MAPC's 3A Analytical Toolbox: District Suitability

Appendix B: Technical Documentation

Updated February 2024

How we established criteria, indicators, and weighting

Criteria for the 3A District Suitability Analysis were determined based on conversations between MAPC's Data Services and Housing teams, using the following methodology:

1. List all **criteria** that might determine what areas are suitable for 3A districts. Consider factors from Housing Production Plans, smart growth principles, and from the Executive Office of Housing and Livable Communities' (EOHLC) Section 3A Guidelines.
2. Through conversations between Data Services and Housing teams, narrow down to 5-6 most important criteria.
3. List all potential data layers (**indicators**) that could represent each criterion.
4. With feedback from Housing team, narrow down to those that are publicly available, relatively recent, cover the entire region, and are relatively reliable sources of information.

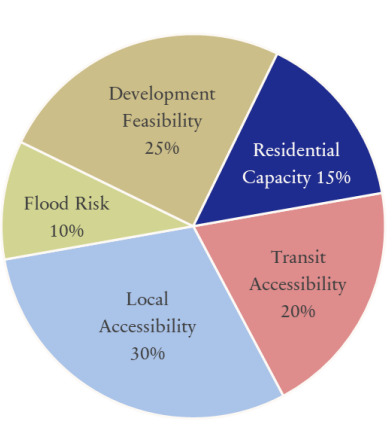
Dynamic Criteria Weighting

The weighting scheme for the District Suitability Model is dynamic, reflecting EOHLC's Compliance Model which assigns each municipality a unique requirement for the "portion of the multi-family zoning district that must be within a transit station area," or within a 0.5 mile buffer zone from a transit station[1]. This proportion – called the "Station Area Requirement" in this model - ranges from 0% (for municipalities with limited or no transit station area) to 90% (for municipalities where there is plentiful developable area within station areas). More information about how this station area requirement is determined can be found in EOHLC's Section 3A Guidelines (See section: "Location of Districts")

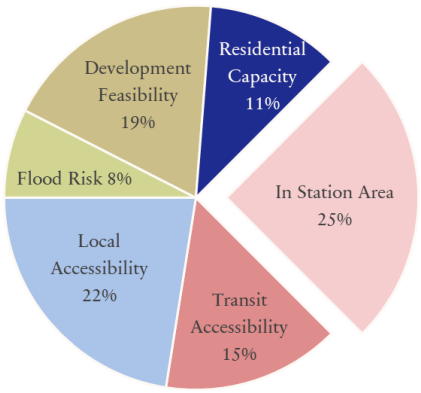
Weights for the remaining criteria reflect priorities outlined by EOHLC, smart growth principles, and iterative conversations between Data Services and Land Use staff. Of the criteria not related to transit station area, Local Accessibility receives the highest weight (up to 30%), followed by Development Feasibility (25%), Transit Accessibility (20%), Net Residential Capacity (15%), and Flood Risk (10%).

Based on the methodology described above, the following dynamic weighting scheme was developed. Two scenarios are provided; the first for a municipality with a Station Area Requirement of 0%, and the second for a municipality with a Station Area Requirement of 90%, thus reflecting the minimum and maximum requirement. A list of criteria weights by municipality can be found at the end of this document.

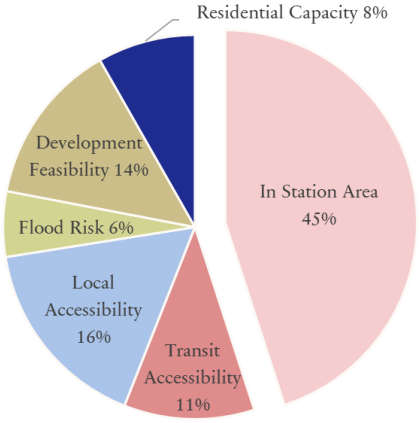
Criteria	Weight Calculation	Scenario 1 **Muni with 0% station area requirement**	Scenario 2 **Muni with 90% station area requirement**
In Station Area	0.5 x Station Area Requirement	0%	45%
Transit Accessibility	0.2 x (1 – Station Area Weight)	20%	11%
Local Accessibility	0.3 x (1 – Station Area Weight)	30%	16.5%
Flood Risk	0.1 x (1 – Station Area Weight)	10%	5.5%
Development Feasibility	0.25 x (1 – Station Area Weight)	25%	13.75%
Net Residential Capacity	0.15 x (1 – Station Area Weight)	15%	8.25%
		100%	**100%**



Scenario 1 | Muni with 0% station area requirement



Scenario 2 | Muni with 50% station area requirement



Scenario 3 | Muni with 90% station area requirement

Indicators and Weighting

Once criteria were defined, indicators were selected to represent each criterion. Indicators are introduced below, along with their data source and weight within their criteria.

