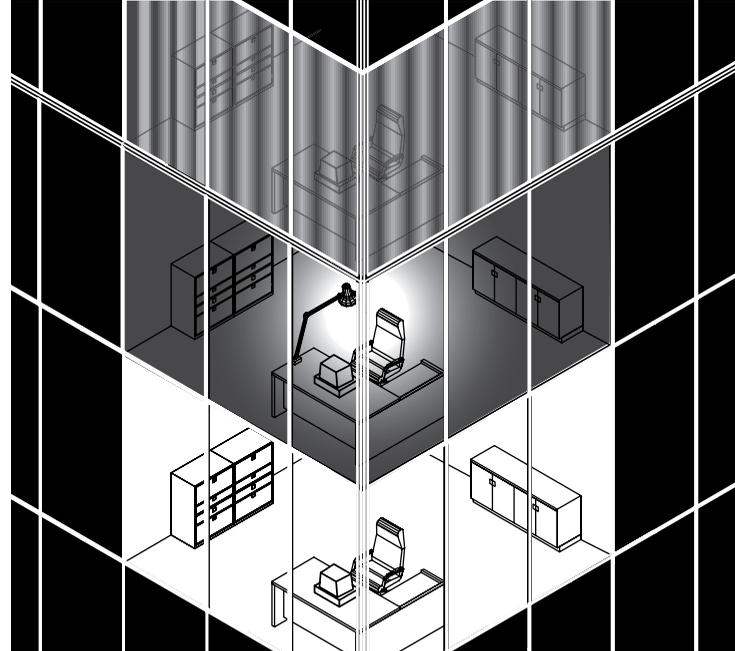
Preferred lighting designs project light downward, reducing waste and light pollution.

## DISCOURAGED



Discouraged lighting designs cause spill light to be directed into the sky where it is not needed.

## CONSIDER INTERIOR LIGHT TRESPASS



Light trespass from within buildings can be reduced through design and operational changes.

- Design lights to shut off using automatic controls, including photo-sensors, infrared and motion detectors. These devices generally pay for themselves in energy savings within one year.
- Reduce the need for extensive overhead lighting.
- Encourage the use of localized task lighting and shades.
- Reduce perimeter lighting and/or draw shades wherever possible.

LEED

Coordinate with LEED Credits  
SS 8.0 Light Pollution Reduction  
EQ 6.1 Controllability of Systems: Lighting  
EA 1 Optimize Energy Performance

## WASTED LIGHT

Light pollution is largely the result of bad lighting design, which allows artificial light to shine outward and upward into the sky, where it's not wanted, instead of focusing it downward, where it is.  
*National Geographic,*  
November 2008

# Products and Innovations

While product innovations continue to emerge, many currently available products have potential bird-safety features even if they were developed for other purposes such as balanced daylighting, innovative aesthetics, building safety and security, and energy efficiency.

The following material sources may contribute to bird safety for new or existing buildings. Products and manufacturers listed below are for information only, and are neither recommended nor endorsed by Audubon Minnesota and its Project BirdSafe partners.

## Translucent and Decorative Glazing:

3Form ([3-form.com](http://3-form.com))  
 Bendheim ([bendheim.com](http://bendheim.com))  
 Cabont Nanogel/Aerogel ([cabot-corp.com](http://cabot-corp.com))  
 Goldray Industries ([goldrayindustries.com](http://goldrayindustries.com))  
 Kalwall ([kalwall.com](http://kalwall.com))  
 Major Industries ([majorskylights.com](http://majorskylights.com))  
 Schott ([us.schott.com](http://us.schott.com))  
 TG P/Pilkington Profilit ([tgpamerica.com](http://tgpamerica.com))  
 Viracon ([viracon.com](http://viracon.com))

## Decorative Ceramic Fritting:

Goldray Industries ([goldrayindustries.com](http://goldrayindustries.com))  
 Oldcastle Glass ([oldcastleglass.com](http://oldcastleglass.com))  
 Viracon ([www.viracon.com](http://www.viracon.com))  
 PPG Industries ([ppg.com](http://ppg.com))

## Applied Window Films and Spectrally Selective Glass:

Arnold Glas, Ornilux ([glaswerke-arnold.de](http://glaswerke-arnold.de))  
 Collidescape ([fetchgraphics.com](http://fetchgraphics.com))  
 Solutia / CPFilms Inc. ([cpfilms.com](http://cpfilms.com))  
 SurfaceCare USA ([surfacecareusa.com](http://surfacecareusa.com))  
 The Convenience Group ([conveniencegroup.com](http://conveniencegroup.com))  
 U.S. Dept. of Energy ([eere.energy.gov](http://eere.energy.gov))

## Electrochromic Glass:

Sage Electrochromics Inc. ([sage-ec.com](http://sage-ec.com))  
 Smart Glass International ([smartglassinternational.com](http://smartglassinternational.com))

## Architectural Metal Mesh:

Cambridge Architectural ([cambridgearchitectural.com](http://cambridgearchitectural.com))  
 GKD Metal Fabrics ([gkdmetailfabrics.com](http://gkdmetailfabrics.com))  
 Johnson Screens ([johnsonscreens.com](http://johnsonscreens.com))

## Building-Integrated Photovoltaics:

PowerFilm ([powerfilmsolar.com](http://powerfilmsolar.com))  
 Uni-Solar ([www.uni-solar.com](http://www.uni-solar.com))  
 ARCH Aluminum and Glass ([archaluminum.net](http://archaluminum.net))

## Exterior Louvers and Sunscreens:

Hunter Douglas Contract ([hunterdouglascontract.com](http://hunterdouglascontract.com))  
 Industrial Louvers Inc. ([www.industriallouvers.com](http://www.industriallouvers.com))  
 Nysan Shading Systems ([nysan.com](http://nysan.com))  
 Savannah Trims ([suncontrolers.com](http://suncontrolers.com))

## Façade-Integrated LEDs:

Cambridge Architectural ([cambridgearchitectural.com](http://cambridgearchitectural.com))  
 GKD Metal Fabrics ([gkdmetailfabrics.com](http://gkdmetailfabrics.com))  
 Schott ([us.schott.com](http://us.schott.com))

## Window Treatments and Banners:

Banner Creations ([bannercreations.com](http://bannercreations.com))  
 Biographix ([rainierdisplays.com/biographix.html](http://rainierdisplays.com/biographix.html))

## Exterior Coverings, Nettings, Screening:

Bird-B-Gone ([birdbgone.com](http://birdbgone.com))  
 Nixalite bird exclusion netting ([nixalite.com](http://nixalite.com))  
 StealthNet ([birdbarrier.com](http://birdbarrier.com))  
 TopRite Netting ([cutlersupply.com](http://cutlersupply.com))



Tennessee Warbler

JIM WILLIAMS

# Attachment 8



## TCAAP Energy Integration Resiliency Framework

March 31, 2015



# TCAAP Energy Integration Resiliency Framework

## Brief

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### Acknowledgements

The Project Team would like to thank the City of Arden Hills, Ramsey County, the Energy Resiliency Advisory Board, and the Joint Development Authority for all of their input and guidance. Their leadership and insights proved invaluable as the Project Team progressed toward the TCAAP energy vision. The Project Team is also grateful to the Minnesota Army National Guard, the University of Minnesota Center for Sustainable Building Research, and Xcel Energy for their cooperation and partnership through the development of this Framework.

### About the Project Team

#### 1.1. Ever-Green Energy

Ever-Green Energy is one of the country's premier community energy system experts, with decades of experience in developing, operating, and managing district energy systems. The unique combination of technical expertise, business acumen, and operations know-how has helped communities, colleges and universities, and government organizations advance their exploration and implementation of integrated energy systems.

#### 1.2. Burns & McDonnell

Burns & McDonnell, headquartered in Kansas City, MO, is a full-service engineering, architecture, construction, environmental and consulting solutions firm. The company's multidisciplinary staff of nearly 5,000 employee-owners includes engineers, architects, construction professionals, planners, estimators, economists, technicians, and scientists, representing virtually all design disciplines.

#### 1.3. Center for Energy and the Environment

The Center for Energy and Environment is a nonprofit organization that promotes energy efficiency to strengthen the economy while improving the environment. CEE conducts research and develops programs so that: businesses operate more efficiently and profitably; government agencies and nonprofits spend less on facilities and functions; utilities achieve their energy-efficiency goals at least-cost; and households save money and improve comfort.

#### 1.4. Fresh Energy

For more than 20 years, Fresh Energy has transformed widely held economic and environmental ideas into smart energy policy. Fresh Energy works in the realm of public policy, changing the rules that govern our energy system. The organization's efforts focus on energy efficiency, clean energy, transportation and land use, and carbon reduction.

# TCAAP Energy Integration Resiliency Framework

## Brief

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### Brief: TCAAP Energy Integration Resiliency Framework

The redevelopment of the Twin Cities Army Ammunition Plant (TCAAP) site in Arden Hills, Minnesota, offers unique and exciting opportunities to build a vibrant community that attracts residents and businesses, and serves as a national model for sustainable redevelopment. Ramsey County (County), Arden Hills (City), and neighboring property owners are working together to build a forward-looking community that optimizes innovative energy supply systems that can be developed for reliability and resiliency, increases the use of local renewable energy systems that can reduce the environmental impact of the community, and develops energy efficient buildings that can provide low-cost energy for residents and tenants.

TCAAP is a 427-acre site that has recently gone through an extensive demolition and environmental remediation program. The site is centrally located at the intersection of I-35 E and Highway 10, just ten miles from downtown Minneapolis and downtown Saint Paul. TCAAP is unique for its size, prime location, greenfield condition, and potential partnerships. The partnerships between the Minnesota Army National Guard (MNARNG), the U.S. Army, Xcel Energy, the City, and the County create dynamic and beneficial opportunities for all entities.

To facilitate TCAAP redevelopment, the County and the City have engaged in a partnership through the formation of a Joint Development Authority (JDA). For the purposes of energy planning, they have also established the Energy Resiliency Advisory Board (ERAB) and appointed community stakeholders to help define an energy vision for TCAAP. The Project Team includes Ever-Green Energy, Center for Energy and Environment, Fresh Energy, and Burns & McDonnell.

### Findings

- Given current market drivers and the timing of TCAAP development, implementation of the opportunities identified in this Framework should begin immediately.
- Partnership with Xcel Energy and the Minnesota Army National Guard will be essential to achieving the vision for TCAAP.
- Implementing the opportunities recommended in this Framework can reduce greenhouse gas emissions by as much as 70%.
- A solar photovoltaic (PV) installation at the Primer Tracer site has the potential to provide sufficient power to TCAAP and AHATS when operating at peak conditions.

# TCAAP Energy Integration Resiliency Framework

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- Combined heat and power (CHP) is an efficient and effective step toward developing a microgrid at TCAAP and AHATS.
- The locally treated groundwater possesses enough energy to meet all of the thermal needs of the planned TCAAP residential neighborhoods.
- Enhanced building design standards applied in the request for proposal (RFP) process can attract and streamline energy efficient development.
- Building orientation, co-location of complementary use buildings, and use of sub-meters can reduce energy consumption and improve energy efficiency.
- Integrating several of these energy opportunities would allow residents of TCAAP to achieve net-zero energy status.
- The County and JDA should allow corridors for future energy infrastructure along the Spine Road
- The JDA should begin pursuing funding opportunities that support the strategies in this Framework.
- The strategies identified in this Framework should be incorporated into the developer selection process.

The City, County, and ERAB have worked with the Project Team to develop a two-part TCAAP Energy Integration Resiliency Framework that outlines the appropriate planning guidelines and policies with careful consideration of local resources, stakeholder interests, project goals, and the best available technologies for implementation over the next 50 years. Phase one of the study was the development of the *Policy White Paper* which was accepted by the JDA and the Arden Hills City Council in November 2014. The *White Paper* helps guide policy and provides a unifying vision for the site's energy future and identifies a number of opportunities for energy efficiency and efficient energy supply options.

Phase two of the study focused on the development of this document, the Energy Integration Resiliency Framework (Framework) which provides more details about how the County, the City, and the JDA can technically achieve the vision and recommendations put forth in the *White Paper*. The Framework considers the *TCAAP Redevelopment Plan*, which outlines land use, infrastructure planning, and the site development timeline. The expectation is for TCAAP to be redeveloped as a mixed-use community with residential, commercial, and retail space. The Framework evaluates the energy supply alternatives and demand-side management strategies that were the most immediately implementable concepts from the *White Paper*. The Framework outlines the energy supply technologies that can be

# TCAAP Energy Integration Resiliency Framework

## Brief

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built during the early phases of site development and would be financially beneficial, financeable, practical, and achievable. The Framework also provides a detailed analysis of the optimal initial energy efficiency strategies, including site and building planning, demand-side management, advanced technology, and building design. Energy supply and energy efficiency solutions at TCAAP will also be influenced by collaboration between partners, including the MNARNG and Xcel Energy. These partnership opportunities are immediate and implementable to meet the loads of the buildings that are currently in the area, as well as the future buildings expected to be built within TCAAP and nearby.

During development of the *White Paper*, the ERAB outlined their vision and guiding principles for TCAAP energy development.

### Vision Statement

TCAAP will be a vibrant development that leverages long-term energy conservation and resilience to attract investment and partnership, and achieves sustainable benefits for Arden Hills and the surrounding community.

### Guiding Principles

- Establish TCAAP as a national model for development of integrated energy systems.
- Develop a resilient community for energy and other utilities.
- Implement infrastructure solutions that are flexible and scalable over the next 50 years.
- Deliver a model of efficient energy and water usage that minimizes TCAAP's impact on the environment.
- Create an economically competitive and attractive environment for developers and businesses.

### Partnership Opportunities (Outlined in Section 2)

The Project Team has begun to assess several potential partnerships, including infrastructure and operations opportunities with the local utility provider, Xcel Energy, and MNARNG. The MNARNG owns and operates the Arden Hills Army Training Site (AHATS) adjacent to the TCAAP site. The MNARNG has developed a master plan for the buildings on its site that includes the goals of net-zero energy, water, and waste, and is currently working on implementation plans to achieve these goals. The MNARNG has

# TCAAP Energy Integration Resiliency Framework

## Brief

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expressed a strong interest in collaborating with the County and JDA on the development of energy solutions for the area.

Xcel Energy is committed to reaching energy efficiency and renewable energy goals, as well as the potential for innovative demonstration projects that showcase energy efficiency and resilient energy. Xcel Energy leadership has expressed a commitment to partnership with the County in the implementation of the energy plan for TCAAP, and the County should continue to pursue opportunities that can benefit both parties and achieve the energy vision for TCAAP.

**Partnerships with Xcel Energy and MNARNG could create unique and exciting opportunities to optimize energy supply and energy efficiency at TCAAP.**

Additionally, there are two areas for additional partnership. The Ramsey County Public Works (RCPW) facility on County Highway 96 is an existing facility adjacent to AHATS and TCAAP. In the Primer Tracer area on the north edge of TCAAP and AHATS, the Department of Public Safety is contemplating the installation of an emergency operations facility. Both of these facilities should be considered when planning energy solutions for the area. Through partnership discussions, a number of immediate and implementable partnership opportunities were identified to meet the loads of the buildings that are currently in the area, as well as the initial buildings expected to be built at TCAAP.

### Energy Source Recommendations (Outlined in Section 3)

After evaluating a range of possible energy sources and considering the TCAAP goals, timeline, and resources, the Project Team recommends the development of solar PV, CHP, low-temperature district energy system, and the foundational components of a future microgrid. Beyond meeting the energy needs of customers and the goals of stakeholders, these recommendations are customized to the distinctive features of TCAAP.

When considering the recommended technologies, it is important to consider the potential CO<sub>2</sub> reductions that accompany these strategies. In total, over 8510 tons of CO<sub>2</sub>/year can be avoided, which is the equivalent of removing 1625 cars from the road each year. The environmental benefits of reduced greenhouse gas emissions will be further increased through integration with the other energy supply alternatives recommended and implementation of demand-side management strategies, ultimately leading to more sustainable redevelopment of TCAAP and the long-term potential of reaching carbon-neutrality for the site in the future.

# TCAAP Energy Integration Resiliency Framework

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### Solar PV

The utilization of solar technology can enable the generation and utilization of renewable energy at TCAAP.

#### Solar PV at Prime Tracer

Based on generally accepted solar generation estimates, a large-scale solar installation on 40-acre of the Prime Tracer site could generate approximately 8 megawatts of electricity (MWe) in peak conditions. Conservatively, this could account for approximately 70% of the peak electric load in the area. Implementing a solar PV array in the Primer Tracer area will result in a reduction of greenhouse gas emissions by approximately 7,524 tons of CO<sub>2</sub> per year.

**A solar PV array at the Primer Tracer site could meet the electricity needs of TCAAP and AHATS when operating at peak conditions.**

#### Solar PV at AHATS

A 2 MWe solar PV installation at the capped soil area west of the existing AHATS Field Maintenance Shop would primarily meet a portion of the electric needs of the AHATS site, but could provide additional renewable electric energy to TCAAP during the non-peak energy usage times at AHATS.

### Combined Heat and Power

The vision for the TCAAP site is for the Thumb, Town Center, and Flex areas to be served electrically and thermally by a CHP energy system located at or near TCAAP. This localized energy source would enable achievement of many of the guiding principles established by the ERAB, potentially reducing greenhouse gas emission reductions by 20%.

Depending upon the type of business that develops in the Thumb, a CHP plant located on that property could efficiently serve the electric and thermal energy needs of that business, as well as the thermal needs of buildings in the Town. A CHP plant located close to AHATS and the existing facility at Ramsey County Public Works could be used to meet the electric needs of MNARNG, while simultaneously meeting the thermal needs of MNARNG and RCPW buildings. As TCAAP development progresses, these two CHP systems could be integrated to serve the majority of the thermal energy needs of the commercial portion of TCAAP.

**Implementing a CHP system at the Thumb could reduce greenhouse gas emissions by as much as 20%, reduce energy costs, increase energy efficiency, and establish the foundation of a future microgrid.**

# TCAAP Energy Integration Resiliency Framework

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*Microgrid* – There is an opportunity to implement and demonstrate “next generation” electricity grid technologies that will help achieve the TCAAP energy vision, including development of a microgrid connected to a CHP plant. It will be important for Xcel Energy, the MNARNG, and the JDA to develop a plan to expand the scope of the CHP plant and develop a microgrid for the broader area as TCAAP development proceeds.

### Low-Temperature District Energy System

The residential neighborhoods planned for the TCAAP site present a unique and highly visible opportunity to leverage low-grade energy from the treated groundwater as an energy supply for the neighborhoods, distributed via a low-temperature district energy system. This energy would be sufficient to meet the heating and cooling needs of the Hill and Creek residential neighborhoods of TCAAP, with approximately 3 MMBtu/hour of excess capacity available for additional TCAAP buildings.

For the proposed system to be successfully implemented, it would need to be constructed as the first homes are being built, so that service can be provided from the outset of development. To optimize the economic benefits of the system, every home in the selected neighborhoods should be constructed with a heat pump HVAC system and be connected to the proposed system. This would provide the most financeable, cost-effective implementation plan, and also maximize energy efficiency for TCAAP.

One important advantage of a low-temperature district energy system is the reduction of greenhouse gas emissions. Comparing emission rates between traditional heating ventilation and air-conditioning (HVAC) systems and the proposed low-temperature district energy system in the Hill and Creek neighborhoods shows carbon dioxide emissions are could be reduced by almost 30% or 310 tons CO<sub>2</sub>/year.

Implementing a low-temperature district energy system in the residential neighborhoods of TCAAP can deliver several benefits to the site and stakeholders, including the following:

- An energy system that is more energy efficient than traditional heating and cooling systems.
- Reduced fossil fuel usage and greenhouse gas emissions.
- Competitive, stable costs of energy for homeowners.
- Xcel Energy could avoid installing gas pipe in the neighborhoods

**The available energy from the treated groundwater can serve all of the TCAAP homes with a lower-cost energy source that reduces GHG emissions by ~30%.**

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- Installation of an infrastructure network in the neighborhoods will allow for easier integration of future energy sources or technology advancements as they become available.
- Implementation of this system would establish the TCAAP approach to sustainable neighborhoods as a national model for energy efficiency and innovative site development.

### Additional Energy Technology Opportunities

While not recommended for any of the initial options in this Framework, there are two additional technologies that should be considered for future TCAAP energy system integration:

**Thermal Energy Storage** – On the AHATS site, there is an existing one million gallon water storage tank and related water distribution piping. This tank could be used as a thermal energy storage tank to store water for the heating and cooling needs of the area. This would work like a battery, which would fill up during non-peak energy hours and be discharged during peak energy usage times to balance out the energy usage profile for the area.

**Solar Thermal** – The MNARNG utilizes solar-thermal technology on its buildings and is investigating further integration of it as their site is built out. This technology should be considered for individual sites or as part of a larger energy plan for TCAAP development.

### Energy Efficiency Strategies through Demand-Side Management (Outlined in Section 4)

To promote energy efficiency at TCAAP, the Project Team recommends a combined approach through flexible building design assistance, readily available technical resources, planning best practices, and development RFP criteria that will attract and streamline energy efficient development. High-performance buildings with a lower energy profile will provide an economically attractive environment where building owners save money through increased efficiency and lower energy bills. The implementation of improved building energy efficiency will be as important as the energy sources to achieving the community's low-carbon, resiliency goals. Considering demand-side management alongside development increases the opportunities for demonstration projects and resident, tenant, and commercial participation. For these efforts, Xcel Energy and the Center for Sustainable Building Research at the University of Minnesota will be valuable partners.

Throughout the development of TCAAP, the recommended demand-side initiatives will depend strongly on engaging developers, who can help implement the TCAAP energy vision. These energy efficiency recommendations make use of the truly unique opportunities at TCAAP, which include:

- A greenfield development to minimize the cost of initial installation of energy efficient systems.

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- The advantage of large scale deployment to optimize economies of scale.
- Focus on replicable designs and proven technologies to simplify developer implementation.
- Emphasis on building performance based standards, instead of only design conditions.
- Important strategic partnerships with Xcel Energy and the Center for Sustainable Building Research at the University of Minnesota.

### High-Efficiency Commercial Buildings

As development moves forward it is recommended that the County, the JDA, and development consultants utilize building standards, technical resources, planning tactics, and proposal criteria to attract and streamline energy efficient development.

#### *Utilize SB 2030*

*Minnesota's Sustainable Buildings 2030 (SB 2030)* is a performance based building energy standard developed to incrementally move new commercial building construction to net-zero energy by 2030. On average, SB 2030 will require commercial buildings to be 35% to 45% more efficient than the new building code (IECC 2012). As nearly 75% of the energy loads for TCAAP are estimated to be in the retail, commercial, and flex areas of the development, energy conservation measures for these areas will be paramount for successful achievement of the Energy Vision. The key way to incentivize use of SB 2030 is to give preference during the RFP review process to proposals that plan to implement these standards.

**On average, SB 2030 will require commercial buildings to be 35% to 45% more efficient than the new building code (IECC 2012).**

### Sub-metering

Commercial and multi-family building sub-metering is an important consideration because the additional design cost is relatively low when considered up front, but has the potential to maintain lower energy use since tenants directly see and pay for their energy use.

Sub-metering has been shown to save up to 21% in leased building spaces.<sup>1</sup> The material, software, and labor cost for each sub-meter ranges from \$5,000 to \$7,500. Several metering companies provide sub-metering services by owning, operating, and maintaining the meters. Monthly fees are based on

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<sup>1</sup> "Tenant Occupants of Green Office Buildings: Driving the Market for Improving Existing Building Stock" McGraw-Hill Construction and CBRE. September, 2011. [www.cbre.com/EN/aboutus/MediaCentre/2011/Pages/10062011.aspx](http://www.cbre.com/EN/aboutus/MediaCentre/2011/Pages/10062011.aspx)

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the type of service needed and the quantity of sub-meters served, but costs per sub-meter range from \$150 to \$400.

