A Report on the City of Salem's Existing and Possible Urban Tree Canopy

Project Background

The analysis of the City of Salem's urban tree canopy (UTC) was carried out by the Virginia Department of Forestry in collaboration with the City of Salem and the Roanoke Valley—Alleghany Regional Commission. Assistance was provided by the Virginia Geospatial Extension Program (VGEP) at Virginia Tech's Department of Forestry and by the Spatial Analysis Laboratory (SAL) of the University of Vermont.

The goal of the project was to apply the USDA Forest Service's UTC assessment protocols to the City of Salem. This analysis was conducted based on year 2008 data.

Why is Tree Canopy Important?

Urban tree canopy (UTC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. Urban tree canopy provides many benefits to communities including improving water quality, conserving energy, lowering city temperatures, reducing air pollution, enhancing property values, providing wildlife habitat, facilitating social and educational opportunities, and providing aesthetic benefits.

Key Terms

UTC: Urban tree canopy (UTC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above.
Land Cover: Physical features on the earth mapped from satellite or aerial imagery such as trees, or water.
Existing UTC: The amount of UTC present within parcel boundaries.
Possible UTC: The amount of land that is theoretically available for the establishment of tree canopy within parcel boundaries. Possible UTC excludes areas covered by tree canopy, roads, buildings, and water. It is the combination of Possible UTC - Vegetation and Possible UTC - Impervious.
Possible UTC - Vegetation: The amount of land that is theoretically available for the establishment of tree canopy in non-tree vegetation areas within parcel boundaries. This excludes areas covered by tree canopy, impervious surfaces, and water.
Possible UTC - Impervious: The amount of land that is theoretically available for the establishment of tree canopy in impervious areas within parcel boundaries. This includes impervious areas (roads, parking lots, and sidewalks) except for buildings.

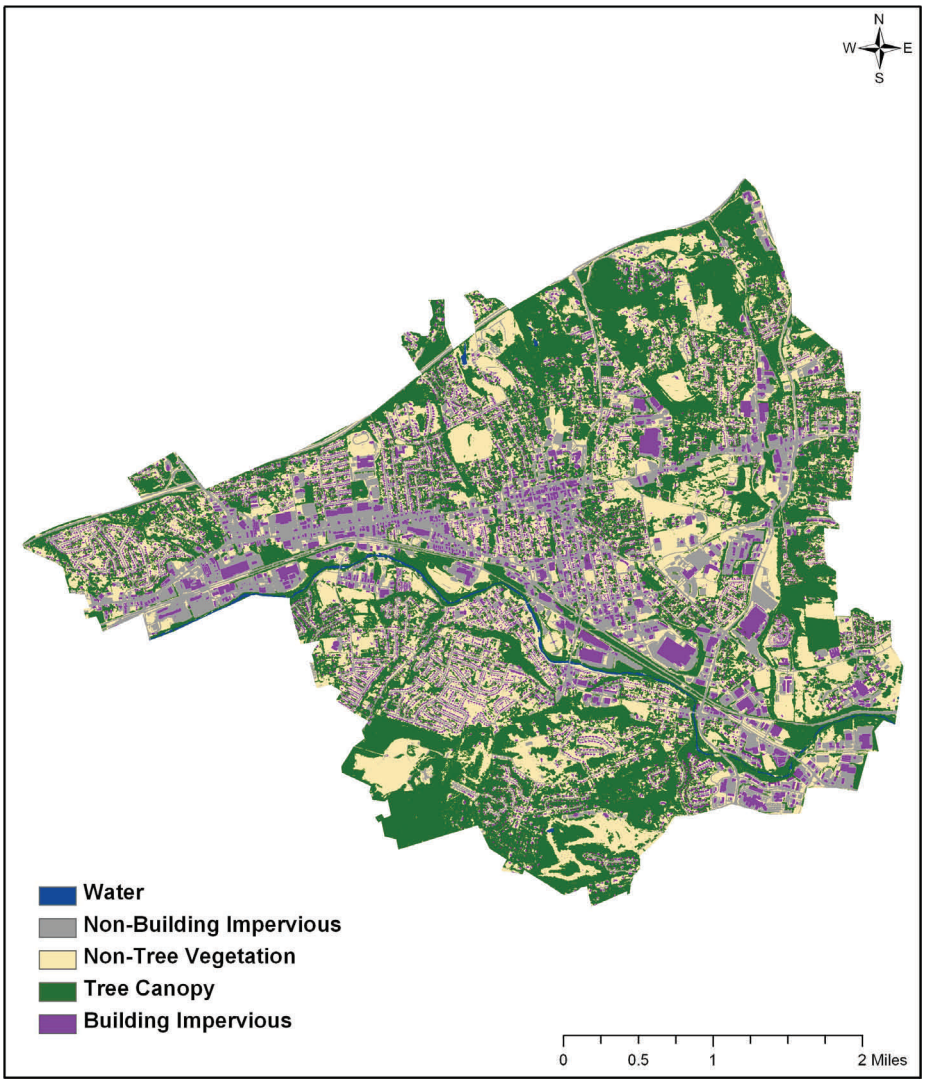


Figure 1: Land cover for the City of Salem.