Criteria 1: Transit Station Area			
Indicator	**Relationship to district suitability**	**Data Source**	**Weight**
Within half-mile radius of transit stations	In municipalities with Transit Station Area requirements for 3A districts, parcels within the transit station area are more suitable.	EOHLC Transit Station Areas (2022)	100%
Criteria 2: Transit Accessibility			
Indicator	**Relationship to district suitability**	**Data Source**	**Weight**
Distance from transit stations, up to 1 mile	Parcels closer to transit stations are more suitable than those further away (up to 1 mile).	EOHLC Transit Station Points (2022)	20%
Half mile walkshed from commuter rail stations	Being within a half mile walkshed of commuter rail station indicates higher district suitability.	MIT Transit Access (2020)	20%
Number of jobs within 45 minutes by transit	Parcels located in census blocks with more jobs within 45 minutes by transit are more suitable.	MAPC, University of Minnesota (2019)	40%
Share of non-auto commuters	Being located within census tracts with a higher share of non-auto commuters suggests an existing population without reliance on vehicles. Parcels in these locations have higher suitability.	American Community Survey (ACS), 2017-2021	20%
Criteria 3: Local Accessibility			
Indicator	**Relationship to district suitability**	**Data Source**	**Weight**
School walkshed scores	Walkable access to schools reduces reliance on motor vehicles. Parcels with higher school walkshed scores are more suitable.	MAPC's My School Commute study (2017)	20%
Walk Score	High walk scores indicate walkable access to nearby amenities and are therefore indicate suitable locations.	Walk Score (2016)	40%
Distance to nearest town center (MAPC)	Living within or near town centers indicates less need for reliance on motor vehicles. Parcels in these locations have higher suitability.	MAPC's Town and Village Centers (2018)	40%
Criteria 4: Development Feasibility			
Indicator	**Relationship to district suitability**	**Data Source**	**Weight**
Improvement to land ratio	Parcels are considered more suitable if they have a low ratio of building value to land value, as this suggests they may be underbuilt relative to their land value.	MAPC Land Parcel Database (2023)	14%
Retail strip (MAPC)	A 2022 analysis of retail strips in Metro Boston identified strip malls with greater potential for retrofit. Parcels that score in the top 25% of sites in that analysis have greater district suitability.	MAPC's Rethinking the Retail Strip	14%
Historic sites	Parcels are considered suitable if they do not contain a location with a legal historic designation applied under local, state or federal law.	MHC Historic Inventory, subset[2]	14%

Building value per square foot	Parcels are considered more suitable if they have a low building value per square foot, as this suggests they are more likely to be redeveloped.	MAPC Land Parcel Database (2023)	14%
Build year	Parcels are considered suitable if they contain structures built before 2000. Structures built later than that indicate newer construction that would be less likely for retrofits or new development.	MAPC Land Parcel Database (2023)	14%
Condominiums	Parcels with condominiums have multiple owners, creating logistical challenges to increasing capacity. Parcels with the land use of "Condominium" are less suitable.	MAPC Land Parcel Database (2023)	14%
Vacant land	Unrestricted parcels with no buildings located on them are more suitable for development.	MAPC Land Parcel Database (2023)	14%
Criteria 5: Net Residential Capacity			
Indicator	**Relationship to district suitability**	**Data Source**	**Weight**
Existing floor area ratio (FAR)	Low existing Floor Area Ratios indicate opportunities for increasing density. Parcels with lower FAR have higher suitability.	MAPC Land Parcel Database (2023)	33.3%
Existing DU per acre	Low existing development units per acre signifies potential for increasing density. Parcels with lower DU per acre have higher suitability.	MAPC Land Parcel Database (2023)	33.3%
Unconstrained land area	Unconstrained land area represents a parcel's total land area, with excluded land area (described above in "Excluded Parcels") subtracted. Parcels with higher unconstrained land area have more available land for development and therefore receive higher suitability scores.	EOHLC Excluded Land (2022)	33.3%
Criteria 6: Climate Vulnerability			
Indicator	**Relationship to district suitability**	**Data Source**	**Weight**
FEMA Flood zones	Parcels are suitable if they have less than 10% overlap with FEMA 1% and 0.2% flood zones are considered suitable.	FEMA National Flood Hazard Layer (2023)	50%
MA Coastal Flood Risk Model (MC-FRM)	Parcels are suitable if they have less than 10% overlap with MCFRM inundation extent (1% storm, 2.4ft sea level rise scenario)	MCFRM (2022)	50%

Analysis Methodology

The following steps were conducted for each municipality separately. Analysis was conducted in Python and is outlined in more detail in the project's GitHub repository.