### Strategic Building Siting and Co-Location

The County and JDA could facilitate building co-location through the platting and RFP process. Building energy use types can be identified as potential candidates, and referred to energy design experts to define the specific energy benefits that could be achieved through co-location. Buildings with processes that produce hot water or heat could sell their excess to adjacent buildings that have use for it at different times of day. District energy infrastructure could enhance this load diversity and energy sharing. Businesses would be interested in this opportunity because it would improve the efficiency of their consumption, reduce upfront capital equipment and maintenance costs, and increase comfort.<sup>2</sup>

### Low-Load Residential Development

Residential developments at TCAAP could feature homes that do not require natural gas, by utilizing electric appliances and serving minimal heating and cooling demands through ground-source heat pump technology. A low-load home would not require the larger heating and cooling capacity of traditional systems, but instead could meet residents' comfort needs with smaller capacity systems. The key technologies and strategies include high levels of building insulation and passive solar design, a tight building shell, and high efficiency lighting and appliances. These homes do not require significant insulation like a passive house, but are 40% to 50% more efficient than what is required by the new energy code (IECC 2012).

**Homes built at TCAAP could be 40% to 50% more efficient than what is required by the new energy code.**

Incorporation of high-performance technologies that have little to no impact on the up-front costs, such as efficient appliances and low-flow plumbing, will help minimize hot water use and help maximize home efficiency.

### Building Orientation and Passive Solar

The process for solar-oriented development should be described in residential and commercial building RFPs and should be integrated as evaluation criteria for development proposals. It should be evaluated based on lowest total energy load of the homes or buildings to be sited under one proposal and should consider street orientation, building orientation, and passive solar building envelope design elements.

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<sup>2</sup> The Primary Energy Factor (PEF) difference between district heating systems and Gas-fired heating (0.8/1.3=0.61)  
[http://www.euroheat.org/Files/Files/documents/Publications/District%20Heating%20in%20buildings\\_final.pdf](http://www.euroheat.org/Files/Files/documents/Publications/District%20Heating%20in%20buildings_final.pdf)

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The thermal loads of homes and commercial buildings will be impacted by the building envelope, street orientation, lot and building orientation, and building massing. The likely locations where street orientation could vary significantly to accommodate energy implications would be the Creek, the Hill, and the Transition neighborhood on the periphery of the Town Center.

**By pairing solar heat gains and window design strategies, heating energy savings can be up to 30%**

By considering these variables prior to the subdivision process, planners and developers have the opportunity to produce efficient results with little or no-cost impacts.

### High-Efficiency Streetlights

The City of Arden Hills has included a site-wide requirement for all streetlights to be “high-efficiency lighting, such as LED lamps.” This requirement will trigger the inclusion of high efficiency lights in the development process. Current LED technology saves approximately 50% to 70% of lighting energy use. Another significant cost savings occurs by additionally reducing maintenance costs, given the longer life of the bulbs.

### Community Participation and Education

Community participation and education have been consistently mentioned as important factors for TCAAP, both to engage the wider Arden Hills community and to leverage the energy savings potential from facilitating ongoing awareness of energy use by site tenants and residents. Many details of community engagement will need to be planned once the site sees its first residents and tenants. However, certain engagement elements can be planned for or implemented during the early development stage, including:

- A TCAAP or Arden Hills-wide website that tracks energy goals and performance of buildings at the site, including energy and carbon savings. The website could promote major metrics and milestones, and issue periodic challenges (e.g. the “lowest user” challenge).
- Community-wide open house or showcase events of leading edge technologies on the site, especially for housing, that will attract and excite potential residents.
- Commissioning of design or signage elements in public spaces that connect users to the site’s energy resiliency goals and their contribution and participation in those goals. A targeted marketing campaign around community solar development, as an early symbol of community-driven, low carbon energy use at the site.

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### Demonstration Opportunities

#### Advanced Distribution Grid

TCAAP's greenfield status, combined with the site's forward looking energy vision, make it an ideal opportunity to pilot and demonstrate advanced technologies in the electric distribution grid. Many of the opportunities outlined in this report, such as high solar PV penetration, advanced commercial building metering, or responsive electric loads, are all facilitated by a distribution system with increased communications and control functions. Implementing an advanced distribution grid can save customers money and reduce the environmental impact of their energy use.

**By laying the groundwork for an advanced distribution system at TCAAP during the planning phase, residents and businesses would have access to cutting edge opportunities such as advanced rate design or real-time load response.**

#### Innovative Energy Technologies

In addition to pilot opportunities at the grid level, TCAAP is ideal for demonstrating innovative energy technologies at scale. The Project Team recommends that the JDA and County seek and attract partnerships to demonstrate proven technologies and strategies. While the technologies may be proven, TCAAP offers scalable and living demonstration opportunities, where an apartment, house, or street of homes could serve as a living lab. Additionally, as a cold climate site that can attract multiple partners, there is great opportunity to demonstrate the synergies that can exist between multiple innovative technologies and design strategies. This might include piloting new in-road luminescent street or pedestrian path lighting products in conjunction with high efficiency overhead LED street lighting, electric vehicle storage and integration, or homes that have on-site electric storage and remote controlled appliances/electronics that communicate with each other.

### Conclusion

The ERAB has adopted a very forward-thinking vision for the TCAAP site. This will be achievable through strategic partnerships with Xcel Energy, the MNARNG, the University of Minnesota Center for Sustainable Building Research, environmentally conscious citizens, and developers who see the economic and environmental value of the TCAAP energy vision. Through these partnerships, TCAAP will be uniquely poised to be the national model for the development of integrated energy systems.

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The first steps toward achieving the energy vision include implementing energy supply options that focus on efficiency, reliability, scalability, and sustainability, such as the low-temperature district energy system in the residential neighborhoods and the community solar garden at the Primer Tracer site. These specific opportunities have been shown to be financially beneficial and financeable. Developing a CHP that meets the needs of current buildings in the area and is expandable in the future provides a platform for establishing a resilient TCAAP microgrid as TCAAP development progresses.

Implementing a demand-side management strategy that focuses on building performance through the development RFP process will build a resilient community for energy use. Focusing on improving performance in the buildings to reduce the energy needs of the buildings will provide an economically attractive environment as building owners are able to take advantage of the financial savings realized by the increased efficiency, compared to traditional energy expenditures.

**Initial focus should be on energy efficient designs, the low-temperature district energy system in the residential neighborhoods, and the community solar garden at the Primer Tracer site.**

### Schedule and Next Steps (Outlined in Section 6)

The development schedule that is currently proposed is scheduled to begin in 2016 with the construction of the interchanges of County Hwy 96 and County Road H with the Spine Road. The Spine Road construction is also expected to begin in 2016. Currently, site development is projected to begin with the residential and retail areas in the northern region of TCAAP in late 2016 or early 2017. Development is expected to progress southward from the Town and Creek neighborhoods as the market allows. The Thumb area is being actively marketed by the JDA at this time, and could be developed as soon as the right proposal is received from the development community. The current development plan is included in the appendix as Exhibit III.

**Development at TCAAP will begin in 2016, therefore development and implementation of these recommended energy strategies will need to begin immediately.**

Given this development timeline, the JDA will need to begin implementation on each of the individual opportunities presented in this Framework, including immediate focus on the following:

- partnerships
- solar PV
- combined heat and power

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## Brief

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- low-temperature district energy system
- demand-side management
- infrastructure planning
- funding pursuits
- RFP development
- education workshops

The TCAAP site is positioned to be a national model for site redevelopment. With planning and leadership, this area can be developed to meet the bold energy vision of the ERAB to become a vibrant development that leverages long-term energy conservation and resilience to attract investment and partnership, and achieves sustainable benefits for Arden Hills and the surrounding community.

# TCAAP Energy Integration Resiliency Framework

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# TCAAP Energy Integration Resiliency Framework

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## Energy Integration Resiliency Framework

### 1. Introduction

The Twin Cities Army Ammunitions Plant (TCAAP) site offers an incredible opportunity for Ramsey County, Arden Hills, and the surrounding community to build a forward-looking community that optimizes the energy and environmental opportunities of the next generation. Innovative energy supply systems can be developed for reliability and resiliency, increased use of local renewable energy systems can reduce the environmental impact of redevelopment, and energy efficient buildings can provide low-cost energy for residents and tenants. The TCAAP site is positioned to be a national model for site redevelopment. With planning and leadership, this area can be developed to utilize economically competitive, low-carbon energy sources, follow exceptional energy and environmental standards, and engage future residents as stewards of the energy vision.

Beyond being a greenfield, TCAAP has a number of characteristics that make it distinctive. One of the unique opportunities TCAAP redevelopment offers is the potential to partner with the local utility provider, Xcel Energy, and the MNARNG on energy supply infrastructure and operations. The MNARNG owns and operates the AHATS adjacent to the TCAAP site. The MNARNG has developed a master plan for the buildings on its site that includes the goal of net-zero energy, water, and waste, and are currently working on implementation plans to achieve this goal. The partnership between the MNARNG, the City, and County creates dynamic and beneficial opportunities for all entities.

Xcel Energy provides electricity and natural gas to the area in and around Arden Hills. Xcel Energy views the TCAAP redevelopment as an opportunity to partner with local government and the community to develop demonstration projects that showcase energy efficiency and resilient energy projects.

To facilitate TCAAP redevelopment, the County and the City have engaged in a partnership through the formation of a Joint Development Authority (JDA). For the purposes of energy planning, they have also established the Energy Resiliency Advisory Board (ERAB) and appointed community stakeholders to help define the TCAAP energy vision. The ERAB has worked with energy experts on the Project Team to develop a two part TCAAP Energy Integration Resiliency Framework that outlines the appropriate planning guidelines and policies with careful consideration of local resources, stakeholder interests, project goals, and the best available technologies for implementation over the next 50 years.

Phase one of the study was the development of the *Policy White Paper* which was accepted by the JDA and the Arden Hills City Council in November, 2014. The *White Paper* provides a unifying vision for the site's energy future and identifies the most beneficial opportunities for energy efficiency and efficient energy supply options. Phase two of the study is to develop this document, the *Energy Integration Resiliency Framework (Framework,)* which provides more details about how the County, the City, and

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the JDA can technically achieve the vision and recommendations put forth in the *White Paper*. The Framework focuses on determining which energy supply technologies can be built during the early phases of site development and would be financially beneficial, financeable, practical, and achievable. The Framework also provides more detailed analysis of the optimal initial energy efficiency strategies, including demand-side management, advanced technology, and building design. Each of these opportunities is considered with the goals, benefits, and risks for the County, City, JDA, ERAB, the MNARNG, and Xcel Energy in mind.

Through the development of the *White Paper*, the ERAB outlined their vision and guiding principles for TCAAP energy development.

## Vision Statement

TCAAP will be a vibrant development that leverages long-term energy conservation and resilience to attract investment and partnership, and achieves sustainable benefits for Arden Hills and the surrounding community.

## Guiding Principles

- Establish TCAAP as a national model for development of integrated energy systems
- Develop a resilient community for energy and other utilities
- Implement infrastructure solutions that are flexible and scalable over the next 50 years
- Deliver a model of efficient energy and water usage that minimizes TCAAP's impact on the environment
- Create an economically competitive and attractive environment for developers and businesses

## 2. Partnership Opportunities

### 2.1. Background

The TCAAP EIRF Project Team met with members of the Minnesota Army National Guard staff to discuss the potential for working together to meet the energy needs and goals of both sites. In those meetings, it was found that the goals of the MNARNG are very similar to the energy vision established by the ERAB. Together, the MNARNG and the Project Team identified several energy-supply opportunities that should be pursued, including solar photovoltaic (PV), combined heat and power

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(CHP) generation, energy capture from treated groundwater, and thermal energy storage. In addition, the parties identified several opportunities for collaboration on energy efficiency improvements and demand-side management.

The Project Team has also engaged in discussions between the County, the MNARNG, and Xcel Energy to gauge the utility's interest in each of these opportunities. Xcel Energy has expressed interest or support of each option, with further details provided in the following sections.

The remainder of Section 2 provides further details on each of the partnership opportunities identified in the conceptual map provided in Exhibit I.

## 2.2. Energy Loads

Following the development of the *White Paper*, the Project Team refined the estimated loads for the TCAAP site to reflect the changes to the TCAAP Redevelopment Plan. The Project Team also collaborated with the MNARNG to understand the energy needs of current and future buildings on the AHATS site. In addition to the AHATS and TCAAP sites, the Project Team identified one existing campus and one possible future campus that could be connected to the proposed system. The RCPW facility on County Highway 96 is an existing facility adjacent to AHATS and TCAAP that could be integrated with the initial system.

In the Primer Tracer area on the north edge of TCAAP and AHATS, the Department of Public Safety facility is contemplating the installation of an emergency operations facility that, if built, could be a strong candidate for connecting to the proposed system.

The Project Team also worked with Xcel Energy to estimate energy loads that were in line with energy usage in Minnesota. The estimated loads for all prospective customer areas are provided in Table 1.

# TCAAP Energy Integration Resiliency Framework

Estimated Energy Loads			
	Electric	Thermal	Cooling
TCAAP	8.0 <sup>1</sup> MW	38.9 <sup>1</sup> MMBtu/hour	617 <sup>1</sup> tons
AHATS	3.4 MW	7.3 MMBtu/hour	500 tons
DPS EOC	0.07 MW	0.5 MMBtu/hour	30 tons
RCPW	0.40 MW	4.1 MMBtu/hour	240 tons
<b>Estimated Total</b>	<b>11.9 MW</b>	<b>50.8 MMBtu/hour</b>	<b>1,387 tons</b>

Note:

<sup>1</sup> Loads are estimated based upon the current projection of land use.

Table 1: Total estimated energy loads

## 2.3. AHATS Considerations

Through initial discussions with the MNARNG, the following considerations were identified as being important components of energy plan development for the MNARNG:

- The MNARNG has net-zero goals for energy, water, and waste.
- The MNARNG intends to develop an energy resiliency plan for periods of grid outage in order to meet mission requirements, including the ability to be disconnected from the larger grid.
- The MNARNG will need to receive benefit for any opportunity that is developed on its property.
- The development must not be intrusive or obstruct the training at AHATS.
- Funding is limited for the MNARNG. Third-party financing is preferred.
- Third-party operations and maintenance of the installed systems is preferred.

These fundamental goals will continue to drive much of the partnership discussions with the MNARNG and have been included in the planning for the options provided in this Framework.

## 2.4. Xcel Energy Considerations

TCAAP provides an opportunity for Xcel Energy to pilot advanced energy solutions that will help them meet and exceed their Minnesota energy efficiency and renewable energy goals. Through discussions with Xcel Energy, the Project Team has identified the following considerations that will be important through the course of development:

# TCAAP Energy Integration Resiliency Framework

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- Consideration should be given to the potential for an Xcel Energy-owned community solar garden, which could expedite development, minimize potential risks, and visibly demonstrate partnership linkages at the TCAAP site.
- Xcel Energy would be an important support partner in any innovative energy demonstration projects at the site, and for investments at TCAAP that would help the utility further its statewide efficiency or renewable energy goals.
- As a regulated utility, Xcel Energy’s investments into the TCAAP site are more likely to be supported if the ERAB, JDA, and other local partners would advocate for these investments and partnerships with the Public Utilities Commission.

Xcel Energy leadership has expressed a commitment to partnering with the County and the JDA in the implementation of the TCAAP energy plan, and the County should continue to pursue opportunities that can benefit both parties and achieve the energy vision for TCAAP.

## 2.5. Near-Term Partnership Opportunities

Through partnership discussions, a number of immediate and implementable partnership opportunities were identified to meet the loads of the buildings that are currently in the area, as well as the initial buildings expected to be built at TCAAP. The related technologies are introduced in this section and further explored later within the Framework.

### 2.5.1. Solar PV

#### 2.5.1.1. Primer Tracer

The Primer Tracer area neighboring the AHATS and TCAAP sites is currently an area with soil contamination that requires remediation to be suitable for development. The Army Corps of Engineers has shown interest in having this site cleaned up and put to productive use, and it does present a good opportunity for the construction of a solar PV site because of the limited excavation, maintenance, and human interaction that is necessary. The site is approximately 60 acres in size, with 20 acres being considered for the Department of Public Safety State Emergency Operations Center. This would leave 40 acres for a large-scale solar installation. Based on generally accepted solar generation estimates, this 40-acre site could generate approximately 8 megawatts of electricity (MWe) in peak conditions, depending on the technology and system installed. Conservatively, this could account for approximately 70% of the peak electric load for the area.

# TCAAP Energy Integration Resiliency Framework

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## 2.5.1.2. AHATS Solar PV

The 2009 Master Plan for AHATS produced by Jacobs Engineering identifies a two MWe solar PV installation at the capped soil area west of the existing Field Maintenance Shop. This installation would primarily meet a portion of the electric needs of the AHATS site, but could provide renewable electric energy to TCAAP during the non-peak energy usage times at AHATS.

## 2.5.2. Combined Heat and Power

Combined heat and power (CHP) could be used to meet the electric needs of TCAAP and adjacent properties, while simultaneously capturing the thermal energy created from electric generation to meet the thermal needs of the area. This would provide a local energy generation source to the area that could be disconnected from the grid in the event of a grid disruption. As the existing electric and thermal energy loads are based at the AHATS and RCPW buildings, it would be optimal to locate the initial CHP plant as close to those buildings as possible, with the opportunity of expanding it to meet future TCAAP energy needs. This initial proposed location provides two advantages. First, having the plant located near the initial load will reduce the up-front capital cost for the installation of the distribution network providing thermal energy. Second, this location is near the existing and proposed AHATS buildings, meaning that training operations (located in the central and northern areas of AHATS) would not be negatively impacted. Additional CHP facilities could be located in the Thumb area of TCAAP, or near other concentrated loads at TCAAP as development proceeds. The CHP system should be designed to allow for expansion to serve the thermal needs of the TCAAP site as it is developed, to align with the vision of TCAAP as a comprehensive energy program that optimizes efficiencies, minimizes costs, and reduces greenhouse gas emissions. The initial system should also be designed for future fuel flexibility, such as biogas integration, and the ability to meet growing thermal needs of the area.

## 2.5.3. Groundwater Treatment Station

Approximately two million gallons per day (2 MGD) are pumped to AHATS from the groundwater treatment station located on TCAAP. This pumping is required to continue until the chemical remediation goals are reached for the water, which is estimated to be at least another 25-30 years. This groundwater pumping can be useful to meet the energy goals of both AHATS and TCAAP through the implementation of a low-temperature district energy system.

In addition, kinetic energy could be captured from the pumped water at the point of discharge at the gravel pit on the AHATS site. The water is being pumped uphill to a point that provides energy which potentially could be used for micro-hydroelectric generation. This would provide a small amount of electric generation, but could be used to offset the power necessary to pump the groundwater.

# TCAAP Energy Integration Resiliency Framework

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The temperature of the water in this loop is close to 52° F throughout the year. Assuming a thermal energy transfer of 11° F, the energy in the water per hour is estimated to be approximately 10 MMBtu/hour. This energy would be enough to meet the heating and cooling needs of the residential neighborhoods of TCAAP, with approximately 3 MMBtu/hour of excess capacity available for AHATS or additional TCAAP buildings. When groundwater remediation is completed, the district energy infrastructure could be utilized to distribute energy from other sources such as low-grade waste heat recovery or geothermal wells.

## 2.6. Future Potential Opportunities

### 2.6.1. Thermal Energy Storage

On the AHATS site, there is an existing one million gallon water storage tank, and related water distribution piping, that was originally used during ammunitions manufacturing. The tank was built with adequate ground cover to prevent water from freezing in the winter. This tank could be used as a thermal energy storage tank to store water for the heating and cooling needs of the area. This would work like a battery, which would fill up during non-peak energy hours and be discharged during peak energy usage times to balance out the energy usage profile for the area. The size, shape, and structural condition of the tank need to be studied to judge the feasibility of this opportunity. It is likely that the tank would require the installation of a liner or bladder to be able to hold water. While utilization of this tank is not included in any of the immediate options detailed in this Framework, it is a valuable asset that should be contemplated as each energy option is further developed, and as TCAAP redevelopment progresses.

### 2.6.2. Solar Thermal

Solar thermal systems are most commonly installed on residential and small commercial buildings, although larger shared systems are gaining popularity. Solar thermal systems are comprised of solar collectors and a fluid moving between the collectors and a hot water reservoir. Typically the heated fluid is pumped from the tank to a heat exchanger where heat is extracted into the air to heat space or domestic hot water. Solar thermal systems are highly efficient in their ability to capture and transfer solar energy.

When included as part of a broader energy plan, benefits of a solar-thermal system can be enhanced. For example, solar thermal can be paired with thermal storage to capture excess energy when it is available and dispatch to users during higher demand periods. The MNARNG utilizes solar thermal technology on its buildings and is investigating further integration of it as their site is built out. Solar thermal is not a priority recommendation for initial implementation, but this technology should be considered for individual sites or as part of a larger energy plan as TCAAP development progresses.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

### 3. Energy Source Implementation

As outlined in the partnership section, there are immense opportunities for technology development at TCAAP. The success of their implementation hinges on the effectiveness of partnerships and incorporating the right technology solution for the right project within the development. The technologies recommended in the following section were selected to fit the partner interests, development timeline, and both environmental and economic goals. This includes the reduction of greenhouse gas emissions. Through the implementation of the energy supply opportunities presented in this section, the TCAAP development will be poised to reduce the amount of CO<sub>2</sub> emitted into the atmosphere as the equivalent amount of CO<sub>2</sub> produced by 1625 automobiles<sup>3</sup>.

Greenhouse Gas Emissions Reduction Summary		
	Annual CO <sub>2</sub> Reductions	% Reduction from traditional scenarios
Solar PV	7,524 (tons CO <sub>2</sub> /yr)	100%
CHP	676 (tons CO <sub>2</sub> /yr)	19%
Low Temp District Energy	310 (tons CO <sub>2</sub> /yr)	29%
<b>Totals</b>	<b>8,510 (tons CO<sub>2</sub>/yr)</b>	<b>70%</b>

Table 2: Greenhouse Gas Emission Reduction Summary

The environmental benefits shown in Table 2 will be further increased through implementation of demand-side management strategies outlined in section 4, and will lead to more sustainable redevelopment of TCAAP. This combination of responsible energy supply opportunities, sustainable building practices, effective demand side management, continuous commissioning of building systems, and improving occupant awareness set the stage for the possibility of the entire development being carbon-neutral in the future.

#### 3.1. Solar PV

As noted in the *White Paper*, the utilization of solar PV technology can enable the generation and utilization of renewable energy at TCAAP. While individual property owners could choose to install roof-mounted or ground-mounted solar PV systems for some of their site needs,



<sup>3</sup> <http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results>

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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another possibility would be to install a large-scale community solar array adjacent to the TCAAP site.

### *3.1.1. Introduction*

The most prime opportunity for solar PV is likely within the Primer Tracer area north east of the existing TCAAP site. The array, as proposed, would reach a peak of approximately 8MWe of solar PV generation, which would produce approximately 14,500,000 AC kWh of energy annually. The project could be financed by Xcel Energy or a third party developer through a combination of debt and equity, with the land leased from the County or the MNARNG. The project owner could utilize available tax incentives such as the 30% investment tax credit and 5-year accelerated depreciation to help offset the cost of the project and lower the cost of energy from the array. Electric energy sales and associated revenues could be generated from subscribers' purchases or lease interests of the solar garden system through Xcel Energy's existing community solar garden program. Alternatively, Xcel Energy could own, develop, and sell the energy from the project.

### *3.1.2. Implementation Strategy*

#### *3.1.2.1. Existing Project Site*

Between 40 and 60 acres of land are available for the preliminary development of a solar PV array. This plot of land is relatively flat, with minimal elevation change from north to south or east to west. Although a detailed siting study was not conducted, the site characteristics determined by a Google Earth analysis all point to a feasible site with significant potential. This solar array would be built atop land with existing structures currently in place. These structures would be demolished and removed as part of the solar project construction. Current structures, above and below grade would need to be removed to a depth of approximately five feet.