1. Calculate indicator values

Geospatial operations were used to calculate individual metrics for each indicator (for example, determining whether a parcel is within the half-mile transit radius, what year it was built, or whether it overlaps with flood zones). Raw indicator values were rescaled using min-max normalization – with outliers capped - across each municipality, such that the highest value (excluding outliers) for a given indicator in the municipality is rescaled to 1 and the lowest indicator value (excluding outliers) is rescaled to 0. Outliers were automatically assigned a value of 0 or 1 depending on which side of the range it fell. Some indicators are scored inversely as they represent negative qualities that reduce the site's suitability score. In those cases, *less* of that quality make a site *more* suitable.

Following the above methodology, values closer to 1 represent more favorable suitability (i.e., the presence of a desirable quality), while values closer to 0 represent a less favorable suitability (i.e., the presence of an undesirable quality, or the absence of a desirable one). The normalization methodology retains the distribution shape of the raw indicator metrics.

Figure 1 visualizes this process for the indicator *Floor Area Ratio,* which is an indicator under the **Net Residential Capacity** criteria. This indicator has inverse scoring; a *lower* Floor Area Ratio indicates a parcel is *more* suitable for 3A district siting. The full, raw distribution of Floor Area Ratio for parcels in Hingham, seen in the left-most histogram, ranges from 0 to 4. When outliers are excluded, as seen in the center histogram, the distribution of raw values – between 0 and 0.25 - becomes more pronounced. That range is then inverted and normalized on a 0 to 1 scale, as seen in the right-most histogram. Parcels with high FARs, or those closest to 0.25, receive an indicator score closer to 0. Parcels with FARs beyond 0.25 automatically receive a score of 0. Parcels with lower FARs receive an indicator score closer to 1.

To further illustrate this process, the teal call-outs in Figure 1 follow one example parcel – "Parcel X" – that has a raw Floor Area Ratio value of 0.1. Since that parcel's FAR falls somewhere in the low to middle range of the raw data range once outliers are excluded, it receives an indicator score of 0.6/1 (indicating moderate favorability).

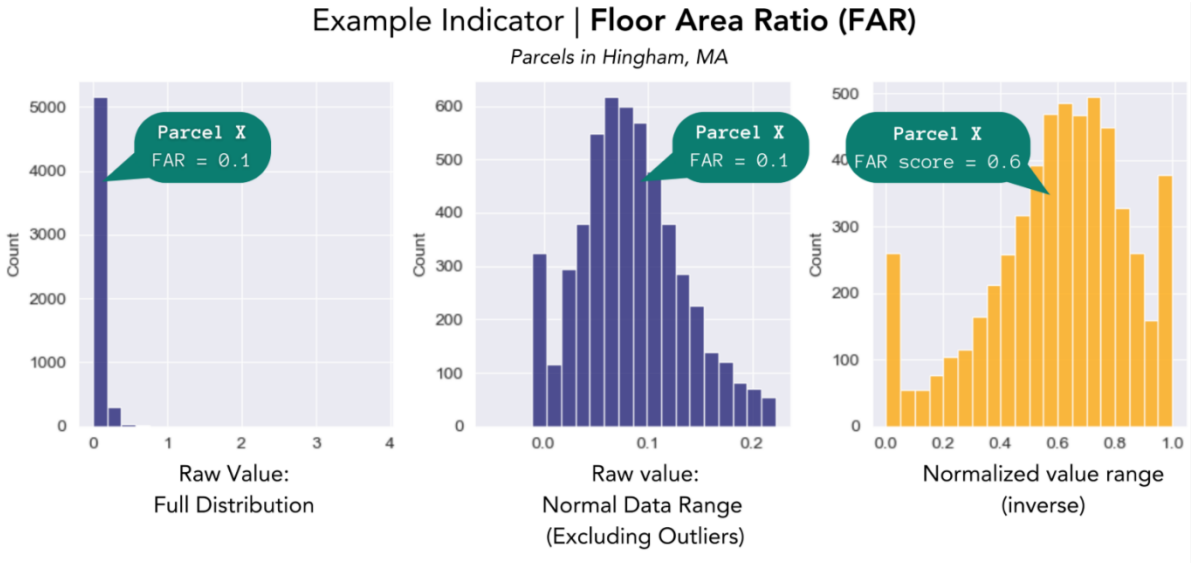


Figure 1

2. Calculate criteria scores based on weighted sum of indicator values

For each criterion, a *weighted average* was calculated based on the normalized indicator values and their respective weights. This weighted average was then used to calculate a percentile ranking, assigning each parcel a value of 0 to 1 representing the percentage of parcels that have a weighted average *less than* its own. The percentile ranking value is the final **criteria score**.