#### *3.1.2.2. Conceptual Solar Plant Site Layout*

A conceptual layout of an 8 megawatt alternating current ( $MW_{AC}$ ) capacity solar PV array was prepared on the proposed parcel of land to assess feasibility of this installation on a 40 acre site. If all 60 acres are able to be utilized, the array could be increased to 12  $MW_{AC}$ . The array would consist of eight, 1  $MW_{AC}$  (1.3 megawatts of direct current -  $MW_{DC}$ ) blocks. Table 3 outlines the high-level plant characteristics for this potential array.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

Characteristic	Value
Plant Capacity (AC)	8MW
Plant Capacity (DC)	10.4MW
Block Capacity (AC/DC)	1MWAC/1.3MWDC
Module	310W poly-crystalline
Inverter	1 – 1000kW Central Inverter/block
Racking System	Fixed-Tilt @ 30°
Pitch	26.2 ft
Internal Access Roads	Inverter Access Roads: 30 ft All other internal roads: 16 ft

Table 3: Solar plant characteristics

A high-level representation of a potential site configuration is shown in Figure 1. Figure 1 depicts the manner in which an 8 MW<sub>AC</sub> capacity plant might be laid out on these 40 acres, but detailed design will need to confirm this configuration.



Figure 1: Solar PV plant conceptual site layout

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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### *3.1.3. Economic Analysis*

#### *3.1.3.1. PV System Components*

Solar PV power plants are simple in their operation. The main components of a solar PV plant include PV Modules, racking, inverters, transformers, combiner boxes, DC cabling and AC cabling. The modules convert the solar irradiance to DC power. A collection of modules are electrically wired together to form what is referred to as a “string.” Multiple strings are combined together into a single DC output in a combiner box. All outputs from the combiner boxes in a block are run to a central skid where they are connected to the inverter. The inverter converts the DC module power into AC power and feeds the AC output through a medium-voltage (MV) transformer. This transformer steps-up the inverter voltage to the solar arrays main collection system voltage. The inverters and medium-voltage transformers are often co-located on a platform referred to as the power conversation station, sometimes referred to as a skid. If a site has a local substation, then all the outputs from the skids feed into the substation where a generator step-up unit outputs the main interconnection voltage.

Racking is an integral part of any solar plant as it provides the support for the modules. In addition to proving a fixed point to which the modules are attached, racking serves as the means to optimize the angle between module surfaces and the solar irradiance. This angle has significant impacts on a solar plant’s energy production. There are two main classes of racking systems, tracking and fixed-tilt, the latter of which was used in this layout.

#### *3.1.3.2. Capital and Operations and Maintenance Costs*

The upfront capital construction costs are incurred during the development and construction of the plant. These costs include material costs, installation costs, contractor markup, and project indirect costs. The capital costs are impacted by relative system size (larger systems have the benefit of economies of scale), project location, and a collection of market factors. Project capital costs are commonly presented as a cost per installed watt basis (\$/W). This allows for project costs to be expressed independently of system size and provides for an easy comparison of costs for systems with difference characteristics. In addition to the cost of the solar PV array, the existing Primer Tracer site will need to have the existing infrastructure removed and the site will need to be redeveloped, before the project can be constructed. The land acquisition is expected to occur through a public benefit sale from the U.S. Government if the County acquired the property. If the MNARNG took possession it would be included in their license and remain in the ownership of the U.S. Government. The cost of the land acquisition is anticipated to be \$0 due to the nature of the site and the proposed usage. It is assumed that there will be no property taxes levied against the properties as the land owner will be a government entity. The estimated cost to remove the existing infrastructure and redevelop the 40

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

acres selected for the solar PV plant project is \$1,250,000. For this analysis, the cost has been assumed to be incurred by the project; however other sources of funding may be available.

Operation and maintenance (O&M) costs are incurred on an annual basis and are the costs associated with keeping the plant in proper working order. Common tasks associated with annual O&M activities include preventative maintenance, inspection, and corrective maintenance. O&M costs are often presented as a cost per installed kilo-Watt (\$/kW) to be incurred every year. When presented as a \$/kW cost, it is assumed that this cost will be incurred annually.

Table 4 provides an approximation of capital costs and O&M costs for the proposed 8MWac system.

Solar PV Costs	\$/W	Total
Solar PV Plant Cost	\$2.10/W <sub>DC</sub> ; \$2.73/W <sub>AC</sub>	\$21,850,000
Site Redevelopment Cost	\$0.12/ W <sub>DC</sub> ; \$0.13/ W <sub>AC</sub>	\$1,250,000
<b>Total Project Capital Cost</b>	<b>\$2.22/W<sub>DC</sub>; \$2.86/W<sub>AC</sub></b>	<b>\$23,100,000</b>
O&M Cost	\$16/kW <sub>AC</sub> /year	\$128,000/year

Table 4: Proposed solar PV capital, operation, and maintenance costs

### 3.1.4. Solar Resource Assessment and Energy Production

The annual energy production for the proposed array can be estimated with the use of the National Renewable Energy Laboratory (NREL) Solar Advisor Model (SAM). SAM uses a collection of input parameters to construct a model of the PV plant and analyze the energy production characteristics. These input parameters include: site location and meteorological data, module characteristics, inverter performance characteristics, solar array dimensions, system losses, and a collection of financial parameters. Using this information, SAM constructs a model of the solar arrays and then predicts plant performance over a typical meteorological year. The basic technical assumptions that were utilized to estimate the solar resource assessment and annual energy production from the solar array are provided in Table 5.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

Modules	Parameters
Cell material Multi-c-Si	St. Paul, MN Weather Data
Module area 1.9 m <sup>2</sup>	Tilt (deg from horizontal) 30
Module capacity 305 DC Watts	Azimuth (deg E of N) 180
Quantity 34,083	Tracking – Fixed
Total capacity 10.4 DC MW / 8.0 AC MW	Shading – No
Total area 65,473 m <sup>2</sup>	Soiling – Yes
	DC Losses (%) 3.0

Inverters	Annual Results (in Year 1)
Custom (Inverter Datasheet Model)	Horizontal solar 1,364 kW/m <sup>2</sup>
Unit capacity 1000 AC kW	Incident solar 1,604 kW/m <sup>2</sup>
Input voltage 620 DC V	Net to inverter 15,130,000 DC kWh
Quantity 8	Gross from inverter 14,675,000 AC kWh
Total capacity 8 AC MW	Net to grid 14,456,000 AC kWh
DC to AC Capacity Ratio 1.30	Capacity factor 15.9%
AC losses (%) 1.5	

Table 5: Solar advisor model solar resource and energy performance assumptions

Figure 2 shows the predicted net AC and DC energy production from the modeled solar resource. The AC energy levels are indicative of the energy exported to the grid at the point of interconnect. All system losses, both AC and DC, with the exception of substation and transmission line losses, have been taken into account.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

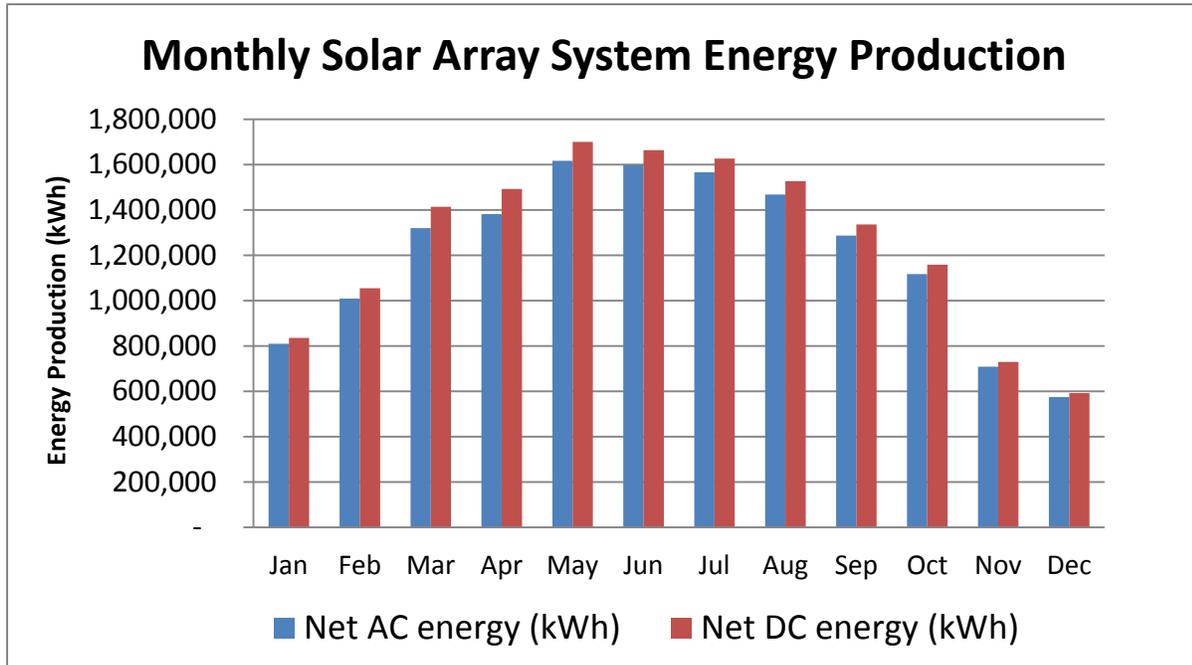


Figure 2: Solar advisor model solar energy production results

### 3.1.5. Financial Assumptions and Economics

SAM was used to estimate the levelized cost of energy (LCOE) and estimated price for the energy from the proposed solar plant project. The project is assumed to be financed by a developer who would be paid through subscriptions by consumers where the third party (a tax-paying entity) owns the solar plant on land leased from the County. Subscriptions with Xcel Energy retail customers are assumed to be established under the Xcel Energy Solar\*Rewards® Community® solar program. The developer would utilize the federal investment tax credit, accelerated depreciation, and a combination of debt and equity to fund the solar project. The key financial assumptions are provided in Table 6. If Xcel Energy were to own the project, these financial projections would likely need to be modified.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

<table border="1"> <tr> <td><b>Project Costs</b></td> </tr> <tr> <td>Total installed cost \$23,100,000</td> </tr> <tr> <td>Salvage value \$809,000</td> </tr> </table>	<b>Project Costs</b>	Total installed cost \$23,100,000	Salvage value \$809,000	<table border="1"> <tr> <td><b>Project Debt Parameters</b></td> </tr> <tr> <td>Debt fraction 57%</td> </tr> <tr> <td>Amount \$13,600,000</td> </tr> <tr> <td>Rate / Term 25 years, 5%</td> </tr> </table>	<b>Project Debt Parameters</b>	Debt fraction 57%	Amount \$13,600,000	Rate / Term 25 years, 5%			
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Table 6: Solar advisor model financial assumptions

Based upon an assumed IRR of 10% for the project developer and other noted assumptions, the Project Team estimated a subscription price for the solar energy of \$0.129 cents/kWh (as shown in Table 7). Xcel Energy retail customers who subscribe to production from the proposed solar garden under individual subscriptions would receive a bill credit equal to the energy purchased multiplied by the retail rates.

<b>Solar Economic Results</b>	
25-Year Nominal LCOE	13.90 cents/kWh
Solar revenues (year one)	\$1,865,000
Project 25-year IRR	10%
Subscription price	12.90 cents/kWh <sup>1</sup>

Note:

1. Subscription price does not include additional \$0.02/kWh bill credit provided if RECs are owned by Xcel Energy

Table 7: Solar advisor model economic results

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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### 3.1.6. Greenhouse Gas Emission Reductions

Implementing a solar PV array in the Primer Tracer area will result in a reduction of greenhouse gas emissions. Electricity offset by the solar output would be reduced to zero tons of CO<sub>2</sub> per year. The estimated greenhouse gas emission reduction is estimated to be 7,524 tons CO<sub>2</sub>/year, calculated by comparing the current Xcel Energy emission rates for the production of electricity in the Upper Midwest Region (1,041 CO<sub>2</sub> lbs/MWh<sup>4</sup>) as detailed in Table 8.

Solar PV Greenhouse Gas Emissions Reduction	
Solar Electric Generation	14,456 MWh
Eliminated Electric Utility Emissions	1,041 lbs CO <sub>2</sub> /MWh
<b>Total CO<sub>2</sub> Emissions Savings per Year</b>	<b>7,524 tons CO<sub>2</sub>/year</b>

Table 8: Estimated annual carbon dioxide emissions reduction

### 3.1.7. Community Solar Garden Program Approach

The modeled subscription rate for solar PV assumes that solar garden developers would elect to sell the Renewable Energy Credits (RECs) to Xcel Energy, for subscribers to receive a \$0.02/kWh enhanced bill credit. If the developer were to retain the RECs for this system, the bill credit would decrease by 2 cents/kWh. The estimated subscription rate is slightly less than the current Xcel Energy average Residential and General Service bill credits; however that difference will increase over time if Xcel Energy applicable retail rates increase and the subscription rate remains fixed. Table 9 shows how this estimated first year subscription price for the electricity generated by the solar garden compares to the Xcel Energy bill credit rates for three types of Xcel Energy customers. It is assumed that the economic benefits of the solar garden subscription would improve as the electricity rate increases over the life of the subscription.

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<sup>4</sup> <https://www.xcelenergy.com/staticfiles/xcel/Corporate/CRR2013/environment/emissions-reporting.html>

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

Rate Category	Solar Subscription (\$/kWh)	First Year Bill Credit (\$/kWh)	First Year Savings (Cost) (\$/kWh)
Xcel Energy Residential	\$0.1290	\$0.1403	\$0.0113
Xcel Energy Small General Service	\$ 0.1290	\$0.1378	\$0.0088
Xcel Energy General Service	\$0.1290	\$0.1146	\$(0.0144)

Table 9: Solar subscription and Xcel Energy bill credit comparison (REC's retained by Xcel Energy)

For the solar PV project to be developed under the Xcel Energy Solar\*Rewards® Community® solar program, it will be important for the developer to have several large credit-worthy subscribers secured to allow the project to be financed at a low cost of debt. This could include the City of Arden Hills, Ramsey County, the MNARNG, and other credit-worthy businesses in the area. Once the project has secured a large portion of the revenue stream from project subscribers, the project can be financed and developed with the potential for future residents and businesses to join as subscribers in the future. \ process for developing and preparing the necessary applications for the project will need to follow the guidelines outlined in the Xcel Energy Solar\*Rewards® Community® solar program<sup>5</sup>.

### 3.1.8. Next Steps

In order to capture the 30% Investment Tax Credit associated with community solar gardens, the proposed system must be in service by December 31, 2016. As such, implementation of this strategy must commence as soon as possible, and the following steps should be taken to continue development:

- Step 1** – Begin the land redevelopment process and secure funding approval. The County and the MNARNG, as potential property owners, will play key roles in this process, as a potential property owner.
- Step 2** – Secure a development partner to move the project through necessary stages of development. This could be either Xcel Energy or another solar developer, who could be selected by issuing an RFP for prospective developers.
- Step 3** – The solar garden developer will need to obtain letters of commitment from large solar garden subscribers to initiate the necessary business and financing structure. The

<sup>5</sup> (2015, 02 23). Retrieved 02 23, 2015, from Xcel Solar Rewards Community:  
[http://www.xcelenergy.com/Energy\\_Solutions/Business\\_Solutions/Renewable\\_Solutions/SolarRewards\\_Community-MN](http://www.xcelenergy.com/Energy_Solutions/Business_Solutions/Renewable_Solutions/SolarRewards_Community-MN)

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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County, City, JDA, MNARNG, the school district, and other partners could work with the selected developer to form an initial coalition of subscribers for the system.

### 3.2. Combined Heat and Power

#### 3.2.1. Introduction

The vision for TCAAP is that the Thumb, Town Center, and Flex areas could be served by a CHP energy system located at the TCAAP site or nearby. This localized energy source would enable achievement of many of the guiding principles established by the ERAB. The MNARNG has a similar energy vision for the AHATS site, and the partnership potential for a CHP system is very attractive. The Project Team recommends that the JDA and County collaborate with the MNARNG and Xcel Energy to define a preferred initial CHP strategy, considering the following:

- Collaboration between the JDA, the County, Xcel Energy, and the MNARNG could help identify an operational strategy and location for the initial CHP that is beneficial for all parties.
- Incorporation of a CHP system that meets the energy needs of all three sites would improve the economic competitiveness of CHP, due to the potential diversity of usage and load profiles.
- Due to regulatory statutes, Xcel Energy has the exclusive authority to distribute and sell electricity across multiple properties in Arden Hills. If Xcel Energy is the owner, the CHP system could function as a microgrid system for the area, providing a local energy source for reliable electric and thermal energy for TCAAP, RCPW, and the MNARNG in the event of a grid disruption, meeting the goals of each of the sites.
- In the event that Xcel Energy is not the owner of the CHP, the proposed system may only distribute thermal energy across property lines, unless the electricity is sold to the Midwest Independent System Operators (MISO), in which case there would be an additional cost for the use of Xcel's infrastructure, which may prove to be cost prohibitive depending on the production cost and market dynamics.

While construction of independent CHP systems on both the TCAAP and AHATS sites could potentially be feasible, the economics of a connected system would be much more beneficial to both sites. However, the current uncertainty regarding the timing and type of TCAAP development restricts the opportunity to perform a complete evaluation of a CHP and district energy system for TCAAP at this time. With the unknown development conditions of TCAAP in mind, the Project Team has evaluated a scenario for CHP implementation in the Thumb and Town areas of TCAAP based on the assumed energy loads and envisioning how a CHP system could be implemented in the Thumb.

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## Energy Source Implementation

### 3.2.2. Initial Proposed CHP

An initial step toward a more comprehensive microgrid could be a small-scale CHP system that serves the existing loads of the Thumb and Town areas, as shown in Figure 3. The initial CHP plant could be located within the corporate campus area of the Thumb, which would provide the advantage of reducing the up-front capital cost for the installation of the distribution network providing thermal energy to the corporate campus and the Town. The CHP plant could be designed to allow for the integration of multiple fuel sources in the future to further increase renewable generation and system sustainability. Additionally, the CHP plant and district heating network, as proposed, could be designed to allow for expansion to serve additional buildings.

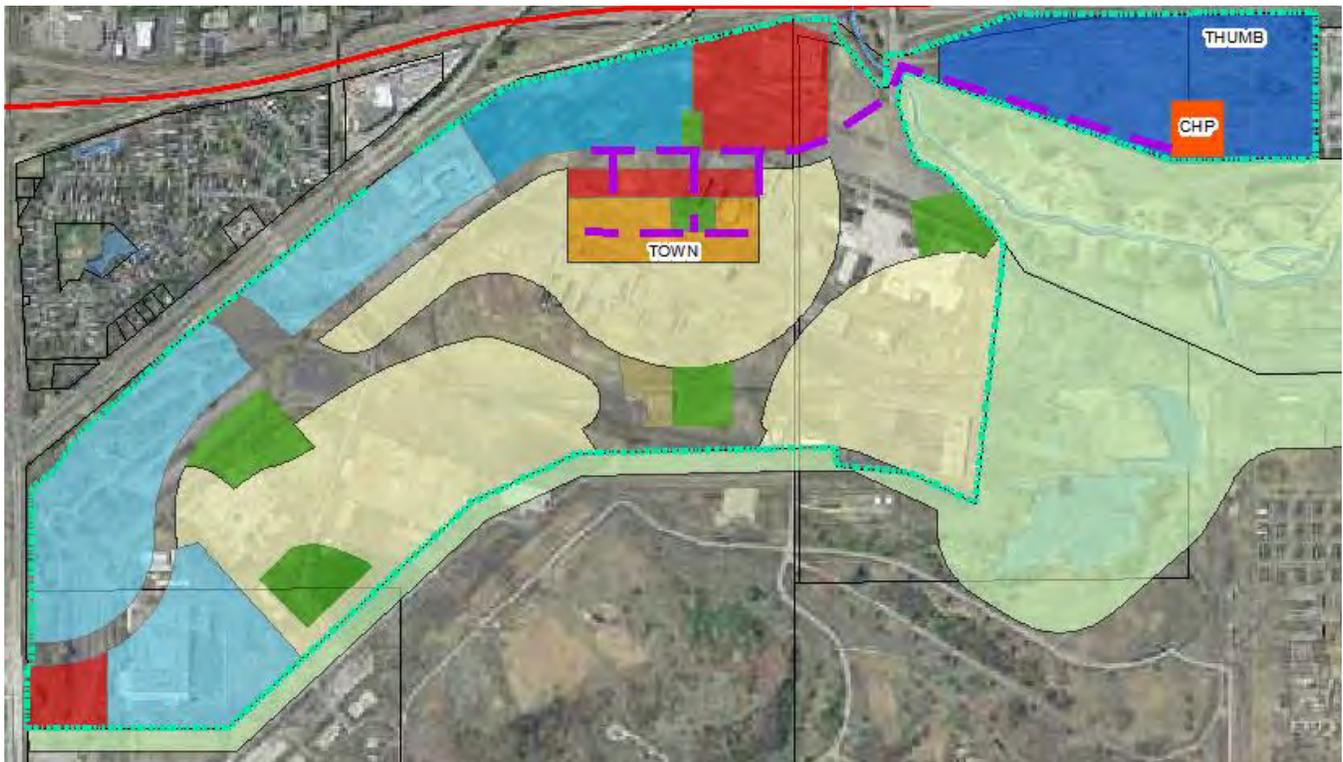


Figure 3: Initial potential CHP location and distribution plan north TCAAP

As TCAAP development progresses southward, those additional properties could also be served from the CHP facility in the Thumb by extending piping to those buildings in the Spine Road right of way, and expanding the capacity of the CHP.

In the next stage of CHP development, the design team should carefully analyze the pros and cons of the CHP application, and work with the JDA, County, and potential Thumb developers to determine the

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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optimal location and operational strategy for the initial CHP system. Regardless of the system’s initial configuration and location, the CHP design should allow for expansion to produce more electricity and thermal energy as energy demand in the area increases with TCAAP development. Expansion could also enable the development of a more comprehensive microgrid that would meet the MNARNG’s resiliency goals and the TCAAP energy vision.

### 3.2.3. Development Strategy

#### 3.2.3.1. Load Analysis

Before selecting the appropriate technology and size for a proposed CHP plant, a careful review of the potential electric and thermal loads must be considered. The proposed CHP project would be developed to serve the future electrical load of the Thumb area as well as the combined thermal loads of the Thumb and the adjacent Town area. A summary of the potential thermal and electric loads that the initial plant could serve is shown in Table 10.

	Annual Energy Usage	Annual Electrical Usage	Peak Energy Usage	Peak Electrical Usage
<b>Town</b>	12,485 MMBtu	2,561,111 kWh	4.06 MMBtu/hr	0.41 MW
<b>Thumb</b>	6,096 MMBtu	4,172,302 kWh	3.33 MMBtu/hr	1.19 MW

Table 10: Monthly Projected Energy Usage

The monthly aggregated load profiles are presented in Figure 4 and Figure 5. The Project Team assumed that the load profile for these areas would follow normal patterns of use for commercial buildings.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

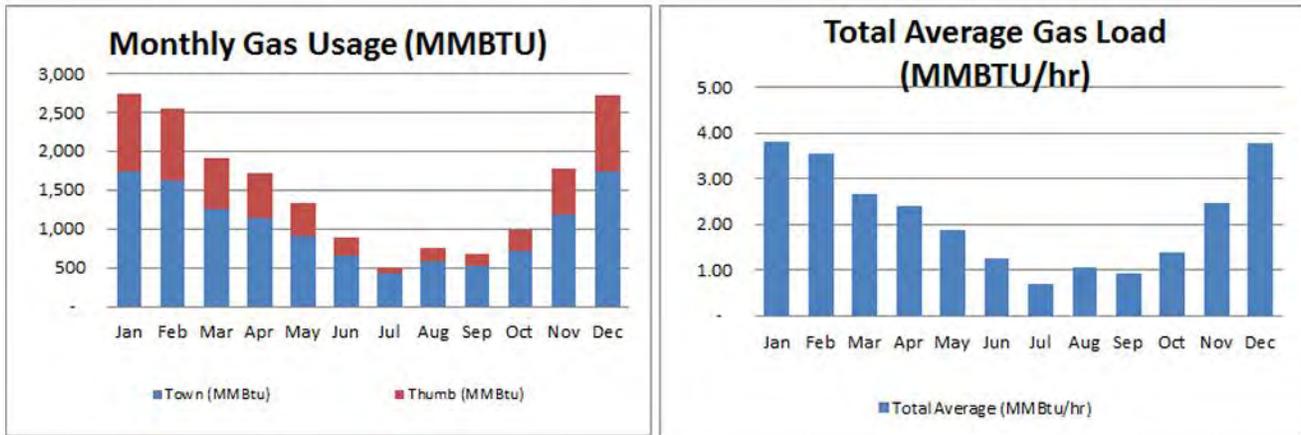


Figure 4: Monthly site gas usage

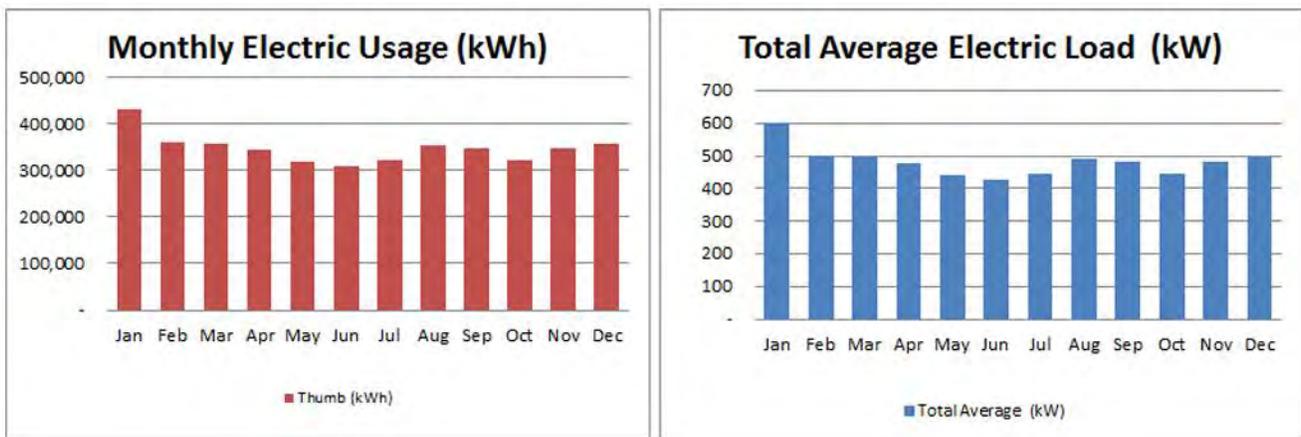


Figure 5: Monthly total site electric usage

### 3.2.3.2. CHP Technology Selection

Based on a review of the future electric load of the Thumb area and the thermal loads of the Town and Thumb areas, the CHP plant should have a maximum generator output no greater than 450 kW. For CHP applications in this size range, the most efficient and economical technology employed is gas fired reciprocating engines, with hot water heat recovery. Additionally, due to the limited heating load available during the summer months, it is generally more economical to employ a generation technology that has a high simple cycle efficiency resulting in a production cost lower than the utility's retail electric rate.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

For the proposed initial CHP, the Project Team assumed that a gas-fired reciprocating engine genset could provide 335 kW of electric power year round with approximately 1,372 MMBtu/hr of waste heat that would be available throughout the year. The waste heat would be utilized to offset hot water production in the existing buildings' boilers during the winter, spring, and fall. The waste heat from the CHP during the summer months would be exhausted and the plant would run in simple cycle mode at a production cost lower than the cost of purchased grid power. In the event that a year-round process heating load is added in the Thumb, additional thermal energy could be captured from the CHP and utilized, improving system economics, efficiencies, and environmental benefits. Figure 6 and Figure 7 provide a representative monthly dispatch chart showing how the plant would provide power and thermal energy to the site.

**In the event that a year-round process heating load is added in the Thumb, additional thermal energy could be captured from the CHP and utilized, improving system economics, efficiencies, and environmental benefits.**

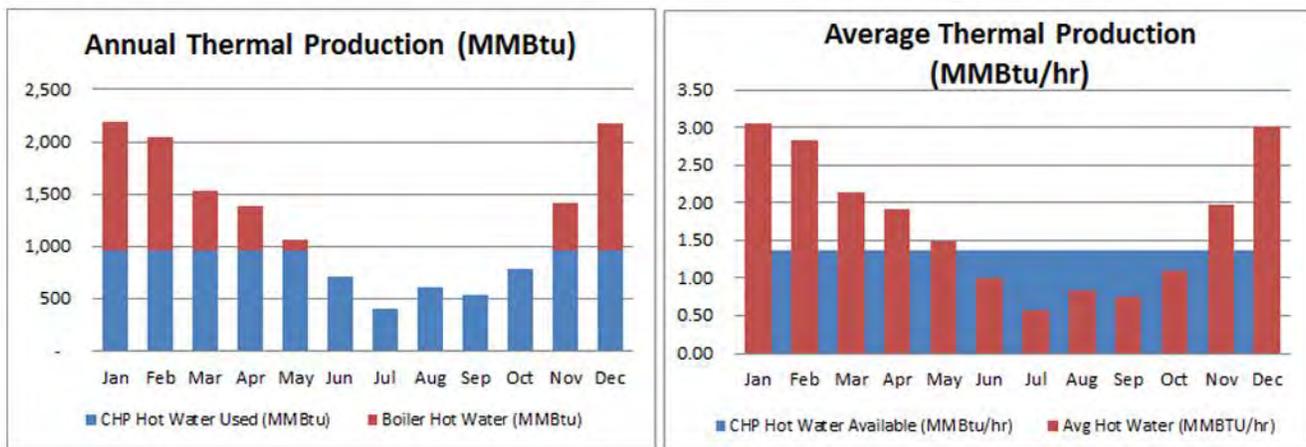


Figure 6: Monthly site thermal energy production by resource

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

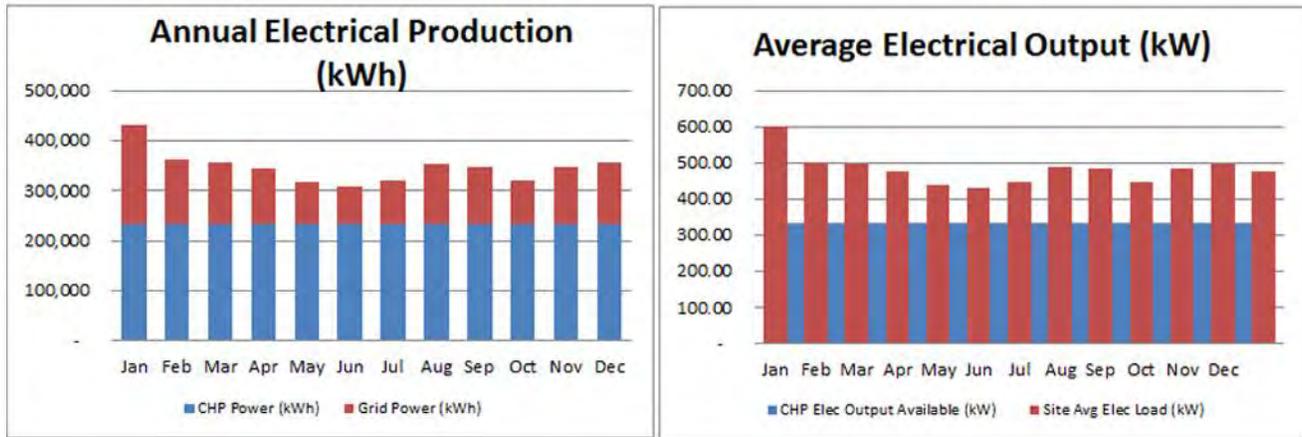


Figure 7: Monthly site electric energy production by resource

### 3.2.3.3. CHP Plant System Components

One new packaged cogeneration unit could meet the energy needs presented above. Waste heat from the engine cooling water loop and engine exhaust would be recovered to produce 1,372 MMBtu/hr of hot water at full-load. The hot water would be delivered to a hot water distribution system to provide heating energy to the Thumb and Town. The engine cooling water loop would produce 180-185 degree hot water, which would be used to provide the necessary thermal energy for heating the buildings and heating domestic hot water. A supplementary radiator located atop the CHP unit would remove heat from the engine cooling water loop when there is no need for building heating during the summer months.

In addition to the CHP plant, new hot water distribution piping and pumping would need to be installed to provide hot water supply and return to the connected buildings from the CHP plant. This distribution piping is assumed to be direct buried and would be routed as efficiently as possible to each of the buildings' central mechanical rooms. The district heating building interface, based on initial site investigations, could be achieved through a direct connect interface allowing for a low-cost installation at each building. The distribution configurations shown in Figure 8 are possible layouts for the initial system, but the actual location of the plant and routing of the pipe will need to be determined in the next stage of system development.

The full-load electric output of the genset is proposed to be 335kW at 480V. The genset power is assumed to be electrically interconnected to provide power to the future facility located at the Thumb, with standby and supplemental service provided by the electrical grid. The power from the CHP plant would be delivered to each of the Thumb buildings behind the meter and would offset retail electric purchases from Xcel Energy at the existing retail rate. For the economic evaluation, it was assumed the

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

genset would be operated at full-load with an availability of 95%. A conceptual process diagram of the proposed CHP plant is provided in Figure 8.

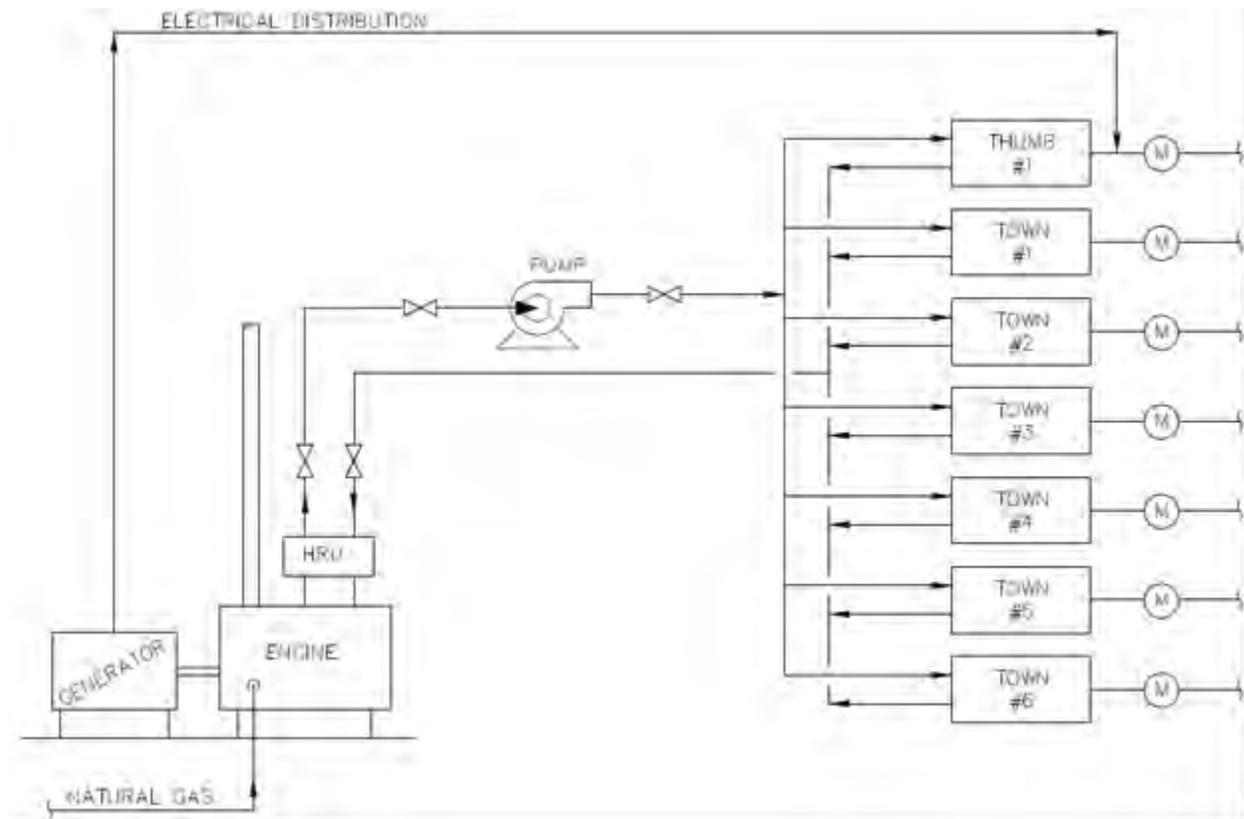


Figure 8: CHP project conceptual process diagram

The thermal needs of the Town are assumed to be met by the CHP system through the thermal energy distribution system. For the purposes of the economic model, the Project Team has assumed that Xcel Energy will not own the CHP facility and the Town will receive electricity from the electric grid. If Xcel Energy were the owner of the CHP, the initial plant size could be increased to also meet the electric needs of the Town, as well as the surrounding TCAAP developments.

### 3.2.4. Economic Analysis

#### 3.2.4.1. CHP Plant System Capital and O&M Costs

Estimated costs for the CHP plant were developed based on major equipment budgetary pricing and a conceptual distribution system layout. The initial CHP project primarily consists of the CHP plant, the distribution piping connecting the buildings, and the electric infrastructure required to connect the

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

output from the engine generator into the Thumb buildings. For the analysis, the Project Team has assumed that the CHP plant will be located within the Thumb to minimize the cost of electrical distribution to the corporate campus. A summary of the costs are provided in Table 11.

CHP Initial Capital Costs		
	Traditional Scenario	CHP Scenario
Heating Plant	\$800,000 <sup>1</sup>	\$1,800,000
HW Distribution Piping	\$0	\$2,000,000
HW Building Connections	\$0	\$120,000
Electric Distribution Infrastructure	\$0	\$700,000
<b>Total Project Cost</b>	<b>\$800,000</b>	<b>\$4,600,000</b>

Note:

1. Includes boiler equipment, mechanical equipment and piping, electrical connections, controls, civil construction, direct and indirect costs.

Table 11: CHP project initial capital costs

The O&M cost difference associated with the proposed CHP project would consist of a long-term service agreement for the gas fired engine. Service contracts for small gas engines can be structured on an hourly basis or annual fixed fee basis. The annual O&M cost assumed for the project is \$0.02/kWh which equals \$56,000 per year.

### 3.2.4.2. Financial Assumptions and Economics

CHP facilities provide energy savings greater than the traditional scenario of purchasing power from the local electric utility and generating thermal energy on-site with gas-fired or oil-fired boilers. The annual life cycle costs of the traditional scenario were compared to that of the proposed CHP plant to determine the overall savings provided by the project. At this stage in the development process, the ultimate owner of the project is yet to be determined and the capital financing structure and funding source is unknown. For the purposes of the assessment, the project was assumed to be structured as a private, non-profit, funded with a cost of capital of 4.7%, financed over 25 years, with the annual debt service paid through energy sales revenues. The basic economic assumptions for the project are provided in Table 12.

**CHP facilities provide energy savings over the traditional scenario of purchasing power from the local electric utility and generating thermal energy on-site with gas-fired or oil-fired boilers.**

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

CHP Economic Assumptions		
	Traditional Scenario	CHP Scenario
<b>Description</b>	Purchased Grid Power with Gas Boilers	Gas Engine CHP with District Energy
<b>Site</b>	Thumb & Town	Thumb & Town
<b>Analysis Term</b>	25 years	25 years
<b>Gas Price</b>	\$7.00/MMBtu <sup>1</sup>	\$5.50/MMBtu <sup>2</sup>
<b>Electric Price</b>	\$0.10/kWh	\$0.10/kWh
<b>Escalation</b>	3%	3%
<b>Project Cost</b>	\$800,000	\$4,600,000
<b>O and M Cost<sup>3</sup></b>	\$0/yr	\$56,000/yr

Notes:

1. Firm commercial gas rate
2. Interruptible gas rate
3. Incremental cost difference

Table 12: CHP project economic assumptions

The economic assumptions provided above were coupled with the CHP energy production numbers developed to estimate the annual savings generated by the CHP project. The annual energy usage, annual utility costs, and economic performance of the project are provided in Table 13.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

CHP Economic Results		
	Traditional Scenario	CHP Scenario
<b>Grid Power</b>	4,172,302 kWh	1,364,734 kWh
<b>CHP Power</b>	-	2,807,568 kWh
<b>Total Power</b>	<b>4,172,302 kWh</b>	<b>4,172,302 kWh</b>
<b>Boiler Heating</b>	14,865 MMBtu	5,105 MMBtu
<b>CHP Heating</b>	-	9,760 MMBtu
<b>Total Heating</b>	<b>14,865 MMBtu</b>	<b>14,865 MMBtu</b>
<b>Electric Costs</b>	\$417,000	\$136,000
<b>Boiler Gas</b>	\$130,000	\$35,000
<b>CHP Gas</b>	\$ -	\$145,000
<b>CHP O and M<sup>1</sup></b>	\$ -	\$56,000
<b>Annual Costs</b>	<b>\$547,000</b>	<b>\$372,000</b>
<b>CHP Project Cost</b>	<b>\$800,000</b>	<b>\$4,600,000</b>
<b>25-Year Cost</b>	\$21,520,000	\$21,505,000
<b>25-Year Difference</b>	\$ -	\$15,000

Note:

1. Incremental cost difference

Table 13: CHP project economic results

### 3.2.4.3. Interpretation of the economic analysis

The economics of the CHP system are tied to the energy loads connected to the system. As shown in Table 13, the annual costs of the initial proposed CHP operations are significantly reduced from the traditional scenario. The primary factor contributing to the 25-year cost of the CHP is the capital cost for the initial construction of the system. If additional energy load was connected to the initial system, the debt service payments could be spread out across more energy consumers, and energy rates could be decreased. In order to optimize the economic return of a CHP system, the remaining capacity of its thermal energy output (approximately 1 MMBtu/hr) could be utilized. If the thermal demand of TCAAP development included higher continuous loads (light manufacturing processes, restaurants, domestic hot water, etc.), the 25-year savings could be increased by an estimated \$900,000.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

Additionally, the economic analysis did not take into account any rebates, grants, or savings for which the project could be eligible. These potential funding sources could be used to offset the cost of the initial construction, thus making the initial CHP system more economically attractive. The list of potential funding sources is provided in Exhibit IV.

### 3.2.5. Greenhouse Gas Reduction

One of the advantages of a CHP system is the reduction of greenhouse gas emissions due to the higher efficiency of the CHP system. Implementation of a CHP system to meet the energy loads in Section 3.2.2.1 could reduce carbon dioxide emissions by approximately 20%, as shown in Table 14.

Estimated Annual Carbon Dioxide Emissions Reductions		
	Traditional Scenario	CHP Scenario
<b>Natural Gas Usage</b>	18,581 MMBtu/yr	32,772 MMBtu/yr
<b>CO<sub>2</sub> Emission Rate<sup>1</sup></b>	117 lb/MMBtu	117 lb/MMBtu
<b>CO<sub>2</sub> Emissions from Natural Gas Usage</b>	<b>1,087 tons/yr</b>	<b>1,917 tons/yr</b>
<b>Electric Usage</b>	4,172 MWh/yr	1,365 MWh/yr
<b>CO<sub>2</sub> Emission Rate<sup>1</sup></b>	1,041 lb/MWh	1,041 lb/MWh
<b>CO<sub>2</sub> Emissions from Electricity Usage</b>	<b>2,172 tons/yr</b>	<b>710 tons/yr</b>
<b>Total CO<sub>2</sub> Emissions</b>	<b>3,259 tons/yr</b>	<b>2,628 tons/yr</b>
<b>Total CO<sub>2</sub> Emissions Reduction</b>		<b>631 tons/yr</b>

Note:

1. <https://www.xcelenergy.com/staticfiles/xcel/Corporate/CRR2013/environment/emissions-reporting.html>

Table 14: Estimated annual carbon dioxide emission reductions

The greenhouse gas emission savings presented in Table 14 are based upon a CHP operational strategy of meeting the Thumb’s electrical needs from a gas-fired generator. In the event that other renewable energy sources are included in the CHP solution, the greenhouse gas emission reductions would increase.

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## Energy Source Implementation

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### *3.2.6. Developing a Microgrid for the Area*

While an initial CHP approach might be focused on the current campuses of the Thumb and the Town, the energy vision adopted by the ERAB includes developing a resilient energy system for the greater community, including the remainder TCAAP and the adjacent properties. The initial CHP plant is one implementable opportunity. However, to achieve the TCAAP energy vision, it will be important for the partner organizations to develop a plan to expand the scope of the CHP plant and develop a microgrid for the broader area as TCAAP development proceeds.

### *3.2.7. Suggested Next Steps*

As part of the Thumb development, the County and JDA could develop a CHP strategy for the developer selection process, so that the CHP project, electric distribution, and thermal distribution systems designs can be integrated into the development plans. Several of the initial activities that will need to occur prior to the RFP are listed below:

- The ownership and initial project funding strategy for CHP will need to be established to allow initial project development activities to commence. An agreement will need to be developed to establish the initial energy system concept and conduct additional due diligence on the technical, business, and regulatory issues that are associated with the project. The JDA should work with Xcel Energy to define Xcel Energy's interest in owning the proposed CHP. Xcel Energy ownership will provide the benefit of increasing the plant size and system efficiency as electric and thermal demand grows.
- If Xcel Energy is interested in owning a CHP system, the JDA should collaborate with Xcel Energy to develop an initial CHP plant that could serve as the foundation of a broader microgrid strategy for TCAAP, AHATS, and the community. If Xcel Energy is not an owner of the CHP, the initial electric output could be sized to meet the needs of the Thumb, with thermal energy distributed to the other sites. Additional electric output could be added on other sites and integrated into a district energy system as the energy needs of the future buildings are defined, or the CHP electrical output could be increased if the developer secured a power-purchase agreement with Xcel Energy.
- The JDA should integrate and reserve space within easements and right of way for the future construction of district energy distribution facilities during the platting of the development and the design of the Spine Road.
- During site marketing, the JDA should emphasize the benefits and opportunities presented by the incorporation of CHP into the Thumb development, and could pursue businesses that have coincidental thermal and electric energy needs. Additionally, prioritizing site marketing to

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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companies with additional process or domestic hot water load would optimize the efficiency of the CHP system.

### 3.3. Low-Temperature District Energy System

#### 3.3.1. Introduction

The residential neighborhoods of TCAAP present a unique and highly visible opportunity to leverage low-grade energy from the treated groundwater as an energy supply for the neighborhoods, distributed via a low-temperature district energy system. The proposed system would utilize thermal energy from the TCAAP Groundwater Treatment station described in section 1.5.4 by transferring energy from the groundwater to the district energy system. The groundwater, which is consistently ~52°, can be used to transfer energy to and from the closed-loop distribution system to meet heating and cooling demand in the buildings, while not affecting the quality of the treated groundwater. The pumped groundwater is estimated to have 9.8 MMBtu of energy available. The Hill and Creek neighborhoods are projected to demand 68% of this energy. Thus, an additional 3.1 MMBtu could be available for utilization in other areas of TCAAP or AHATS.

#### 3.3.2. System Description

The proposed energy system would require an energy transfer station to be constructed at, or near, the current pumping location for the groundwater treatment station. This energy transfer station would consist of a heat exchanger to separate the groundwater from the system water, pumps to circulate the distribution loop, controls, metering, and piping.

The existing building that houses the groundwater treatment station was originally the domestic water treatment plant for the TCAAP site during the ammunitions manufacturing period. This building was decommissioned, as the groundwater treatment system is housed in a building addition, and is now largely vacant. The facility is more than adequate to house the proposed energy transfer station. The building is owned by the Army, and will remain in the custody of the Army until the groundwater treatment operations cease. Given these conditions, there would need to be an agreement between the district energy district energy business and the Army for the use of this building.

As noted in Section 1.5.3, the operations of the groundwater treatment system are anticipated to continue for a minimum of 30 years. By the end of this period, an alternative energy source may need to be identified should the groundwater pumping be discontinued or unavailable for energy transfer. At that stage, there would be multiple technologies that could be incorporated:

- A separate field of geothermal heat exchange wells could be constructed in the vicinity of the energy transfer station.

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## Energy Source Implementation

- Construction of a solar thermal garden in the vicinity of the energy transfer station.
- Installation of a commercial size heat pump at the energy transfer station.
- Future technologies that are currently unavailable in the market.

The proposed distribution system would consist of two pipes, supply and return, spanning from the energy transfer station to the homes. To prevent the pipes from freezing, and to efficiently transfer the energy, these pipes can be insulated and buried at shallow depths, or uninsulated, and buried at greater depths. To keep the initial construction costs of the distribution system to a minimum, the proposed district energy business could construct the distribution system and service extensions to the homes, in coordination with site development.