Criteria Scores range from 0 to 1, where values closer to 1 represent parcels that have the highest weighted average relative to other parcels in the municipality. For example, a parcel in Hingham with a Local Accessibility score of 0.8 has a higher weighted average than 80% of the rest of the parcels in Hingham. In other words, it's in the top 20% of favorable parcels for that criteria. Figure 2 illustrates this methodology for the Local Accessibility criteria for parcels in Hingham.

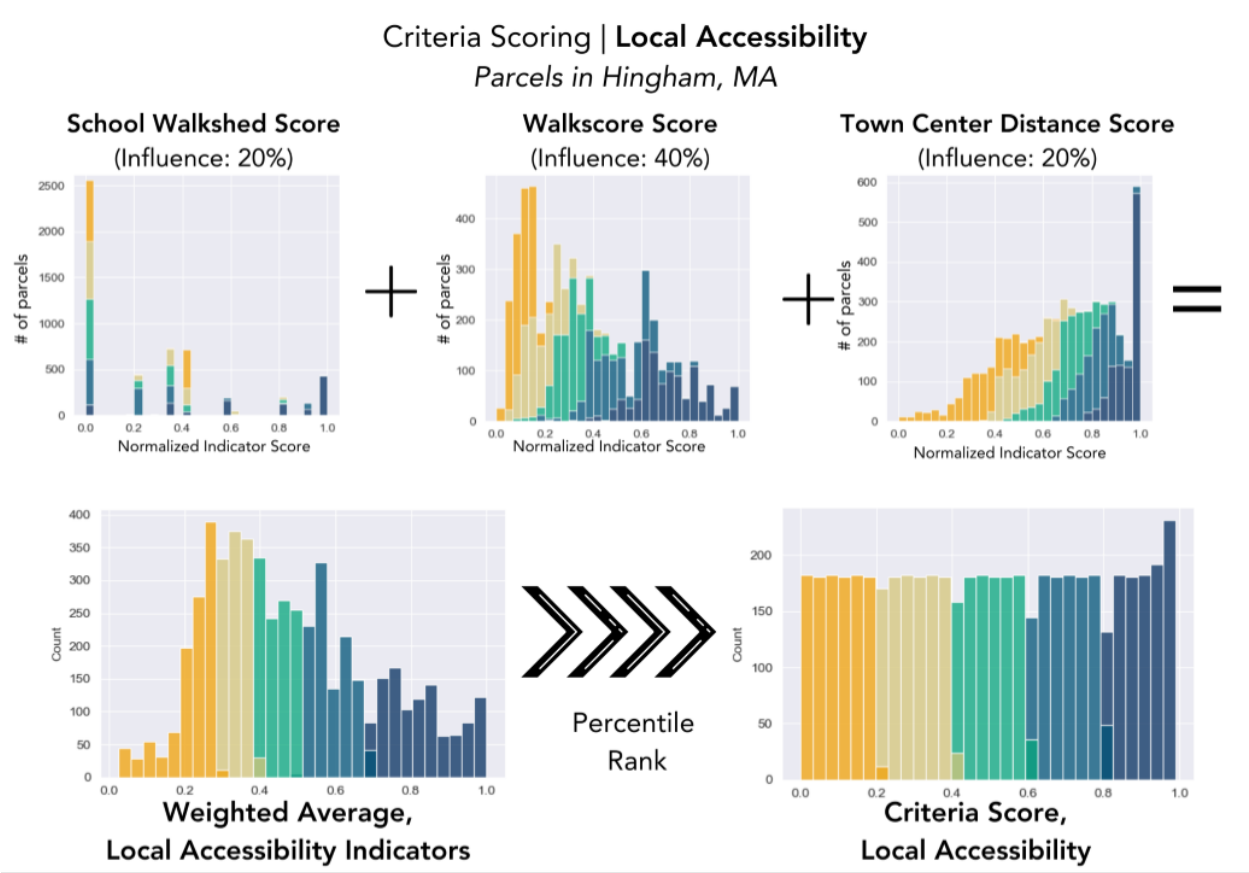


Figure 2

3. Rank final suitability scores based on weighted sum of criteria averages

A similar methodology was used to determine the final suitability score. Each criterion's weighted average was averaged together (according to dynamic criteria weights). This final weighted average is then assigned a value based on percentile rank. This rank is the **final suitability score.** Figure 3 illustrates this process for parcels in Hingham.