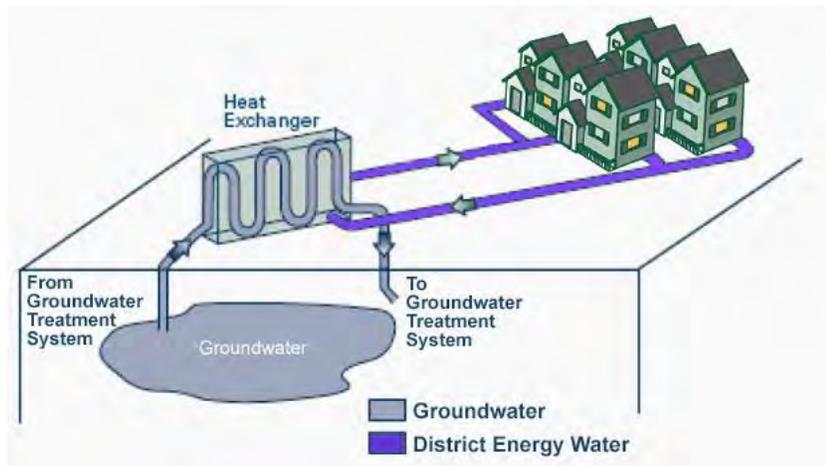


Figure 9: Distributed ground source heat pump schematic

A set of two pipes would span between each home and the distribution system, one delivering water to the home and one returning water to the distribution system. Each home would be equipped with a water source heat pump unit, powered by electricity. This would replace the need for traditional forced-air furnaces and electrically-driven air-conditioners. During the winter months, the heat pump would take heat from the distribution system water and use it to heat the air inside the home. Conversely, during the summer months, the heat pump will take heat from inside the home and reject it to the distribution system, which is how the home is cooled. Figure 10 shows how home heat pump systems operate inside the homes.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

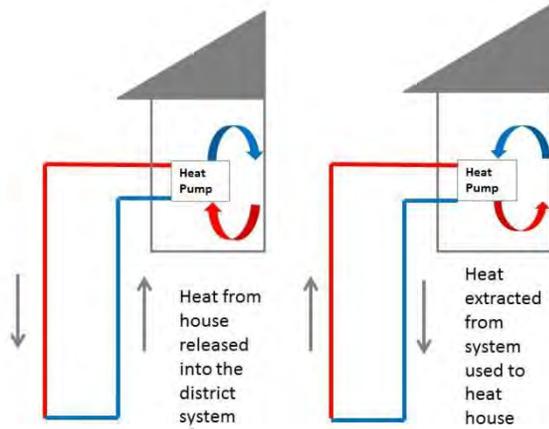


Figure 10: Ground source heat pump operation

### 3.3.3. Greenhouse Gas Reduction

One important advantage of a low-temperature district energy system is the reduction of greenhouse gas emissions. Carbon dioxide is the primary greenhouse gas emission that is monitored and measured for the heating and cooling of buildings. The carbon dioxide emission rates used to calculate the savings of the low-temperature district energy system are included in Table 15.

Carbon Dioxide Emission Rates	
Natural Gas <sup>1</sup>	117 CO <sub>2</sub> lb/MMBtu
EPA MROW Emission Factor <sup>2</sup>	1,536 CO <sub>2</sub> lb/MWh
Electric Utility <sup>1</sup>	1,041 CO <sub>2</sub> lb/MWh

Notes:

1. <https://www.xcelenergy.com/staticfiles/xcel/Corporate/CRR2013/environment/emissions-reporting.html> <http://www.epa.gov/climateleadership/documents/emission-factors.pdf>

2. <http://www.epa.gov/climateleadership/documents/emission-factors.pdf>

Table 15: Carbon dioxide emission rates

When comparing emission rates between traditional HVAC systems and the proposed low-temperature district energy system in the Hill and Creek neighborhoods, carbon dioxide emissions are reduced by almost 30%. The comparison of the estimated greenhouse gas emissions is shown in Table 16.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

<b>Estimated Annual Carbon Dioxide Emission Reductions for Low-Temperature District Energy</b>		
Gas Furnace - Heating	15,874 MMBtu/yr	929 tons CO2/yr
Air conditioner - Cooling	836 MMBtu/yr	128 tons CO2/yr
<b>Total Conventional Emissions</b>		<b>1,057 tons CO2/yr</b>
Heat Pump - Heating	3562 MMBtu/yr	544 tons CO2/yr
Heat Pump - Cooling	484 MMBtu/yr	74 tons CO2/yr
Pumping Station (kWh)	247,280 MMBtu/yr	129 tons CO2/yr
<b>Total Heat Pump Loop Emissions</b>		<b>747 tons CO2/yr</b>
<b>Savings</b>		<b>310 tons CO2/yr</b>
<b>% Emissions Reduction</b>		<b>29%</b>

Table 16: Estimated annual carbon dioxide emissions reduction

This calculation does not take into account the opportunities for carbon-neutral electricity production that would be available to the TCAAP development. These calculations use the base emissions rate from the electric grid, published by Xcel Energy for the Upper Midwest service territory. As the local electricity sources become less dependent on the primary grid, through implementation of community solar gardens or other technologies, the carbon dioxide emissions could be further reduced.

### 3.3.4. Financial Analysis

The initial cost of the low-temperature district energy system was estimated based on the Project Team’s historical data for installation of piping and equipment. The pumping station, heat pumps, furnaces, and air conditioning units were estimated based on major equipment budgetary pricing that is readily available from manufacturers. The distribution piping was estimated based on historical data for similar material installations in Minnesota. The low-temperature of the water allows for flexibility of the piping system construction. The Project Team evaluated the material costs for a number of materials and based the estimate on a high-density polyethylene piping system, due to the material cost and ease of installation. A summary of the initial capital costs are provided in Table 17.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

<b>Total System Capital Cost Comparison</b>			
<b>District Energy Capital Costs</b>		<b>Traditional System Capital Costs</b>	
Pump Station	\$375,950	Xcel Energy Infrastructure	\$0
Distribution Pipe	\$2,527,500		
Service Laterals	\$533,200		
Domestic Water Heaters	\$493,000	Domestic Water Heaters	\$591,600
Heat Pumps	\$2,563,000	High Efficiency Furnaces	\$1,005,720
		AC Units	\$1,135,872
<b>Total</b>	<b>\$6,493,250</b>	<b>Total</b>	<b>\$2,733,192</b>

Table 17: Total system capital cost comparison

For the economic analysis, the Project Team assumed that the district energy facilities at the energy transfer station and the distribution piping would not be paid for by the TCAAP developer. Typically, the district energy entity pays for the production and distribution facilities. The Project Team did assume that the developer would pay for the procurement and installation of the heat pumps, and hot water heaters in the homes. The Project Team also assumed that the developer would pass the minimal additional cost of the heat pump installation on to the homeowner through an increased mortgage amount, and would be able to use the eco-friendly aspects of the system as a selling point. The analysis was completed for straight costs, and did not include any rebates or tax credits that may be applicable for these energy efficient homes. A summary of the initial costs to be paid by the developer is shown in Table 18.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

Developer Capital Cost Comparison			
Heat Pump Capital Costs		Traditional System Capital Costs	
Domestic Water Heaters	\$493,000	Domestic Water Heaters	\$591,600
Heat Pump Units	\$2,563,600	High Efficiency Furnaces	\$1,005,720
		AC Units	\$1,135,872
<b>Total</b>	<b>\$3,056,600</b>	<b>Total</b>	<b>\$2,733,192</b>
Per Unit Cost <sup>1</sup>	\$9,102	Per Unit Cost <sup>1</sup>	\$6,930

Note:

1. 394 homes based on density projections for Hill and Creek neighborhoods available at time of publication

Table 18: Developer capital cost comparison

The capital costs for the construction of the district energy system are shown below in Table 19 and are assumed to be financed over a period of 30 years.

District Energy System Capital Costs	
Pump Station Construction	\$375,950
Distribution Mainline Construction	\$2,527,500
Distribution Service Laterals	\$533,200
<b>Total</b>	<b>\$3,436,650</b>

Note:

1. Includes engineering and indirect costs for the service laterals to each home.

Table 19: District energy system capital costs

The proposed low-temperature district energy system is modeled as a private, non-profit business, with cost-based energy rates. The model assumptions are provided in Table 20.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

Financial Assumptions			
Energy and Demand Rates		Escalation Rates	
Summer Residential Electricity Rate (\$/kWh) <sup>1</sup>	\$ 0.0867	Inflation Rate	2.0%
Winter Residential Electricity Rate (\$/kWh) <sup>1</sup>	\$ 0.0739	Natural Gas Rate Acceleration (EERC Real) <sup>2</sup>	3.93%
Electric Service Charge per Unit Annually <sup>1</sup>	\$ 96.00	Electricity Rate Acceleration <sup>3</sup>	2.53%
Sales Tax <sup>4</sup>	\$ 0.0763	Water and Sewage Acceleration	3.00%
Natural Gas Rate (\$/MMBtu) <sup>1</sup>	\$ 8.3983	Cost of Capital - Developer	6%
Natural Gas Service Charge per Unit Annual <sup>5</sup>	\$ 108.00	Cost of Capital – District Energy Entity	4%
		Payment Periods	30

Equipment Efficiency	
Air Conditioning (SEER <sup>5</sup> )	14.00
Air Conditioning (EER <sup>6</sup> )	11.76
Air Conditioning COP <sup>7</sup>	3.45
Air Conditioning kW/ton	1.02
High Efficiency Furnace <sup>8</sup>	92%
Heat Pump Cooling EER <sup>9</sup>	20.30
Heat Pump Heating COP <sup>11</sup>	4.10

Unit Costs	
Housing Units	394
High-Efficiency Furnace Unit Cost with Install	\$ 2,550
Natural Gas Water Heater Cost with Install	\$ 1,500
Air Conditioner Unit Cost with Install	\$ 2,880
Operation and Maintenance Annually per Unit	\$ 400
Heat Pump Unit Cost with Install <sup>10</sup>	\$ 6,500
Hot Water Heater with Heat Pump <sup>12</sup>	\$ 1,250
Heat Pump Maintenance Per Unit Annually	\$150

Expected Unit Life Expectancy	
High-Efficiency Furnace	18-20 Years
Air Conditioner	12-15 Years
Heat Pump	18-20 Years
Franchise Fees/Easements	\$0

Notes:

1. <http://www.xcelenergy.com/staticfiles/xcel/Regulatory/Regulatory%20PDFs/rates/MN/MNResRateCard.pdf>

2. Energy Escalation Rate Calculator - 2% inflation, start date is 2015, duration is 30 years. Annual energy escalation rate is 1.89% (Real) and 3.93% (Nominal).

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

3. Energy Escalation Rate Calculator - 2% inflation, start date is 2015, duration is 30 years. Annual energy escalation rate is 0.52% (Real) and 2.53% (Nominal).
4. Sales tax not applied to heating due to state heating fuels law.
5. Seasonal Energy Efficiency Ratio (Btu/Watt-hr) – the cooling output during a typical cooling season divided by the total electric energy input during the same period.
6. Energy Efficient Ratio (Btu output/Watt input) – the ratio of output cooling energy (in Btu) to input electrical energy (in W).
7. Coefficient of Performance – the ratio of output energy (in Btu or W) to input electrical energy (in the same units).
8. [http://apps1.eere.energy.gov/buildings/publications/pdfs/building\\_america/highefficiency\\_gas\\_furnaces.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/highefficiency_gas_furnaces.pdf)
9. <http://www.waterfurnace.com/literature/3series/SC2300AL.pdf>
10. <http://www.homeadvisor.com/cost/heating-and-cooling/install-a-heat-pump/#>, <http://home.costhelper.com/geothermal-heat-pump.html>, Estimate for 4-loop heat pump provided by S&B Geothermal (adjusted for economies of scale and 1 loop unit)
11. <http://www.waterfurnace.com/literature/3series/SC2300AL.pdf>
12. Heat pump to supply DHW to tank, electric element in tank as redundant source.

Table 20: Financial assumptions

Using the energy usage estimates prepared as part of this study, the Project Team estimated the annual cost of providing heating and cooling to the areas homes under a traditional scenario (independent high efficiency furnaces and AC units) and under a low-temperature district energy scenario (energy transfer station, distribution system, heat pump HVAC units). The life cycle cost analysis for the low-temperature district energy system, including the costs covered by the developer, was compared to the traditional scenario. The 30-year costs include systems operation, maintenance, and equipment replacement, but do not account for any profit for the district energy business. This analysis is summarized in Table 21.

District Energy Life Cycle Cost Comparisons for Connected Homes			
	Initial Cost	30-Year Cost	Average Annual Costs Per Home
Traditional Service	\$ 2,733,192	\$20,288,675	\$1,715
District Service	\$3,056,600	\$18,482,181	\$1,562
District Service Savings (Cost)	\$(323,408)	\$1,806,494	\$153

Table 21: District energy system life cycle cost comparison for all homes connected

As shown, the district system is lower in cost over the-30 year period than a traditional gas-fired furnace and electric A/C unit; however, it is assumed that the benefits beyond the 30-year initial agreement would be significantly greater as the debt payment for the initial system construction is completed.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

Lastly, to validate that this system is the optimal means of capturing ground-source energy, the Project Team compared the life-cycle cost for the low-temperature district energy system to a scenario where homeowners would install independent geothermal systems that would serve each home. In this comparison, both homes would have heat pumps to meet their comfort needs. Because this would add initial cost to the developer, it was assumed that the developer would pass this cost along to the home owner in the form of a premium added to the mortgage amount. This analysis is summarized in Table 22.

<b>Ground-Source Loop System Life Cycle Cost</b>			
	<b>Initial Cost</b>	<b>30-Year Cost</b>	<b>Average Annual Costs Per Home</b>
<b>Individual Geothermal<sup>1</sup></b>	\$9,600 <sup>2</sup>	\$45,596	\$1,521
<b>District Service</b>	\$ -	\$46,862	\$1,562
<b>District Service Savings (Cost)</b>	<b>\$9,600</b>	<b>\$(1,266)</b>	<b>\$(41)</b>

Notes:

1. Assumes that home owners would be required to pay a premium to the developer for the construction of geothermal well field.
2. Estimate provided by S&B Geothermal, \$2,400/well, assumed four wells.

Table 22: Independent geothermal loop system life cycle cost comparison

Independent geothermal systems could be built for the residents in TCAAP, and would be less costly than the district energy system capturing energy from the treated groundwater. However, the relatively small gains in cost over 30 years would be offset by the volatility of natural gas markets, inconvenience of maintaining independent systems in each home, the initial cost of the systems, and the future flexibility provided by installing district energy infrastructure.

### 3.3.5. Potential Savings Opportunities

Under the assumptions provided in this Framework, the implementation of a low-temperature district energy system that utilizes energy from the treated groundwater appears to be technically and financially implementable. The economic benefits of this system could be improved by realizing one or more of the following cost reduction opportunities.

- The distribution piping is the single largest cost for the implementation of the low-temperature system. The primary opportunity to reduce this cost is through coordinating the distribution piping construction with the construction of the public utilities. This coordinated construction has been assumed in the financial model.

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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Additional savings could be realized if the piping were installed in a joint trench with the water main, meaning that the distribution piping and water main would be constructed at the same depth and in the same trench. This would eliminate the need for a second trench excavation for the distribution piping, and would only require a marginal increase in the size of the excavation of the water main trench.

- Xcel Energy could partner with the County, JDA, and the City to further evaluate and promote a neighborhood development that does not utilize natural gas. This promotion would include providing technical assistance, contributing electric vehicle charging stations, or promoting the efficiency and low-carbon possibilities of the neighborhood.
- Energy efficiency savings related to micro-hydro, community solar garden subscription, or other renewable electric generation were not included in the model for the energy transfer station or customer properties. Utilization of these technologies could improve the payback time for the system.

Equipment rebates and tax credits were not included into the model, though Xcel Energy offers rebates on high efficiency equipment and variable frequency drives, for which the energy transfer station will be eligible. Xcel Energy also has a number of other energy conservation programs that could be leveraged to offset initial capital costs of the system. None of these rebates were assumed in the current model.

- The Federal Government offers a 30% tax credit to home owners who install a groundwater heat pump that is applicable from the date of occupancy by the homeowner for new homes. However, this tax credit is only applicable if the home is used as a residence by the taxpayer, and is scheduled to end on December 31, 2016.<sup>6</sup> The inherent ambiguity regarding construction date and owner usage, the Project Team has not included this tax credit in the model.

### *3.3.6. Implementation Planning and Suggested Next Steps*

Implementing a low-temperature district energy system in the residential neighborhoods of TCAAP can deliver several benefits to the site and stakeholders, including the following.

- An energy system that is more energy efficient than traditional heating and cooling systems.
- Reduced fossil fuel usage and greenhouse gas emissions.
- Competitive, stable costs of energy for homeowners.

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<sup>6</sup> <http://energy.gov/savings/residential-renewable-energy-tax-credit>

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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- Xcel Energy could avoid gas pipe distribution infrastructure costs in the neighborhoods, saving rate payers money.
- Installation of a flexible infrastructure network in the neighborhoods will allow for easier integration of future energy sources or technology advancements as they become available.
- Implementation of this system would establish the TCAAP approach to sustainable neighborhoods as a national model for energy efficiency and innovative site development.

For the proposed system to be successfully implemented, it would need to be constructed as the first homes are being built, so that service can be provided from the outset of development. To optimize the economic benefits of the system, every home in the selected neighborhoods should be constructed with a heat pump HVAC system and be connected to the proposed system. This would provide the most financeable, cost-effective implementation plan, and also maximize energy efficiency for TCAAP.

Implementing the low-temperature district energy system requires several areas of focus, including the following next steps.

### *3.3.6.1. Develop the System Business Plan*

Before beginning the implementation of the proposed system, a business will need to be formed to facilitate the distribution of energy to the customers it will serve. As part of determining the ownership structure, a business plan should be developed to resolve a number of organizational preferences for the business. Resolving these items will be important to help guide development of the proposed system. Among those preferences, the following should be determined:

- The mission of the organization
- The organizational structure
- Governance of the business
- The energy sales rate structure
- The system financing strategy
- The expected structure of energy service agreements with customers
- The engineering strategy
- The construction contracting strategy
- The system operational strategy
- The system management strategy
- The energy transfer station location strategy
- Permitting and regulatory strategy
- Developer outreach and education strategy
- Easement and franchise agreement strategy, needs, or restrictions

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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The City, County and JDA should resolve these items prior to commencing with the site development RFP process. While all of the items listed above are important for development, the following items will likely require the most attention.

### ***Forming the Business***

Unless Ramsey County or Arden Hills is the owner of the low-temperature district energy system, an ownership entity should be developed, based upon the system mission. The ownership entity will handle the system operations, maintenance, and billings. The business could be best served by one of the following structures: Municipally Owned, Private Non-Profit, Private For-Profit, or a Hybrid Publicly-Owned Infrastructure/Private Non-Profit Company. Each structure has inherent benefits and detriments, which will need to be evaluated as the business structure is determined.

The private, non-profit model operational structure is the business structure that was assumed in the financial analysis. This business structure operates under the governance of local stakeholders and customers. This type of business model has several advantages, the most prominent being that the rates would be cost-based, meaning that the rates would cover the cost of operating the system and debt service, without mark-ups for profit or return on investment.

### ***Developer Outreach and Education***

A critical aspect of this system is that each home in the system service area should be connected to the system. This will require developers to install heat pump units in each home, instead of traditional forced air furnaces and air conditioner units. The developers should be properly educated on this opportunity and this direction should be clearly stated in the RFP language, so that the developers can understand and implement the strategy from the onset.

### ***Reach Agreement with U.S. Army for use of Existing Building and Treated Groundwater***

The ownership entity will need to negotiate with the Army for the use of energy from the treated groundwater and the existing building to which the groundwater treatment station is attached. This agreement will, at a minimum, need to provide for access to and operation of the energy transfer station equipment. Ideally, an agreement would include ownership transfer of the building and groundwater pumping system at the termination of the groundwater treatment operations, so that the heat pump loop can continue to meet the heating and cooling needs of the development.

### ***System Financing***

Depending upon the preferred ownership structure, the financing strategy for the system could be very different. If the system is publicly owned, it could be financed through the public institution or in private markets. If a private, non-profit, the system could be 100% debt-financed based upon long-

# TCAAP Energy Integration Resiliency Framework

## Energy Source Implementation

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term agreements with homeowners. Under this scenario, the phasing of housing development may require City or County backing of the debt as not all homes will be occupied when the system begins operation.

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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### 4. Energy Efficiency Strategies (Demand Side Management)

Given the pressing timeline of near-term infrastructure investments, much of the Framework is focused on energy supply options for TCAAP and the Arden Hills community. However, implementation of improved building energy efficiency will be necessary to achieve the community's low-carbon, resiliency goals. The following are the leading opportunities for near-term, low energy use development at the site. Unlike many next steps for energy supply and infrastructure, the demand-side initiatives will strongly depend on engaging developers who can help implement the TCAAP energy vision. These recommendations make use of the truly unique opportunities at TCAAP, which include:

- Availability of a local, renewable ground heat energy source via the site remediation process.
- Advantages of both greenfield development and large scale deployment to optimize economies of scale.
- Focus on replicable designs and technologies to simplify developer implementation.
- Emphasis on actual building performance, beyond prescriptive design requirements.
- Important strategic partnerships with Xcel Energy and the Center for Sustainable Building Research at the University of Minnesota.

#### 4.1. Energy Resilient Design and Construction

To meet the energy resilience goals for TCAAP, building design verification and benchmarking will be needed on an ongoing basis. As development moves forward it is recommended that the County, the JDA, City Staff, and development consultants utilize the following building standards, technical resources, planning tactics, and proposal criteria to attract and streamline energy efficient development.

##### 4.1.1. Meeting SB 2030 Guidelines

All commercial developments on the TCAAP site can be measured against the requirements of Minnesota's Sustainable Buildings 2030 (SB 2030), a performance based building energy standard developed to incrementally move new construction to net zero energy design by 2030. The standing program is not only a standard for design and construction, but an ongoing energy performance benchmarking program and guideline. The standard is designed specifically for Minnesota's climate, is administered by the Center for Sustainable Building Research (CSBR), and is supported by both the State of Minnesota's Division of Energy Resources and Xcel Energy.

SB 2030 has several advantages as a consistent site standard, as outlined in the *Policy White Paper*. To recap:

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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- SB 2030 is designed and tailored for Minnesota buildings.
- SB 2030 is a performance based standard, providing guidance for the design of energy efficient buildings beyond prescriptive requirements, giving developers site-specific flexibility, however prescriptive guidelines are available.
- It has building use based standards that cover all development types applicable to TCAAP: commercial, multi-family, and detached residential.

As a comprehensive, performance-based energy standard, SB 2030 looks at all of the systems in a building and how they collectively impact its efficiency. Systems that are modeled or calculated under the standard are:

- Building Envelope
- Equipment Energy Efficiency
- Lighting Power Density & Controls
- Domestic Hot Water
- Mechanical Systems
- Use of Renewables

### *Resources & Benefits*

- Xcel Energy's Energy Design Assistance Program is a free resource for designers and developers to help meet some of the SB 2030 requirements and will help developers navigate rebate opportunities. (Additional assistance is available when design teams commit to designing at 30% more efficient than typical design.)
- Xcel Energy's custom efficiency program allows large users to obtain tailored, performance based efficiency assessments and rebates.

On average, SB 2030 will require commercial buildings to be 35 to 45% more efficient than the new building code (IECC 2012). Table 23 outlines specific efficiency improvements for a few building types relevant for TCAAP.<sup>7</sup>

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<sup>7</sup> For single-family homes and townhomes, SB 2030 will be more efficient than the residential IECC 2012 code, but not to the extent of commercial building requirements.