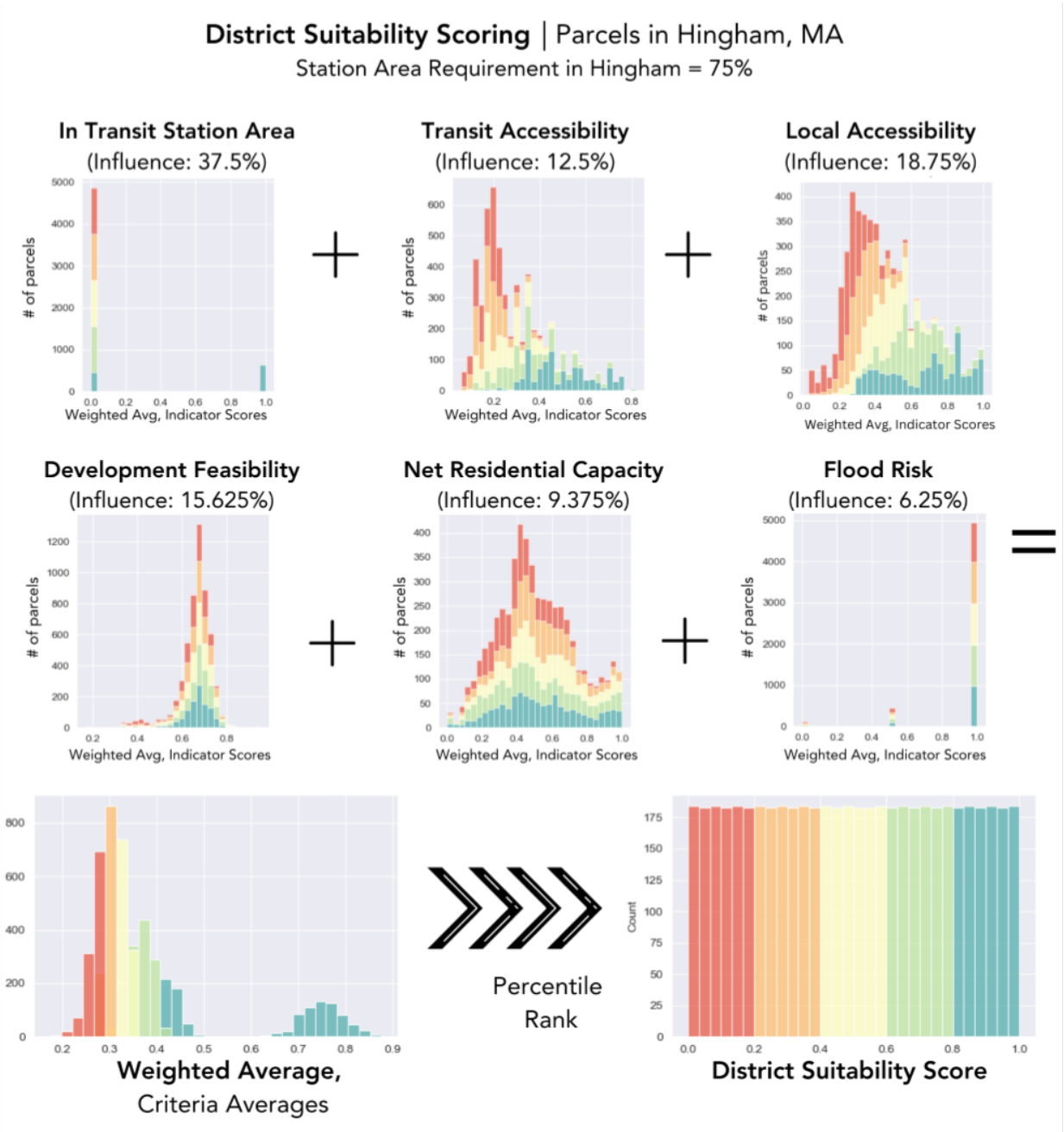


Figure 3

Interpreting Results

Indicator Scores

Indicators represent either quantitative or qualitative variables.