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

Increase in Energy Efficiency Above Commercial Building Code (IECC 2012)				
Medium Office	Stand-Alone Retail	Small Hotel	Restaurant	Warehouse
42%	29%	50%	55%	60%

Table 23: SB 2030 (70% benchmark) Energy Efficiency Improvement over Code<sup>8</sup>

The key way to incentivize use of SB 2030 is to give preference to proposals designing to these standards during the RFP review process (outlined below). Development teams would have access to SB 2030 tools and case studies that outline recommended cost-effective design approaches. During schematic design and design development phases, the design team will set goals and targets for the project with guidance from the SB 2030 team. When construction documents are nearly complete, the SB 2030 team provides a full plan review with course corrections and feedback to achieve the project targets. After construction, the SB 2030 team will again work with project stakeholders to initiate the energy benchmarking and tracking process. The cost to the developer/builder for all of these program services is approximately \$8,000 to \$10,000 per commercial site, a greater value than comparable certification programs that do not provide review services.

Given the scale and visibility of TCAAP, there are potential adjustments that can be made to streamline this process for developers.

- Targeted education and design guidelines that are site specific and assist developers to quickly identify what major design features to focus on for a specific site and building type.
- Potential cost buy-down for the upfront cost of the study and review

SB 2030 may face a challenge in that while it is relevant for Minnesota buildings it does not yet have the market visibility of other national standards such as LEED. Marketing of the TCAAP site could include a marketing campaign around the benefits of SB 2030, to increase awareness, acceptance, and a value reflection in the market. The County or City may also consider sharing review costs with developers to help grow collaboration and buy-in.

<sup>8</sup> Analyzed by comparing improvements in ASHRAE 90.1 and applying the 70% reduction compared to the 1989 baseline by building use type (CEE).

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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### 4.3. Leading Near-Term DSM Opportunities

#### 4.3.1. Low-Load Residential Development

##### Recommendation:

The JDA should consider all residential neighborhoods as eligible areas for development of low-load homes and utilization of a shared ground source water loop for retrieving low-cost heat.

Section 6.4.1.1 (p. 34-35) of the *Policy White Paper* outlined the concept of a residential development featuring low-energy, all electric homes, fed by the ground source heat for heating and cooling needs. A low-load home would not require the larger heating and cooling capacity of traditional systems, but instead could meet residents' comfort needs with smaller capacity systems. A low-load home does not have to cost significantly more than a traditionally built home, and can be valued more in the marketplace.<sup>9</sup>

The Project Team estimates that low-load homes in Minnesota could obtain a maximum combined space heating and cooling load of less than 10 Btu/hour/square foot (conditioned floor area).<sup>10</sup> The key technologies and strategies include high levels of building insulation and passive solar design, a tight building shell, and high efficiency appliances. These homes do not require significant insulation like a passive house, but are 40% to 50% more efficient than what is required by the new IECC 2012 code.

The primary opportunity for implementing low-load homes at TCAAP is the integration of a low-temperature district energy system fed by the treated groundwater on-site. This energy source could be implemented in homes in the Creek, Hill and eastern Town residential developments, given their proximity to the treated ground water. This opportunity deserves significant consideration since the homes at TCAAP have the unique ability to tap the renewable resource of the pumped ground water through a district energy system combined with in-home water-to-air heat pumps.

Incorporation of high-performance technologies that have little to no impact on the up-front costs, such as efficient appliances and low-flow plumbing, will help minimize hot water use and help maximize home efficiency. The following is a summary of the specific technologies and design elements that can be considered for a low-load, all electric home at TCAAP:

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<sup>9</sup> Multiple recent housing market studies have shown that homebuyers are willing to pay a 9-15% premium for homes that perform more efficiently. (CA Housing Study 2012; NHBA Market Study 2013)

<sup>10</sup> <http://www.nrel.gov/docs/fy14osti/60712.pdf>

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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- Insulation, air sealing, and passive solar design to reduce space conditioning load to 10 Btu/hr/square foot
- Ground source heat pump technology (electric driven)
- High-efficiency appliances such as refrigerators, dishwashers, washer/dryers (with additional consideration of low water use)
- Consideration of heat pump dryers
- Propane on localized natural gas stoves and grills
- Magnified benefit from rooftop PV electricity or purchase of community solar shares

Some marketing benefits of implementing these solutions include:

- Availability of high-tech, low maintenance equipment
- Cutting edge all-electric design
- True net-zero or net-zero ready potential
- Low-cost energy living

### *Low Load Home Performance Verification*

Coordination between ground water system capacity and home design will be necessary up-front and on an ongoing basis. This will provide developers and users with the necessary assurance that the designed loads will be compatible with the capacity of the system. Verification of home energy design and performance can most easily be achieved by a third-party with design and construction expertise. The County and JDA could specify building standards to help homes reach these performance targets, such as SB 2030, which has standards for single-family homes that could be personalized for TCAAP. This program could be administered between utility energy-efficiency verification programs like Energy Star for New Homes and coordination help from the City's inspection division.

### *4.3.1.1. Case Studies*

#### *Zero Carbon Residential Development | Bainbridge Island, Washington*

Bainbridge Island is a mixed residential development of 24 single-family homes, rental apartments, senior-living, and condos. Buildings were designed to meet the criteria of a stringent building certification program, the Living Building Challenge, and included “ultra-insulated” envelopes, high-efficiency appliances, and an opt-in opportunity to buy or finance roof-top solar. Mini-split heat pumps with energy recovery ventilators provide high-efficiency heating. Additionally, all parking is underground and broader sustainability innovations are woven in such as walkability, water

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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conservation, and edible landscapes. All of the single family homes sold out quickly and all home buyers opted to install solar PV systems.

### *Low Load Housing Development | Townsend, Massachusetts*

A premiere example of low-load homes being built at scale is the 35 single-family houses on Coppersmith Way in Townsend, MA. These homes, each 1,700 square feet, were built to meet a strict efficiency standard with an additional cost of approximately \$8.40 per square foot (incorporating a \$4,550 Massachusetts rebate).<sup>11</sup> The resulting thermal load was served by two efficient “mini-split” systems – one on each floor – and homes continue to be reported by residents as a comfortable and responsive living environment.

### *Carbon Zero Residential Development | Issaquah, Washington*

At a built cost of about \$375,000 each, the 10 townhome development outside of Seattle (started in 2008) sold out completely within the first year with homebuyers showing a willingness to pay \$20 to \$40 more per square foot than less efficient homes of similar size and location.<sup>12</sup> The neighborhood, similar to what is being proposed at TCAAP, successfully utilized a community-based ground source system in combination with in-home heat pumps. The shared walls between townhomes contributed to reduced heating loads that made it financially viable. The builder/developer attests that the visible elements of the net zero energy homes, such as the in-floor radiant heating, heat pump technology, roof-top solar, and triple pane windows were key to the value that homebuyers saw. The developer (Ichijo U.S.A.) continues to build low-load homes and sees ROI that makes sense in the market.

### *Ground Source Heat Pump Housing Development | Kennewick, Washington*

SouthCliffe is a 400+ lot residential development in southeastern Washington that is comprised of low-load homes serviced by a ground source water loop and heat pumps, very similar to what is being proposed at TCAAP. Heating and hot water needs of each home are both serviced by this combination of technologies. The ground source water loop added approximately 5% to the cost of each lot, but led to immediate monthly energy cost savings. Milo Bauder and Grant Young were the developers of this project, and have worked with ThermLink in Duluth: a pioneer in ground source installations and equipment.<sup>13</sup>

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<sup>11</sup> Homes achieved a HERS score of 40. The exterior walls were built to R-46, the basement walls were R-20, the attic was insulated to R-63 and the under basement slab was insulated with 2 inches of rigid foam with an R-value of 10.

<sup>12</sup> Conversation with Nick Neid, project manager with Ichijo USA, the developer and builder (February 2015)

<sup>13</sup> <http://www.distinctiveprop.com/files/files/soiuthcliffepressrelease.pdf>

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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### 4.3.2. Building orientation and passive solar

#### Recommendation:

The process for solar oriented development should be described in residential and commercial building RFPs and should be integrated as evaluation criteria for development proposals. It should be evaluated based on lowest total energy load of the homes or buildings to be sited under one proposal and should consider street orientation, building orientation, and passive solar building envelope design elements. As part of the platting process, the County could plat the land and maximize building orientation prior to sale to developers.

The TCAAP *Policy White Paper* included the recommendations for the TCAAP subdivision review process to assess the energy implications of street and building orientation on solar heat gain and loss. Beyond the building envelope, street orientation, lot and building orientation, and building massing, all impact the thermal loads of homes and commercial buildings. By jointly considering these variables prior to the subdivision process, planners and developers have the opportunity to make tradeoff decisions while still producing efficient results. Site orientation is potentially a no-cost way to reduce building energy loads and improve daylighting when considered in site planning.

In line with solar oriented design, homes should be designed and sited so that the longest sides of a house face south and southern faces have the greatest window area.<sup>14</sup> This general window orientation is a proven strategy to reduce a home's heating energy by approximately 4% and cooling costs by 2%, without affecting any other parts of the design. Figure 11 shows the energy savings achieved from southern window orientation, assuming that the largest exterior walls are facing north and south, but without optimizing any other window characteristics or the window to wall ratio on each side.

Alone, window orientation results in moderate energy savings, but when paired with improved window insulation, higher solar heat gain coefficients, and optimum window to wall ratios, the heating energy savings will be 20% to 30%.<sup>15</sup> Proper building and window orientation magnify the impact of the remaining window decision. When aligned, homes with a well-insulated double or triple pane windows

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<sup>14</sup>[http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/Residential/Water\\_Heating/2013\\_CASE\\_R\\_Solar\\_Ready\\_Solar\\_Oriented\\_Developments\\_Sept\\_2011.pdf](http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/Residential/Water_Heating/2013_CASE_R_Solar_Ready_Solar_Oriented_Developments_Sept_2011.pdf)

<sup>15</sup> <http://www.efficientwindows.org/downloads/ColdDesignGuide.pdf>

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

and optimum window to wall ratios, annual energy cost savings for homes in central Minnesota have been shown to be approximately \$300 annually.

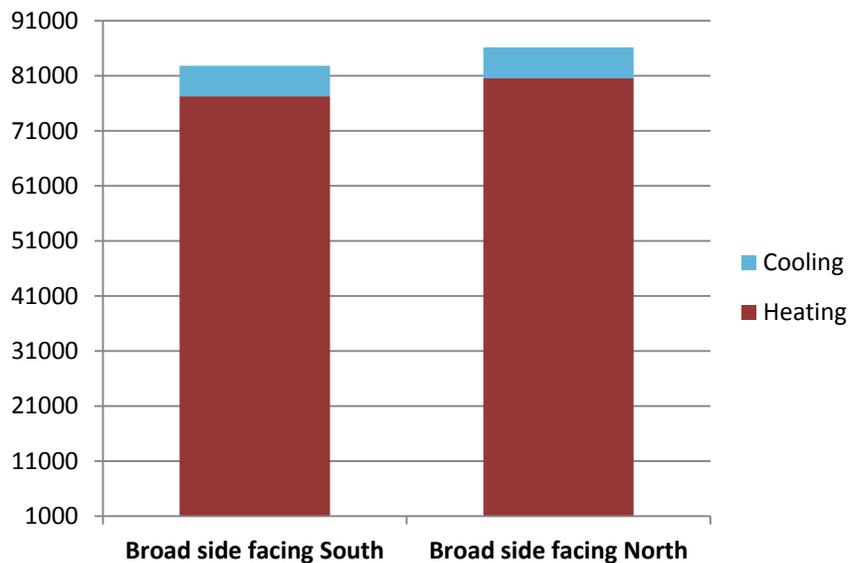


Figure 11: Thermal Load with Respect to House Orientation

The likely locations where street orientation could vary significantly to accommodate energy implications would be the Creek, the Hill, and the Transition neighborhood on the periphery of the Town. It is important to remember that in order to utilize building orientation and passive solar at TCAAP; two mutually dependent factors are required:

- Optimizing street orientation during the subdivision process
- Designing homes to take advantage of the passive solar resource

Optimizing orientation during the subdivision process would be appropriate to solicit during the RFP process. These goals can be included as RFP evaluation criteria.

### 4.3.3. High efficiency commercial buildings

#### 4.3.3.1. Utilizing SB 2030

As shown in the *White Paper*, the primary energy loads for TCAAP are estimated to be in the retail, commercial, and flex areas of the development. Thus DSM energy conservation measures for these areas of the development will be paramount for successful achievement of the Energy Vision. However, until specific use types are more clearly defined during the RFP process, specific commercial building efficiency strategies are challenging to define. The Project Team recommends that the JDA

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

establish the SB 2030 process into the commercial development RFPs, as the SB 2030 process provides an overarching framework for pursuing high commercial efficiency performance. The process for how to use SB 2030 is described above.

### 4.3.4. Sub-metering

Commercial and multi-family building sub-metering (*Policy White Paper*, p. 31) is included as an important consideration because it is a relatively low additional design cost when considered up front, but has the potential to help maintain low energy use since tenants directly see and pay for their energy use.

Sub-metering has been shown to save up to 21% in leased building spaces.<sup>16</sup> The material, software, and labor cost for each sub-meter point ranges from \$5,000 to \$7,500. Several metering companies provide sub-metering services by owning, operating, and maintaining the meters. Monthly fees are based on the type of service needed and the quantity of sub-meters served, but costs per sub-meter range from \$150 to \$400.

Value Add for Sub-Metering		
Item	Application Level(s)	Primary Use
Energy Procurement and billing	Building	Management
Baselining & optimizing building performance	Building; System	Management; Diagnostics
Project energy measurement & verification	System; Circuit	Management; Diagnostics
Equipment and plug-load diagnostics	Tenant; Circuit; Device	Management; Diagnostics; Utility efficiency programs
Occupant awareness and behavior change	Tenant; Circuit; Device	Management; Diagnostics; Utility efficiency programs; Research

Table 24: Value add for sub-metering<sup>17</sup>

<sup>16</sup> “Tenant Occupants of Green Office Buildings: Driving the Market for Improving Existing Building Stock” McGraw-Hill Construction and CBRE. September, 2011. [www.cbre.com/EN/aboutus/MediaCentre/2011/Pages/10062011.aspx](http://www.cbre.com/EN/aboutus/MediaCentre/2011/Pages/10062011.aspx)

<sup>17</sup> [http://www.gsa.gov/portal/mediaId/181031/fileName/Sub-metering\\_Business\\_Case\\_How\\_to\\_calculate\\_cost-effective\\_solutions\\_in\\_the\\_building\\_context](http://www.gsa.gov/portal/mediaId/181031/fileName/Sub-metering_Business_Case_How_to_calculate_cost-effective_solutions_in_the_building_context)

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

Estimated Savings from Sub-Metering	
Action	Observed Savings
Sub-meter bills allocated to all tenants	2.5% - 5% (improved occupant awareness)
Building tune-up & load management	5% - 15% (improved awareness, identification of simple O&M improvements, and load management)
Ongoing commissioning	15% - 45% (improved awareness and ongoing monitoring & commissioning)

Table 25: Estimated savings from sub-metering (DOE 2006)<sup>18</sup>

### 4.3.4.1. Case Study

#### Legrand North America | Better Building, Better Plants Challenge<sup>19</sup>

Legrand, an international provider of information networks, installed sub-meters in its 14 largest manufacturing and assembly facilities in North America.

- The Company had to achieve energy savings of 1.5% of total energy consumption for the dashboard to pay for itself in just 1.5 years. Project ROI was 83%.
- Actions enabled by sub-metering dropped the minimum (baseload) usage by a factor of two.
- The systems empowered Legrand to engage in conservation competition across facilities, something that TCAAP businesses could do across the site.

Building sub-metering should be considered by architects and engineers at the building design stage. While SB 2030 guidelines require minimum sub-metering, additional sub-metering would offer business opportunities like those capitalized on at Legrand properties. Once sub-meters are in place, ongoing energy feedback program opportunities could also be pursued in coordination with the electric utility.

<sup>18</sup> FEMP, *Guidance for Electric Metering in Federal Buildings*. 2006. [www1.eere.energy.gov/femp/pdfs/adv\\_metering.pdf](http://www1.eere.energy.gov/femp/pdfs/adv_metering.pdf).

<sup>19</sup> <http://www4.eere.energy.gov/challenge/sites/default/files/uploaded-files/submeter-guide.pdf>

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

### 4.3.6. Co-location and strategic siting strategies

#### Recommendation:

Attract high energy use businesses and building types through RFP materials and developer workshops, and help facilitate energy savings opportunities for these projects through strategic siting.

One opportunity for energy supply alternatives that has been recommended in the *White Paper* is the development of a district energy system, possibly fed from a CHP plant. Planned siting and co-location can bring increased efficiency to a district system or create opportunities for miniature district systems in areas that are not connected (e.g. some of the Flex areas).

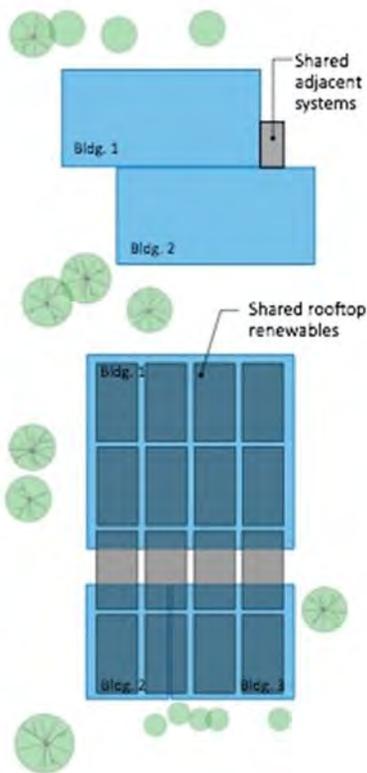


Figure 12: Building co-location examples

Because of the greenfield advantage, high energy use businesses and building use types could be motivated to develop at TCAAP because of the future energy cost savings. For those on the district

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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system, they may be able to benefit from the efficiency that they bring to the system through lower rates or even bill credits when they decrease their return temperature.

For businesses that may not be in proximity to a future district energy system, the County and JDA could facilitate building co-location. Certain project types can be identified as potential candidates for co-location. Table 26 outlines business and building types that are high users of hot water or have concentrated periods of high electricity use. As proposals are reviewed, the County and JDA should identify projects that are the same use as those listed in Table 26. Such candidates could be grouped and referred to energy design experts as to the specific energy benefits that could be achieved through co-location. For example, a hotel development could be sited adjacent to a laundromat to make their combined hot water load more even throughout the day and surface the opportunities to share hot water heating and recovery equipment.

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

Solar Thermal Sharing Opportunities	Peak Times	Hot Water <sup>1</sup>
Hotels and lodging	Mornings	31.4 kBtu/SF
Multifamily buildings	Morning/Night	na
Health Care (inpatient)	All Day	48.4 kBtu/SF
Bars and restaurants	Afternoon/Night	40.4 kBtu/SF
Laundromats/cleaning services	Daytime	na
Car washes	Late afternoons	na
Small manufacturing	Night/All Day	variable
Gardens/Nurseries		na

Photovoltaics Sharing Opportunities	Peak Times	Total Electric <sup>2</sup>
Education facilities <sup>3</sup>	Morning/ Afternoon	11.01 kWh/SF
Offices	Daytime	17.3 kWh/SF
Health Care (inpatient)	All Day	27.5 kWh/SF
Restaurants	Night	38.4 kWh/SF
Grocers/Food sales	All Day	49.4 kWh/SF
Retail (malls in particular)	Afternoon/ Night	22.3 kWh/SF
Data Centers	All Day	na

Notes:

1. E2A base on historic CBECS 2003 data

2. E3A base on historic CBECS 2003 data

3. Education facilities are seasonal, but high demand 9 out of 12 months.

Table 26: Applicable Business Types for Building Co-Location

Co-locating buildings does not require the sharing of exterior walls. The proximity to one another may even render opportunities to create unique outdoor employee or community spaces. The hot water or heat producers could sell their excess to adjacent buildings that have use for it at different times of day. Shared decentralized hot water storage units could even be used in some cases. Businesses would be interested in this opportunity because it would improve the efficiency of their consumption, reduce upfront capital equipment and maintenance costs, and increase comfort.<sup>20</sup>

<sup>20</sup> The Primary Energy Factor (PEF) difference between district heating systems and Gas-fired heating (0.8/1.3=0.61)  
[http://www.euroheat.org/Files/Files/documents/Publications/District%20Heating%20in%20buildings\\_final.pdf](http://www.euroheat.org/Files/Files/documents/Publications/District%20Heating%20in%20buildings_final.pdf)

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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Co-location opportunities will require coordination on the part of the JDA and County, but communicating the interest to facilitate co-location upfront for developers and business will make coordination easier. High energy use project types may be motivated to propose a project at TCAAP if efforts are being made to facilitate energy savings. Marketing materials and RFP language that highlights appropriate co-location building use types can help attract these projects.

### *4.3.7. Streetlights*

The City of Arden Hills has included a site-wide requirement for all streetlights to be “high-efficiency lighting, such as LED lamps” in the *TCAAP Redevelopment Code*. This requirement will trigger the inclusion of high efficiency lights in the development process. Current LED technology saves approximately 50% to 70% of lighting energy use. A significant cost savings occurs by additionally reducing maintenance costs, given the longer life of the bulbs. The City can work with Xcel Energy to utilize any future high efficiency streetlight program offerings that support this effort in a manner that is timely and commensurate with current development staging.

### *4.3.8. Community participation and education*

Community participation and education have been consistently mentioned as important factors at TCAAP, both to engage the wider Arden Hills community and to leverage the energy savings potential from facilitating ongoing awareness of energy use by site tenants and residents. Many details of community engagement will need to be planned once the site sees its first residents and tenants. However, certain engagement elements can be planned for or implemented during the early development stage, including:

- A TCAAP or Arden Hills-wide website that tracks energy goals and performance of buildings at the site, including energy and carbon savings. The website could promote major metrics and milestones, and issue periodic challenges (e.g. the “lowest user” challenge).
- Community-wide open house or showcase events of leading edge technologies on the site, especially for housing, that will attract and excite potential residents (e.g. cook a meal in an all-electric kitchen)
- Commissioning of design or signage elements in public spaces that connect users to the site’s energy resiliency goals and their contribution and participation in those goals. A targeted marketing campaign around community solar development, as an early symbol of community-driven, low carbon energy use at the site.

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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### 4.4. Demonstration Opportunities

#### 4.4.1. Advanced Distribution Grid

TCAAP's greenfield status, combined with the site's forward looking energy vision, make it an ideal opportunity to pilot and demonstrate advanced technologies in the electric distribution grid. Many of the opportunities outlined in this report, such as high solar PV penetration, advanced commercial building metering, or responsive electric loads, are all facilitated by a distribution system with increased communications and control functions.

Features that could be piloted at the site might include increased reliability testing, or load management strategies that rely on advanced metering and communications throughout the distribution network. Load management—the real-time increase or reduction of electric demand in response to external signals—can change customer electricity use in response to signals such as physical constraints or environmental signals, such as an excess renewable energy capacity. The results can save customers money and reduce the environmental impact of their energy use.

By laying the groundwork for an advanced distribution system at TCAAP during the planning phase, residents and businesses would have access to cutting edge opportunities such as advanced rate design or real-time load response. Moving forward on these opportunities would likely require the collaboration of Xcel Energy, the Public Utilities Commission, and the Minnesota Department of Commerce, Division of Energy Resources.

#### 4.4.2. Innovative Energy Technologies

In addition to pilot opportunities at the grid level, TCAAP is ideal for demonstrating innovative energy technologies at scale. The Project Team recommends that the JDA and County seek and attract partnerships to demonstrate proven technologies and strategies. While the technologies may be proven, TCAAP offers scalable and living demonstration opportunities, where an apartment, house, or street of homes could serve as a living lab. Additionally, as a cold climate site that can attract multiple partners, there is great opportunity to demonstrate the synergies that can exist between multiple innovative technologies and design strategies. This might include piloting new in-road luminescent street or pedestrian path lighting products in conjunction with high efficiency overhead LED street lighting or homes that have on-site electric storage and remote controlled appliances/electronics that communicate with each other.

The following case studies outline how demonstration opportunities can make economic sense for developers, the partnerships that brought opportunities to life, and key technologies that could be demonstrated at scale.

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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### 4.4.3. Technology Demonstration: Case Studies

#### 4.4.3.1. Builders Leading with Home Connectivity | Standard Pacific Homes, KB Homes, TruMark Co.

A number of leading home builders in the U.S. are capitalizing on the benefits of developing homes that are connected – to the internet, to smart phones, cars, on-site renewables, thermostats, lighting, and other home electronics and appliances. Basic network capabilities are being installed in homes as a new standard feature and then buyers can specify additional features they want making buyer costs incremental and personalized. Control capability for homeowners may range from remote control of lights and programmable thermostats, to automatic shutoff of leaky faucets and geofencing capabilities as users approach home. Networks and devices need to achieve this have dropped significantly in price and developers are starting to see these home features as low-cost ways to improve market value. Costs to developers start around \$200 and top out around \$2,000.



Figure 13: Geofencing enabled demand-side management

Examples of Potential Demonstration Technologies:

- Smart home appliances (e.g. Samsung)
- In-home network hubs, software and apps (e.g. SmartThings)
- Smart switches, plugs, and plug switching capabilities (e.g. Belkin WEMO)

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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- Connect light bulbs (e.g. Philips Hue)
- In-home energy storage/fuel cells and car-to-car charging (e.g. Honda’s Home Energy Management System<sup>21</sup>)
- In-home zoned temperature controls (e.g. Honeywell)

### 4.4.3.2. Net Zero Energy Commercial Building Envelopes | Guardian Industries Detroit, MI

Guardian Industries, a glass and building products manufacturer demonstrated a PV spandrel panel system on its new Science and Technology Center in suburban Detroit. The 12,000 square foot building showcases a cutting edge building panel system that brings solar power generation capability to the vertical surfaces of one or two story commercial buildings. The panels convert sunlight in to electricity at an efficiency of 17% allowing each square foot of panel to produce eight watts of power. Builder Turner Construction also incorporated Guardian’s own transparent PV glass to demonstrate ease of integration into the panel system. Eligible for federal modified accelerated cost-recovery System depreciation and a first year federal tax credit of 30% (available through 2017), the 2014 built project expects to achieve 100% payback in two years.



Figure 14: Building integrated PV panel systems

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<sup>21</sup> <http://www.hondasmarthome.com/>

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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### Examples of Potential Demonstration Technologies:

- Building integrated photovoltaic panel systems (e.g. BISEM)
- Photovoltaic or electrochromatic glass (e.g. Guardian Ecoguard glass)

### *Vehicle & Storage Integration Demonstration | SMUD Sacramento, CA*

Many major automakers have been working with Sumitomo Electric to demonstrate the value of a cloud-based communication system between electric vehicles and utilities.<sup>22</sup> The communication software allows the utility to ask charging cars if they want to temporarily stop charging, based on how much charge a user has programmed in to the charger. Users can opt into this program to receive discounted electricity rates or other incentives while the utility would see less stress on the grid and achieve greater service reliability.<sup>23</sup> Most recently this two-way communication system was demonstrated at the Sacramento Municipal Utility District's (SMUD) Service Center.

There are opportunities to demonstrate these grid benefits and customer incentives in Minnesota at TCAAP. The integration of these communication capabilities into the grid could be demonstrated across multiple individual EV users or a fleet (from a future TCAAP business or other TCAAP neighbors such as Ramsey County or AHATS). The synergy of additional technologies, such as on-site electric storage and renewables and in-home DC power access could be incorporated as part of such a grid integration project. Such an effort could be achieved in partnership with Xcel Energy with the opportunity for the University of Minnesota or other third-parties to play a role in research and community learning.

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<sup>22</sup> <http://www.epri.com/Press-Releases/Pages/EPRI,-Utilities,-Automakers-to-Demonstrate-Technology-Enabling.aspx>

<sup>23</sup> <http://www.af.mil/News/ArticleDisplay/tabid/223/Article/554343/af-tests-first-all-electric-vehicle-fleet-in-california.aspx>

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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*Figure 15: Integrating electric vehicles & storage with utility communication software*

Examples of Potential Demonstration Technologies:

- Cloud-based communication software for a utility (e.g. Sumitomo Electric)
- Electric vehicles (e.g. Honda, BMW, Nissan)
- Intelligent electric vehicle integration software (e.g. Nuvve, EURISCO)
- On-street charging stations (e.g. AeroVironment EV Solutions)

### **4.5. Recommended Development Request for Proposal Language**

In order to embed the energy resilience principals of TCAAP into the fabric of the site, it is recommended that the JDA incorporate evaluation language as part of the Request for Proposal (RFP) for all commercial development projects. The language below presents conservation guidelines as criteria by which each proposal could be evaluated. In the cases where it is possible to provide direct incentives or funnel state economic development fund to developers, these standards could be made requirements for these resources.

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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### *4.5.1. Energy Resilience Proposal Evaluation Criteria*

#### *Sustainable Buildings 2030 Design Standards – HIGHLY RECOMMENDED*

Commercial and residential development proposals will be evaluated based on a demonstrated commitment to building to meet or exceed the State of Minnesota’s Sustainable Building 2030 (SB 2030) energy standards. Proposals should highlight design and constructing team experience in developing high-performance buildings and sites. Proposals should also outline preliminary strategies and processes that will be used to meet higher energy performance.

This would include:

- Early design phase energy modeling to inform building orientation, daylighting, passive solar heating, and building envelope decisions
- Specification of high efficiency lighting, operator controls, and mechanical systems/district energy connection
- Integration of tenant and equipment level sub-meters that will monitor ongoing building performance and opportunities for demand response

#### *Further Sub-metering – RECOMMENDED*

Beyond meeting SB 2030, it is recommended that all commercial buildings on the TCAAP site be equipped with local sub-metering. Proposals should describe generally the plans for installing circuit or equipment level sub-meters within each tenant space (e.g. individual building or tenant building systems such as lighting or venting) and power monitoring systems to inform behavior and ongoing commissioning efforts.

#### *Innovative Energy Demonstrations & Partnerships – RECOMMENDED*

The RFP should state the interest in TCAAP servings as a national model and demonstrating proven energy innovations that will help make renewables, energy efficiency, and energy awareness more visible at TCAAP.

- Proposals may describe a unique energy technology to be incorporated at the building or site level.
- Proposals that layout collaboration opportunities with other TCAAP developers or the community will receive additional consideration (e.g. building co-location interest)

#### *Advanced Metering – RECOMMENDED*

# TCAAP Energy Integration Resiliency Framework

## Energy Efficiency Strategies

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This infrastructure will help track and report detailed building performance data to building operators and the utility. It would also allow for the potential of rate programs that give building owners more control of their energy costs and savings (dynamic pricing). All electric utility meters should have two-way, real-time communication capabilities. Xcel Energy could work with developers to help specify and install any advanced meters, and the site development partners could help Xcel Energy obtain the necessary regulatory approvals for piloting these installations.

### *Solar Oriented Development -- RECOMMENDED*

While SB 2030 guidelines will encourage building orientation and site planning that optimizes load minimizing solar heat gains, developers that show intent to incorporate passive solar design will be given additional consideration or even site location preference. This may include conceptual drawings, plans, and other documentation that show how building orientation, building massing, window placement, and site landscaping will utilize passive solar heating and achieve solar access for immediate or future on-site renewables.

# TCAAP Energy Integration Resiliency Framework

## Schedule

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### 5. Schedule

#### 5.1. Overall TCAAP Development Schedule

The development schedule that is currently proposed is likely to begin in 2016 with the construction of the interchanges of County Hwy 96 and County Road H with the Spine Road. The Spine Road construction is also expected to begin in 2016. Currently, site development is projected to begin with the residential and retail areas in the northern region of TCAAP in late 2016 or early 2017. Development is expected to progress southward from the Town and Creek neighborhoods as the market allows. The Thumb area is being actively marketed by the JDA at this time, and could be developed as soon as the right proposal is received from the development community. The current development plan is included in the appendix as Exhibit III.

#### 5.2. Integrating with the TCAAP Development Schedule

Given the development timeline in section 5.1, development of the concepts presented in this Framework will need to follow varying schedules, as provided below.

##### *5.2.1. Future Thermal Energy Grid*

While the most cost-effective time to install thermal energy grids is in coordination with initial site development, this is likely not feasible given the uncertainty of when and what will be developed at TCAAP. Alternatively, a corridor for future energy infrastructure (i.e. district energy piping) could be preserved in the engineering and construction plans for the Spine Road. The Project Team is in discussions with Ramsey County staff to include that corridor in the Spine Road design.

##### *5.2.2. Community Solar*

The proposed community solar garden is technically not located on the TCAAP site, rather it is recommended for the Primer Trace site. As such, TCAAP development will not necessarily have an impact on the schedule for this opportunity. Rather, the community solar garden will need to be completed and in service by December 31, 2016 to be eligible for the 30% income tax credits, assuming they are not extended. If the tax credit is not needed in the developer's business model, this schedule is driven more by market conditions than the TCAAP development schedule.

##### *5.2.3. Low-Temperature District Energy*

Construction of the low-temperature district energy system in the residential neighborhoods will need to coincide with development in order to be ready to serve the initial neighborhood development, avoid any unnecessary developer costs, and minimize the cost of pipe installation. RFPs are likely to be

# TCAAP Energy Integration Resiliency Framework

## Schedule

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issued in late 2015, so the business plan for this system will need to be fully developed in early to mid-2015.

### *5.2.4. Combined Heat and Power*

Development of the initial CHP system is more directly related to the needs of the existing buildings than to the development timeline of TCAAP. Therefore, construction of the initial CHP system should be coordinated with the MNARNG's plans for site expansion, so that the proposed future buildings could be served by the system from the initial construction and unnecessary equipment costs can be avoided. Connection to the other buildings should be completed at this time to take advantages of the economies of scale and optimize thermal energy capture. Expansion of the CHP system to serve development of TCAAP should coincide with that development, and the JDA should engage early with selected developers to identify how the CHP system can be expanded to meet their buildings' needs.

### *5.2.5. Demand-Side Management*

The JDA should work with partner organizations to develop greater comprehension of SB 2030 guidelines by hosting informational gatherings for the development companies that are interested in the TCAAP site. Builders and contractors familiar with the SB 2030 process could be asked to provide insight and feedback about the process. Developer education will build developer acceptance and understanding of process to make the site more attractive.

The JDA should also assess current residential market potential in Twin Cities region by conducting market research and outreach on all-electric, low load home concept. This will help to assuage developer and future resident concerns about unfamiliar technologies and utility structure.

The JDA should lastly work with the site marketing team to market energy conservation concepts to potential developers, builders, and tenants, focusing on the business opportunities available through these concepts.

# TCAAP Energy Integration Resiliency Framework

## Next Steps and Conclusion

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### 6. Next Steps and Conclusion

#### 6.1. Next Steps

To achieve the TCAAP energy vision and achieve sustainable benefits for the City and the surrounding community, the JDA will need to begin implementation on each of the individual opportunities presented in this Framework. The Project Team recommends the following immediate actions related to each opportunity.

##### *6.1.1. Partnerships*

Continue partnership discussions with the MNARNG, Xcel Energy, the University of Minnesota Center for Sustainable Building Research, and other stakeholders as development of the site and the various energy opportunities progress.

##### *6.1.2. Solar PV*

Develop an RFP for the development of a solar array on the Primer Tracer site. The RFPs could be sent to Xcel Energy and local community solar developers. In parallel to the site development RFP process, the County and the MNARNG should begin the process needed to secure the Primer Tracer land for a solar development.

##### *6.1.3. Combined Heat and Power*

As part of the developer selection process, the JDA should work with prospective developers to identify opportunities for serving those buildings' electric and thermal energy needs with a CHP facility. The JDA and County should also coordinate with the MNARNG and Xcel Energy to define an initial CHP facility that can serve the current loads in the area, align with the energy goals of the MNARNG, and be expanded in the future to meet the emerging TCAAP energy loads as they occur.

##### *6.1.4. Low-Temperature District Energy System*

The JDA should develop the business plan for the proposed low-temperature district energy system and form the operational organization in preparation for the site development request for proposals. In addition, the County should work with the Army and the appropriate regulatory authorities to obtain approval to extract energy from the treated ground water, and utilize the existing pump house for the low-temperature district energy distribution loop. Lastly, the JDA should continue collaboration with Xcel Energy to explore a neighborhood that is independent of the natural gas system, through district energy and electric grid services.

# TCAAP Energy Integration Resiliency Framework

## Next Steps and Conclusion

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### *6.1.5. Demand-Side Management*

The JDA should adopt the energy savings design standards it would like to incorporate into the site development RFP process, both for commercial and residential developments. The JDA should also inform developers on the various energy efficiency opportunities that are available to them by developing informational and educational material for prospective developers. Lastly, the JDA should collaborate with developers and Xcel Energy to identify opportunities for an advanced distribution grid and meters, building co-location, and passive-solar design deployment.

### *6.1.6. Infrastructure Planning*

The County should develop a utility coordination program that enables cost-effective implementation of initial utilities and infrastructure on the site, while allowing for future infrastructure to be added as opportunities come available. The County should also incorporate solar orientation into the platting process.

### *6.1.7. Funding Pursuits*

The JDA should identify the funding opportunities that it could be the most successful in pursuing, and collaborate with the City, County, MNARNG and other stakeholders, as appropriate, to develop funding requests for each selected opportunity. In parallel, the stakeholders should develop and implement an outreach campaign to inform decision makers on the energy opportunities that are available at TCAAP.

### *6.1.8. RFP Development*

The JDA and the County should include energy planning in the development of RFPs for the site, and through negotiations and discussions with individual developers. Opportunities for co-location, waste energy capture, energy efficiency improvements, district energy integration, and other options discussed in the *White Paper* and the Framework should be discussed with developers throughout TCAAP development process to achieve the energy vision.

## **6.2. Conclusion**

The ERAB has adopted a very forward-thinking vision for the TCAAP site. This will be achievable through strategic partnerships with Xcel Energy, the MNARNG, the University of Minnesota Center for Sustainable Building Research, environmentally conscious citizens, and developers who see the economic and environmental value of the TCAAP energy vision. Through these partnerships, TCAAP will be uniquely poised to be the national model for the development of integrated energy systems.

The first steps toward achieving the energy vision include implementing energy supply options that focus on efficiency, reliability, scalability, and sustainability, such as the low-temperature district

# TCAAP Energy Integration Resiliency Framework

## Next Steps and Conclusion

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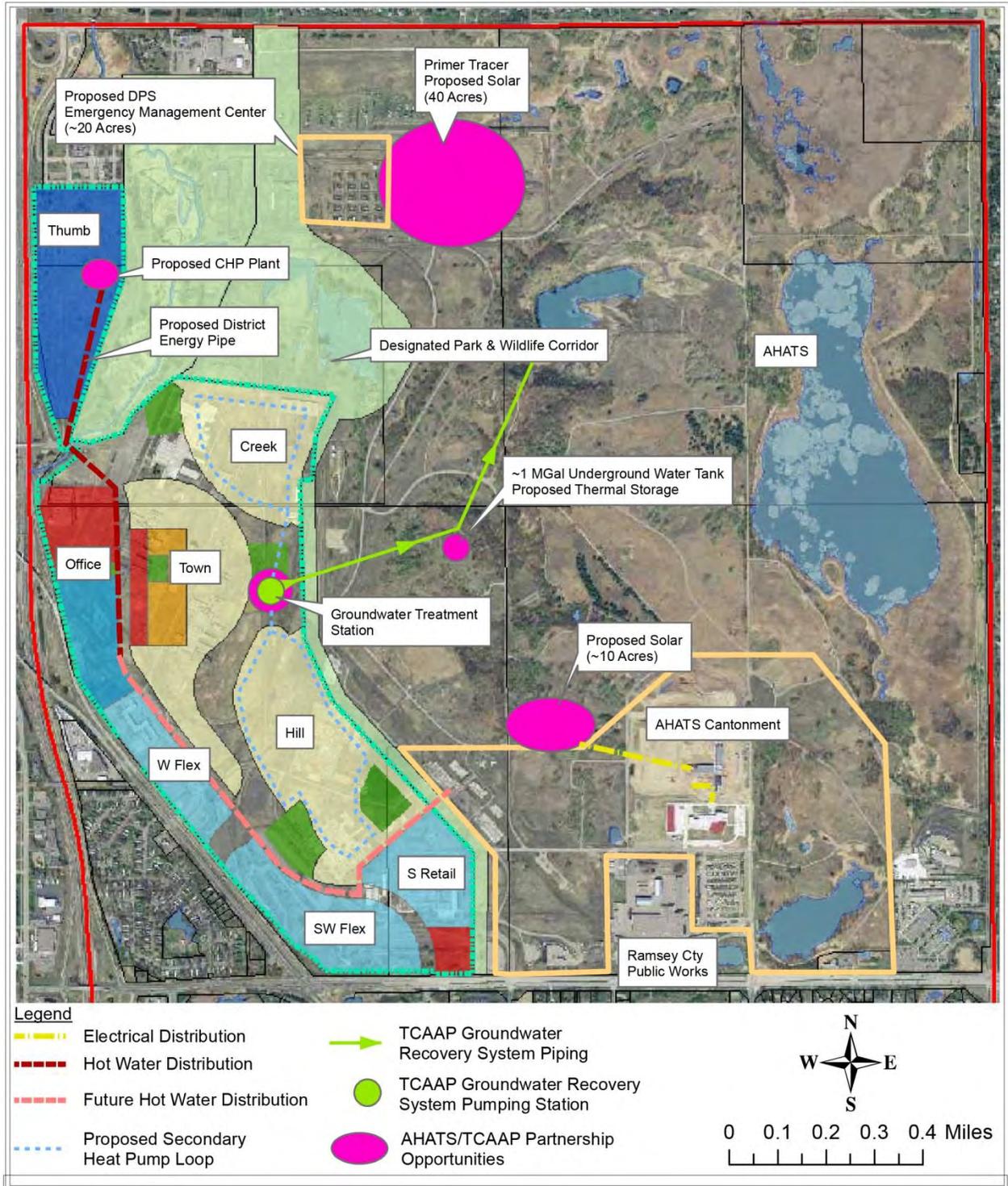
energy system in the residential neighborhoods and the community solar garden at the Primer Tracer site. These specific opportunities have been shown to be financially beneficial and financeable. Developing a CHP approach that meets the needs of current buildings in the area, and is expandable in the future as development proceeds, provides a platform for establishing a resilient TCAAP microgrid in the future.

Implementing a demand-side management strategy that focuses on building performance through the development RFP process will build a resilient community for energy use. Focusing on improving performance in the buildings to reduce, or even eliminate, the energy needs of the buildings will provide an economically attractive environment as building owners are able to take advantage of the financial savings realized by the increased efficiency, compared to traditional energy expenditures.

# TCAAP Energy Integration Resiliency Framework

## Exhibits

### Exhibit I – Partnership Opportunities Map



# TCAAP Energy Integration Resiliency Framework

## Exhibits

### Exhibit II – Demand Side Management Recommended Roles Matrix

	County/City	JDA	Development Broker	Development Engineer	Xcel Energy
<b>Fiber (Spine Road)</b>		Support the installation of TCAAP-wide fiber optic infrastructure. Coordinate with the appropriate utilities so that this infrastructure is installed at the most cost effective development phases.	Convey to developers the benefits of having fiber optic hooked up.	Plan for the installation of TCAAP-wide fiber optic infrastructure. Coordinate with the appropriate utilities so that this infrastructure is installed at the most cost effective development phases.	
<b>Snow melt piping (Spine road)</b>	Invest in this infrastructure as a future maintenance cost savings measure and draw for businesses and residents in the more populated neighborhoods and the Town.	Support the installation of a low-grade heat piping system.	Convey to developers considering Town Center sites the convenience benefits of the street snow melt system.	Plan for the installation of a low-grade heat piping system by keeping green space available along the spine road.	
<b>Low load homes</b>	Help to build a constituency for low-load developments. Also, facilitate the formation of a low temperature district energy business for integration of low-load homes.		Communicate the attractiveness of low-load homes for future home buyers and share the status of constituency interest.		

# TCAAP Energy Integration Resiliency Framework

## Exhibits

	County/City	JDA	Development Broker	Development Engineer	Xcel Energy
<b>Save on natural gas extension trunklines</b>	Support residential development RFPs with preferences for low-load homes and the benefits of not extending natural gas trunkline infrastructure in these neighborhoods.	<p>Coordinate the location of the low-load neighborhoods so that natural gas infrastructure costs can be avoided.</p> <p>Include in residential development RFPs the preference for low-load homes and the benefits of not extending natural gas trunkline infrastructure in these neighborhoods.</p>	Include cost saving information from not having to extend natural gas trunklines onto specific plats or subdivisions.	Help to visually communicate the location of the low-load neighborhoods as they are determined by proposals and the JDA.	
<b>Attracting businesses with electric vehicle fleets</b>		Help identify (with 3rd party help) appropriate locations for such businesses if there is interest.	Market TCAAP to MN and national businesses that have or may have electric vehicle fleets. Convey that TCAAP would help demonstrate reliable EV charging infrastructure at scale through microgrid and local renewables integration.		
<b>Energy Resilience RFP language</b>	Help structure incentive opportunities that would motivate developers to implement options presented in the EIRF and White Paper. This may include being the arbiter of standing federal, state or local incentives for job creation or tax benefits.	Integrate recommended Energy Resilience criteria into proposal evaluation.	Include recommended RFP language in RFP packets, including sell-sheets that describe the benefits of these preferences. Pursue developers with experience implementing energy efficient developments.		

# TCAAP Energy Integration Resiliency Framework

## Exhibits

	County/City	JDA	Development Broker	Development Engineer	Xcel Energy
<b>Street Planning and House Orientation</b>	Be stewards of energy resilient street planning and platting. Work with developers to maximize solar heat gain potential by siting lots that allow for the longer sides of houses to be oriented East/West.	Include RFP language that requests for solar isolation optimization (land grading and building orientation), passive solar house design, passive ventilation, and PV-ready roof size and direction (west or southwest).		Support the County and City in dividing up residential neighborhoods with lots that are North/South oriented, or within 15 degrees.	
<b>Developer Education</b>		Help coordinate developer education sessions to help inform developers of TCAAP Energy Resilience goals and opportunities for support services. Discuss potential partnerships, and cost benefits before proposal submission. After developer selection, share information on specific building or home technologies, answer questions, discuss opportunities for integrating with district systems, and initiate design support.			
<b>Sharing costs: SB 2030 &amp; ENERGY STAR Home certifications</b>	Support the development of high-performance design and development by sharing the administrative costs of the SB 2030 certification with developers (50/50 split).				Provide additional technical support for those projects committed to meeting SB 2030.
<b>Co-locating buildings</b>		Facilitate building co-location by making developers aware of the energy cost benefits of siting on a particular plot of land and even offering potential incentives for doing so.	Communicate to developers what co-location is, why it would be advantageous, and what building use types best leverage this opportunity. Make a special effort to market to developers or businesses that building these types of projects.		

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	County/City	JDA	Development Broker	Development Engineer	Xcel Energy
Advanced Meters					Make advanced meters the standard offering for buildings and homes built on the TCAAP site.