Quantitative variables are scored using their raw data metric. For example, for the Transit Accessibility indicator "Number of Jobs within 45 minutes from transit", a raw value for a parcel in Hingham might be a value like "20,347 jobs". After min-max normalization across Hingham (see the description for "Calculate indicator values" below), that parcel ends up with a normalized indicator score of 0.85, meaning it is close to the higher, or more favorable, end of the range for this indicator across all parcels in Hingham. In the final data table, quantitative indicators have both values provided; their **raw value** and their **indicator score**. The raw value is retained in the table to provide context; the indicator score is used to calculate the criteria score.

For ***qualitative variables***, parcels are scored based on the presence, lack of presence, or overlap with a certain phenomenon. For example, for the Development Feasibility variable "Overlap with Historic Sites", parcels receive an indicator score of 0 (not favorable) if there is a designated historic site located within the parcel boundary. For parcels that overlap with a historic site, there is also a contextual "description" field that provides information about the type of historic designation for the overlapping site. Thus, in the final data table, qualitative indicators have two types of values provided; their **indicator score** (0 or 1), which is used to calculate the criteria score, and one or more **descriptors** to contextualize the overlap.

Criteria Scores

Parcels receive a score for each of the five criteria. The score represents the *percentile rank* for the weighted average of all the indicator scores within that criterion, compared to all other parcels in the municipality. For example, a Transit Assets criteria score of 0.74 indicates that the parcel has a weighted average that is higher than 74% of all other parcels in the municipality for that criterion. In other words, that parcel is in the top 26% of favorable parcels in the municipality for that criterion.

Score	Interpretation
0 – 0.2	Lowest favorability
0.2 - 0.4	Moderately low favorability
0.4 - 0.6	Moderate favorability
0.6 - 0.8	Moderately high favorability
0.8 - 1	Highest favorability

Final Suitability Score

Based on the *weighted averages* of each criterion, parcels receive a final suitability score. The score ranks the parcel's weighted average compared to that of all other parcels in the municipality. Final scores closer to 1 indicate highest suitability according to the criteria, indicators, and weights chosen for this analysis. Final scores closer to 0 indicate lower overall suitability.

Score	Interpretation
0 – 20	Lowest suitability
20 - 40	Moderately low suitability
40 - 60	Moderate suitability
60 - 80	Moderately high suitability
80 - 100	Highest suitability

Criteria Weights by Municipality

Station area req*	Municipalities	Criteria Weights					
		Station area	**Transit accessibility**	**Local Accessibility**	**Development Feasibility**	**Residential Capacity**	**Flood Risk**
90%	Beverly, Brookline, Cambridge, Needham, Newton, Norwood, Quincy, Somerville, Wellesley	45.0%	11.0%	16.5%	13.8%	8.3%	5.5%
75%	Chelsea, Franklin, Hingham, Lynn, Medford, Melrose , Natick, Wakefield, Walpole, Weston, Weymouth, Woburn	37.5%	12.5%	18.8%	15.6%	9.4%	6.3%
50%	Belmont, Braintree, Canton, Concord, Dedham, Gloucester, Malden, Milton, Revere, Waltham, Westwood, Wilmington, Winchester	25.0%	15.0%	22.5%	18.8%	11.3%	7.5%
40%	Ashland, Framingham, Ipswich, Manchester, Norfolk, Reading, Rockport, Salem, Scituate, Sharon, Stoughton	20.0%	16.0%	24.0%	20.0%	12.0%	8.0%
20%	Acton, Cohasset, Everett, Hamilton, Holbrook, Lincoln, Littleton, Randolph, Southborough, Swampscott, Wenham	10.0%	18.0%	27.0%	22.5%	13.5%	9.0%
0%	Arlington, Bedford, Bellingham, Boxborough, Burlington, Carlisle, Danvers, Dover, Duxbury, Essex, Foxborough, Hanover, Holliston, Hopkinton, Hull, Lexington, Lynnfield, Marblehead, Marlborough, Marshfield, Maynard, Medfield, Medway, Middleton, Millis, Nahant, North Reading, Norwell, Peabody, Pembroke, Rockland, Saugus, Sherborn, Stoneham, Stow, Sudbury, Topsfield, Watertown, Wayland, Winthrop, Wrentham	0.0%	20.0%	30.0%	25.0%	15.0%	10.0%

**Station area requirement refers to the Portion of the multi-family zoning district that must be within a transit station area*