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### Exhibit IV – Funding Source Matrix

Funding Name	Type of Funding	Funding Source	Funding Description	Funding Criteria	Limitations	Deadline	Suggested Next Steps	Notes and Additional Info
Property Assessed Clean Energy (PACE)	Financing through Property Assessment	Municipal Financing District	Revenue bonds backed by special assessments and made available to property owners through loans, which are repaid through an annual special tax on individual property bills.	<ol style="list-style-type: none"> <li>1. Energy efficiency improvements;</li> <li>2. Renewable energy systems, and</li> <li>3. Electric Vehicle charging systems.</li> </ol>	Loan cannot be longer than the useful life of improvements (max. 20 years), assessed over 10 years. Limited to the cost of the improvement or 10% of property, whichever is less. Energy audit or feasibility study required. Must demonstrate ability to repay (current on taxes and mortgage). Must demonstrate cost effectiveness, and receive consent of first mortgage lender.	None	Arden Hills City Council should work with the Saint Paul Port Authority (SPPA) to develop a Joint Powers Agreement to allow SPPA to administer PACE program.	<a href="http://mn.gov/commerce/ene/rgy/images/PA-CE-Minnesota-Presentation.pdf">http://mn.gov/commerce/ene/rgy/images/PA-CE-Minnesota-Presentation.pdf</a> <a href="http://www.pacenow.org">www.pacenow.org</a>
Legislative-Citizen Commission on Minnesota Resources	Grant	Environment and Natural Resources Trust Fund	Permanent fund in the state treasury established for the public purpose of the conservation or enhancement of natural resources.	Alignment with LCCMR strategic plan, multiple beneficiaries, outcomes, knowledge base of applicant, extent of impacts, innovation, scientific or technical basis, urgency, capacity and readiness, and leverage.	Natural resource education, capital projects for the protection of unique natural resources, activities that preserve impaired natural resources.	4:30 PM on Monday, May 11, 2015	Immediately review 2016 projects for alignment with LCCMR eligibility and criteria and proceed with application.	Funds from the 2015 application process would be available July 1, 2016. <a href="http://www.lccmr.leg.mn/proposals/2016/2016_lccmr_rfp.pdf">http://www.lccmr.leg.mn/proposals/2016/2016_lccmr_rfp.pdf</a>
Renewable Development Fund	Public Benefits Fund	Xcel Energy	Minnesota Legislature has required Xcel Energy to contribute towards the development of renewable-energy resources for each cask of nuclear fuel stored at Prairie Island and Monticello nuclear power plants. Annual contribution to the fund is approximately \$26 million. Up to \$10.9 million annually must be allocated to support renewable energy production.	Request for proposals issued, and awards based on proposals received. PUC must approve RDF grant awards.	Funds in the RDF account may only be used for: increasing the market penetration of renewable electric energy resources in Minnesota at a reasonable cost, promoting the start-up, expansion, and attraction of renewable electric energy projects and companies within Minnesota, stimulating in-state research and development into renewable electric energy technologies, and developing near-commercial and demonstration scale electric infrastructure delivery projects if those delivery projects enhance the delivery of renewable electric energy.	Next cycle dates not published	Monitor for announcements of next funding and review cycle.	<a href="http://www.xcelenergy.com/environment/renewable_energy/development_fund">http://www.xcelenergy.com/environment/renewable_energy/development_fund</a>
Investment Tax Credit	Corporate tax credit	Internal Revenue Service	The ITC is a 30 percent tax credit for solar systems on residential (under Section 25D) and commercial (under Section 48) properties.	eligible for solar			Evaluate this opportunity if a solar garden agreement is not reached.	

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Funding Name	Type of Funding	Funding Source	Funding Description	Funding Criteria	Limitations	Deadline	Suggested Next Steps	Notes and Additional Info
<b>Production Tax Credit</b>	Corporate tax credit	Internal Revenue Service	The federal renewable electricity production tax credit (PTC) is a per-kilowatt-hour tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year.	eligible for geothermal			Research eligibility and applicability of this fund for a ground-source heat pump district energy system and determine whether this program is still fully funded.	<a href="http://energy.gov/savings/renewable-electricity-production-tax-credit-ptc">http://energy.gov/savings/renewable-electricity-production-tax-credit-ptc</a>
<b>Qualified Energy Conservation Bonds (QECB)</b>	Taxable Bonds	Department of Energy	Taxable bond that enables qualified state, tribal, and local government issuers to borrow money at attractive rates to fund energy conservation projects (e.g. capital expenditures related to reducing energy consumption in public buildings, implementing green community programs, designing/running demonstration projects to promote the commercialization of technologies to reduce peak use of electricity, etc.)		At least 70 percent of the allocations must be used for government projects. No more than 30 percent may be used for private activities. Private activity QECB proceeds may only be used for capital expenditures. Additionally, 100 percent of the available project proceeds of QECBs are to be used for one or more qualified conservation purposes.	September 10, 2010 or Expiration of funds		<a href="http://mn.gov/mmb/images/Notice-of-Guidance-5B1-5D.pdf">http://mn.gov/mmb/images/Notice-of-Guidance-5B1-5D.pdf</a> <a href="http://program.s.dsireusa.org/system/program/detail/3098">http://program.s.dsireusa.org/system/program/detail/3098</a>
<b>Made in Minnesota Solar Incentive</b>	Performance Incentive	Department of Commerce	Incentive for customers of investor owned utilities to utilize solar PV modules or solar thermal panels, up to 40 kW-DC system, manufactured at a registered facility located in Minnesota.	Manufacturer located in the state and be registered and authorized to manufacture in the state. Utility must provide meter, and utility owns the RECS.	40 kW-DC system maximum	February 29 of every year	Evaluate this opportunity if a solar garden agreement is not reached. Or if solar thermal is pursued for development.	
<b>Trillion BTU</b>	Revolving Loan Fund	Saint Paul Port Authority	Money saving opportunities are identified by energy audits and engineering studies (Xcel Energy co-funding and CEE technical assistance available). SPPA is using Federal stimulus monies through the Minnesota Department of Commerce to create this program for Minnesota businesses. Customer chooses the project and contractors, Xcel Energy provides the rebate, SPPA provides the financing. 100% financing available.	Must be an Xcel Energy commercial or industrial customer with a qualified rebate project.	Must be in Xcel service territory	Revolving	Determine need for this mechanism.	<a href="http://sppa.com/wp-content/uploads/sellsheet_03_108.pdf">http://sppa.com/wp-content/uploads/sellsheet_03_108.pdf</a>

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Funding Name	Type of Funding	Funding Source	Funding Description	Funding Criteria	Limitations	Deadline	Suggested Next Steps	Notes and Additional Info
Energy Savings Partnership	Revolving Loan Fund	Saint Paul Port Authority - MN Department of Commerce	Established by a grant from the MN Department of Commerce, a municipal leasing program with U.S. Bank that offers reduced interest rate loans to participants.	Any project that provides energy efficiencies, energy savings, or renewable energy is eligible.	Minimum loan size is \$50,000. Must be a city, county, public school, or regional government entity.	Revolving	Determine need for this mechanism.	<a href="http://sppa.com/wp-content/uploads/2014/03/newESP2014.pdf">http://sppa.com/wp-content/uploads/2014/03/newESP2014.pdf</a>
New Market Tax Credits	Tax Credit	Eligible Financing Agency	The New Markets Tax Credit Program (NMTC Program) was established by Congress in 2000 to spur new or increased investments into operating businesses and real estate projects located in low-income communities. The NMTC Program attracts investment capital to low-income communities by permitting individual and corporate investors to receive a tax credit against their Federal income tax return in exchange for making equity investments in specialized financial institutions called Community Development Entities (CDEs). An organization wishing to receive awards under the NMTC Program must be certified as a CDE by the Fund.	Must be located in an eligible distressed zone. The credit totals 39 percent of the original investment amount and is claimed over a period of seven years (five percent for each of the first three years, and six percent for each of the remaining four years).	The investment in the CDE cannot be redeemed before the end of the seven-year period.	Dispatched annually	Determine need for this mechanism and a financing partner.	
The Resilient Electricity Delivery Infrastructure (REDI) Initiative	Grant	Department of Energy (NETL)	DOE initiative that focuses on technology transfer of smart grid advances to support the White House actions to respond to the needs of communities nationwide that are dealing with the impacts of climate change. Maximum awards range from \$600,000 to \$1,000,000 by topic area.	1) implementation and deployment of the best, pre-commercial and/or commercial smart grid technologies/tools (Topic Area 1) and 2) utilizing smart grid technologies/tools from the DOE National Laboratories (Topic Area 2).	Only available to units of local government. The improvements must be measurable, tangible within 24 months of project start, substantial over a long period of time, accountable for resilience to environmental stressors (e.g., more frequent extreme weather events and other climate change impacts).	4-May-15	Determine if any projects are prepared and eligible to proceed with application.	<a href="https://www.fedconnect.net/FedConnect/?do=c=DE-FOA-0001219&amp;agency=DOE">https://www.fedconnect.net/FedConnect/?do=c=DE-FOA-0001219&amp;agency=DOE</a>

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### Exhibit V – Definitions

*Air Handling Unit (AHU)* – A central unit consisting of a blower, heating and cooling elements, filter racks or chamber, dampers, humidifier, and other central equipment in direct contact with the airflow. This does not include the ductwork through the building.

*Active solar* – As an energy source, energy from the sun collected and stored using mechanical pumps or fans to circulate heat-laden fluids or air between solar collectors and a building.

*Alternating Current (AC)* – An electric current that reverses its direction at regularly recurring intervals. AC is the form in which electric power is delivered to businesses and residences.

*Alternative-rate Energy Efficiency program assistance* – An Energy Efficiency (demand-side management) program assistance that offers special rate structures or discounts on the consumer's monthly electric bill in exchange for participation in Energy Efficiency programs aimed at cutting peak demands or changing load shape. These rates are intended to reduce consumer bills and shift hours of operation of equipment from on-peak to off-peak periods through the application of time-differentiated rates. For example, utilities often pay consumers several dollars a month (refund on their monthly electric bill) for participation in a load control program. Large commercial and industrial customers sometimes obtain interruptible rates, which provide a discount in return for the consumer's agreement to cut electric loads upon request from the utility (usually during critical periods, such as summer afternoons when the system demand approaches the utility's generating capability).

*Arden Hills Army Training Site (AHATS)* – A military training area of Minnesota National Guard and the Minnesota Department of Military Affairs that is directly adjacent to the Rice Creek Commons Project to the east.

*ASHRAE Bin temperature data* – Temperature frequency in 5 F intervals available from American Society of Heating, Refrigerating and Air-Conditioning Engineers.

*Boiler* – A device for generating steam for power, processing, or heating purposes; or hot water for heating purposes or hot water supply. Heat from an external combustion source is transmitted to a fluid contained within the tubes found in the boiler shell. This fluid is delivered to an end-use at a desired pressure, temperature, and quality.

*British Thermal Unit (Btu)* – The amount of heat required to raise the temperature of one pound of water 1 degree Fahrenheit. The Btu is a small amount of heat equivalent to the heat released by a burning matchstick. For district heating systems, heat is often measured in million Btus (MMBtu) which is equivalent to one million Btu's.

*Building Commissioning* - a building performance quality assurance process that begins during design and continues through construction, occupancy, and operations. Commissioning ensures that the new building operates initially as intended by design and that building staff are prepared to operate and maintain its systems and equipment.

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*Capacity* – The maximum output, commonly expressed in megawatts (MW), that generating equipment can supply to system load, adjusted for ambient conditions.

*Chiller* – Any centrally located air conditioning system that produces chilled water in order to cool air. The chilled water or cold air is then distributed throughout the building, using pipes or air ducts or both. These systems are also commonly known as “central chillers,” “centrifugal chillers,” “reciprocating chillers,” or “absorption chillers.” Chillers are generally located in or just outside the building they serve. Buildings receiving district chilled water are served by chillers located at central physical plants.

*Chilled Water* – The product of a Chiller that is distributed through a building or, in the case of a District Cooling system, other adjacent buildings for the purposes of air conditioning.

*Coefficient of Performance (COP)* – Ratio of work or useful output to the amount of work or energy input, both represented in the same unit. Used generally as a measure of the energy-efficiency of chillers and heat pumps.

*Combined Heating and Power (CHP)* – A plant designed to produce both heat and electricity from a single heat source.

*Conservation* – A reduction in energy consumption that corresponds with a reduction in service demand. Service demand can include buildings-sector end uses such as lighting, refrigeration, and heating; industrial processes; or vehicle transportation. Unlike energy efficiency, which is typically a technological measure, conservation is better associated with behavior. Examples of conservation include adjusting the thermostat to reduce the output of a heating unit, using occupancy sensors that turn off lights or appliances, and car-pooling.

*Constant Air Volume (CAV)* – A system designed to provide a constant air flow. This term is applied to HVAC systems that have variable supply-air temperature but constant air flow rates. Most residential forced-air systems are small CAV systems with on/off control.

*Consumer (energy)* – Any individually metered dwelling, building, establishment, or location using natural gas, synthetic natural gas, and/or mixtures of natural and supplemental gas for feedstock or as fuel for any purpose other than in oil or gas lease operations; natural gas treating or processing plants; or pipeline, distribution, or storage compressors.

*Cooling Degree Days* – A degree day is the difference in temperature between the outdoor mean temperature over a 24-hour day and a given base temperature. Cooling degree days occur when the outdoor mean temperature is above 65 F.

*Cubic Feet per Minute (CFM)* – A common means of assigning quantitative values to volumes of air or fluid in transit.

*Customer conversion* – The equipment in a customer building mechanical room that transfers thermal energy from the district heating system to the building systems to allow the heat to be distributed throughout the building. The customer conversion usually consists of heat exchangers, pumps, piping, control sensors, and control valves to enable heat to be efficiently transferred from the higher temperature district heating system to the lower temperature building system.

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*Daylighting* – Designing buildings to maximize the use of natural daylight to reduce the need for electricity.

*Demand-Side Management (Energy Efficiency)* – A utility action that reduces or curtails end-use equipment or processes. Energy Efficiency is often used in order to reduce customer load during peak demand and/or in times of supply constraint. Energy Efficiency includes programs that are focused, deep, and immediate such as the brief curtailment of energy-intensive processes used by a utility's most demanding industrial customers, and programs that are broad, shallow, and less immediate such as the promotion of energy-efficient equipment in residential and commercial sectors.

*Demand-side management costs* – The costs incurred by the utility to achieve the capacity and energy savings from the Demand-Side Management Program.

*Differential temperature (dT, delta T)* – The difference between the supply temperature and return temperature of the district heating water delivered to users. This is an indication of the amount of energy delivered to the customer.

*Direct Current (DC)* – The unidirectional flow of electric charge. Direct current is produced by sources such as batteries, thermocouples, and solar cells. The electric current flows in a constant direction, distinguishing it from alternating current (AC).

*Distributed Control System (DCS)* – A control system of an energy production plant and process wherein control elements are not only located in central location but are also distributed throughout the system with each component sub-system controlled by one or more controllers so the intelligence is distributed across the sections of the system.

*Distribution* – The delivery of energy to retail customers.

*District energy* – A thermal energy delivery system that connects energy users with a central production facility.

*Diversified load* – The actual peak load on an energy system. The diversified load is less than the sum of the peak loads of individual users due to the difference in time of day that each individual user realizes their peak load.

*Distribution system* – The underground piping network that delivers hot water from an energy production facility to the customer buildings. Hot water is circulated through this distribution system using pumps that are located at the production facility.

*Domestic hot water* – Potable water that is heated for use in faucets, showers, laundry, and similar uses.

*Energy Conservation Measure (ECM)* – This includes building shell conservation measures, HVAC conservation measures, lighting conservation measures, any conservation measures, and other conservation measures incorporated by the building. However, this category does not include any Energy Efficiency program participation by the building. Any Energy Efficiency program participation is included in the Energy Efficiency Programs.

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*Energy Transfer Station* – Equipment installed at the point of customer connection to the district energy system. The energy transfer station is utilized to transfer and measure the thermal energy delivered from the district energy distribution network to the customer’s building(s) or other thermal loads.

*Energy Usage Intensity* - The quantity of total energy that a building consumes per square foot per year. Energy is usually expressed in terms of thousand British thermal units (KBtu/SF/year).

*Energy Utilization Index (EUI)* – Measure of the total energy consumed in cooling or heating of a building or facility in a period, expressed as British thermal unit (Btu) per (cooled or heated) gross square foot.

*Equivalent Full Load Hours* – Annual energy usage divided by the peak capacity used.

*Fixed Operations and Maintenance (FOM)* – Costs other than those associated with capital investment that do not vary with the operation, such as maintenance and payroll.

*Fuel Cell CHP* – Electrochemical power generation process generating both electricity and thermal energy suitable for making steam or hot water.

*Geothermal energy* – Hot water or steam extracted from geothermal reservoirs in the earth's crust. Water or steam extracted from geothermal reservoirs can be used for geothermal heat pumps, water heating, or electricity generation.

*Geothermal plant* – A plant in which the prime mover is a steam turbine. The turbine is driven either by steam produced from hot water or by natural steam that derives its energy from heat found in rock.

*Green Spine* – The corridor through the Rice Creek Commons development that will be designated green space for the use of stormwater management, recreational trails, and parks.

*Greenhouse gases (GHG)* – Those gases, such as water vapor, carbon dioxide, nitrous oxide, methane, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride, that are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, thus preventing long-wave radiant energy from leaving Earth's atmosphere. The net effect is a trapping of absorbed radiation and a tendency to warm the planet's surface.

*Ground Source Heat Pump* – A heat pump in which the refrigerant exchanges heat (in a heat exchanger) with a fluid circulating through an earth connection medium (ground or ground water). The fluid is contained in a variety of loop (pipe) configurations depending on the temperature of the ground and the ground area available. Loops may be installed horizontally or vertically in the ground or submersed in a body of water.

*Heat pump* – Heating and/or cooling equipment that, during the heating season, draws heat into a building from outside and, during the cooling season, ejects heat from the building to the outside. Heat pumps are vapor-compression refrigeration systems whose indoor/outdoor coils are used reversibly as condensers or evaporators, depending on the need for heating or cooling.

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*Heating Degree Days* – A degree day is the difference in temperature between the outdoor mean temperature over a 24-hour day and a given base temperature. Heating degree days occur when the outdoor mean temperature is below 65 F.

*Heat exchanger* – A pressure vessel that contains plates or tubes and allows the transfer of heat through the plates or tubes from the district heating system water to the building heat distribution system. A heat exchanger is divided internally into two separate circuits so that the district heating system water and the building heat distribution system fluids do not mix.

*Heating coil* – A heating element made of pipe or tube that is designed to transfer heat energy to a specific area or working fluid.

*Hot water supply and return lines* – The district heating system piping that distributes hot water for heating purposes to customers (supply) and returns the cooler water to the Plant for reheating (return).

*Kilowatt (kW)* – A unit of power equal to one thousand Watts (W)

*Kilowatt-hour (kWh)* – A measure of electricity defined as a unit of work or energy, measured as 1 kilowatt (1,000watts) of power expended for 1 hour. One kWh is equivalent to 3,412 Btu.

*Load* – The amount of energy used by a customer. Typically refers to the Peak Load on the system.

*Levelized Cost of Energy (LCOE)* – The present value of the total cost of building and operating a generating plant over its economic life, converted to equal annual payments. LCOE is determined by dividing the project's total cost of operation by the energy generated.

*Medium temperature hot water* – Thermal heat transferred via hot water at a temperature between 190 °F and 250 °F.

*Megawatt (MW)* – One million Watts (W)

*Megawatt-hour (MWh)* – One thousand kilowatt-hours

*Microgrid* – A group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that act as a single controllable entity with respect to the grid and can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.

*Million BTU (MMBTU)* – One million British Thermal Units (BTU). One MMBTU is equivalent to 293.07 kWh.

*Net Present Value (NPV)* – The difference between the present value of the future cash flows from an investment and the amount of investment. Present value of the expected cash flows is computed by discounting them at the required rate of return. A zero net present value means the project repays original investment plus the required rate of return. A positive net present value means a better return, and a negative net present value means a worse return, than the return from zero net present value.

*Non-diversified load* – The sum of the peak loads of individual users. This is a theoretical maximum system peak load.

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*Normalized* – Adjusted annual data of monthly building usage values measured on different monthly heating degree scales to a common scale prior to averaging.

*N+1 Redundancy* – A measure of system component redundancy to provide backup in the event of failure of any one component. N+1 refers to the number of units installed to carry normal load plus one additional unit as backup. For example, if a system has three chillers to achieve the total design load, each is rated at 33% of the total load, or N=3. For this example, an N+1 system will have a total of four chillers of 33% capacity for a total installed capacity of 133% with one chiller providing backup in the event of failure of any one chiller.

*Operations and Maintenance (O&M)* – The activities related to the performance of routine, preventive, predictive, scheduled, and unscheduled actions aimed at preventing equipment failure or decline with the goal of increasing efficiency, reliability, and safety.

*Outside Air Temperature (OAT)* – A measure of the air temperature outside a building. The temperature and humidity of air inside and outside the building are used in enthalpy calculations to determine when outside air can be used for free heating or cooling.

*Passive solar heating* – A solar heating system that uses no external mechanical power, such as pumps or blowers, to move the collected solar heat.

*Peak load/ Peak demand* – The maximum load during a specified period of time

*Photovoltaic and solar thermal energy* – Energy radiated by the sun as electromagnetic waves (electromagnetic radiation) that is converted at electric utilities into electricity by means of solar (photovoltaic) cells or concentrating (focusing) collectors.

*PSI* – An abbreviation for pounds per square inch. PSI is a unit of pressure measurement.

*Rice Creek Commons (RCC)* – The name of the land development project that is being led by Ramsey County, as the land owner, on the site formerly known as the Twin Cities Army Ammunitions Plant (TCAAP).

*Recommissioning* - A type of commissioning that occurs within an existing, operating building to identify ways the building operation is sub-optimal. The decision to recommission may be triggered by a change in building use or ownership, the onset of operational problems, or some other need. *Renewable energy resources* – Energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action

*Resiliency* – The ability to withstand disruptions to the regional or national energy grids or significant volatility to the market price for energy sources.

*Return on Investment (ROI)* – The earning power of assets measured as the ratio of the net income (profit less depreciation) to the average capital employed (or equity capital) in a company or project. Expressed usually as a percentage, return on investment is a measure of profitability that indicates whether or not a company is using its resources in an efficient manner. For example, if the long-term return on investment of a company is lower

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than its cost-of-capital, then the company will be better off by liquidating its assets and depositing the proceeds in a bank.

*Seasonal energy efficiency ratio (SEER)* – Ratio of the cooling output divided by the power consumption. It is the Btu of cooling output during its normal annual usage divided by the total electric energy input in watt hours during the same period. This is a measure of the cooling performance for rating central air conditioners and central heat pumps.

*Service line/service piping/customer connection* – The segment of the district heating distribution system that extends from the main lines to the inside of the customer building. The service line is typically sized to meet the peak hot water flow requirements for the individual building served by the piping.

*Square Foot (SQ FT or ft<sup>2</sup>)* – Unit of measure to quantify the footprint area of a customer building, used to estimate the Load of a building based on the usage of the building.

*Source Energy* - The total amount of raw fuel that is required to operate an energy-using device or facility. Source energy includes all transmission, delivery, and production losses, thereby enabling a complete assessment of energy efficiency in a building. On the other hand, “Site Energy” is the amount of heat and electricity consumed by a building as reflected in utility bills.

*Solar cooling* – The use of solar thermal energy or solar electricity to power a cooling appliance.

*Solar Photovoltaic Systems (PV)* – Systems that directly convert sunlight into electricity either for use locally or for delivery to the electric grid.

*Solar Thermal* – Systems that directly convert sunlight into heat, generally for domestic hot water though they can also be used to produce space heating.

*Substation* – Facility equipment that switches, changes, or regulates electric voltage.

*Sustainability* - Meeting the needs of the present generation without compromising the ability of future generations to meet their own needs.

*Therm* – One hundred thousand (100,000) Btu

*Thermal energy* – Energy that is generated and measured in the form of heat.

*Thermal Energy Storage* – The storage of heat energy during utility off-peak times at night, for use during the next day without incurring daytime peak electric rates.

*Thumb* – That portion of the Rice Creek Commons development that is at the extreme northwest of the site, and is separated from the remainder of the site by Rice Creek.

*Transit Oriented Development (TOD)* – Land development that takes into account transportation choices as a means of reducing oil and other energy use. Typically it would combine public transit with walkable, mixed-use communities, and approaches to minimize the impact of individual vehicles and commuting.

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*Waste Heat Recovery* – An energy conservation system whereby some space heating or water heating is done by actively capturing byproduct heat that would otherwise be ejected into the environment. In nonresidential buildings, sources of waste heat include refrigeration/air-conditioner compressors, manufacturing or other processes, data processing centers, lighting fixtures, ventilation exhaust air, and the occupants themselves. Not to be considered is the passive use of radiant heat from lighting, workers, motors, ovens, etc., when there are no special systems for collecting and redistributing heat.

*Water source heat pump* – A type of (geothermal) heat pump that uses well (ground) or surface water as a heat source. Water has a more stable seasonal temperature than air thus making for a more efficient heat source.

*Variable Air Volume (VAV)* – An HVAC system that has a stable supply-air temperature, and varies the air flow rate to meet the temperature requirements. Compared to constant air volume (CAV) systems, these systems conserve energy through lower fan speeds during times of lower temperature control demand.

*Variable frequency drive* – an electronic controller that controls the speed of an electric motor by modulating input frequency and voltage to match motor speed to the specific demands of the work being performed.