How Much Tree Canopy Does Salem Have?

Figure 1 shows the urban tree canopy (UTC) analysis for Salem, which is derived from high resolution aerial imagery. 3722 acres of Salem is covered by tree canopy (termed Existing UTC). This corresponds to 40.1% of all land area within the city (Table 1). An additional 3853 acres of the city could theoretically be improved to support urban tree canopy (termed Possible UTC), Table 2.

UTC Classes	Existing UTC		
	Acres	% Total Area	% Land Area
Tree Canopy	3722	39.9%	40.1%
Non-Tree Vegetation	2704	29.0%	29.1%
Non-Building Impervious	2146	23.0%	23.1%
Buildings	717	7.7%	7.7%
Water	46	0.5%	0.0%
Total Area	9336	100.0%	100.0%

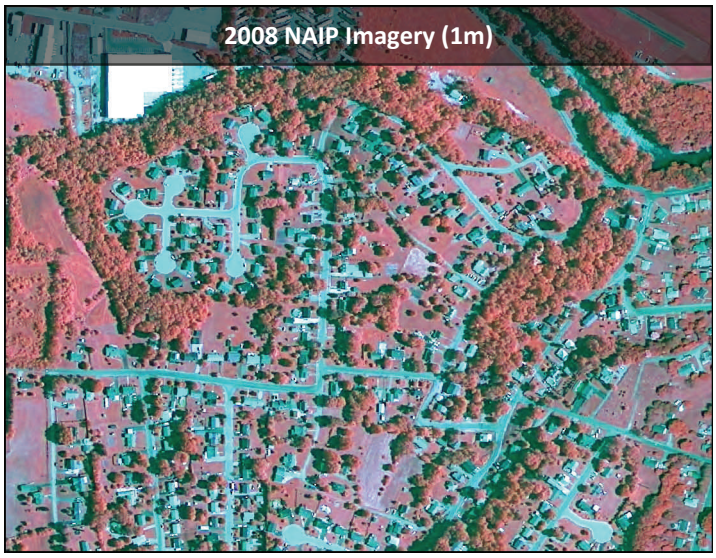
*Table 1: Existing UTC area and percentages for the City * % Total Area includes area covered by water.*

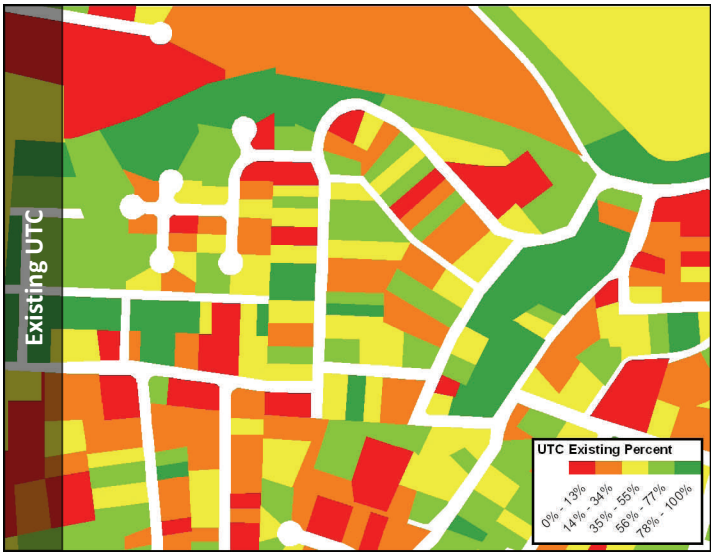
Mapping Salem's Trees

Using high-resolution (1 meter) National Agriculture Imagery Program (NAIP) imagery acquired in the summer of 2008 (Figure 2a) in combination with remote sensing techniques, land cover data for the city was generated (Figure 2b). An accuracy assessment was conducted. Single trees (tree canopies larger than 16 square meters) were detected with a 93% accuracy.

Who "Owns" Salem's Trees?

The detailed land cover mapping conducted as part of this assessment allowed the percentage of Existing and Possible UTC to be calculated for each parcel of land (Figure 3). Using this data, ownership patterns for Existing UTC and Possible UTC (Figure 4) can be examined.





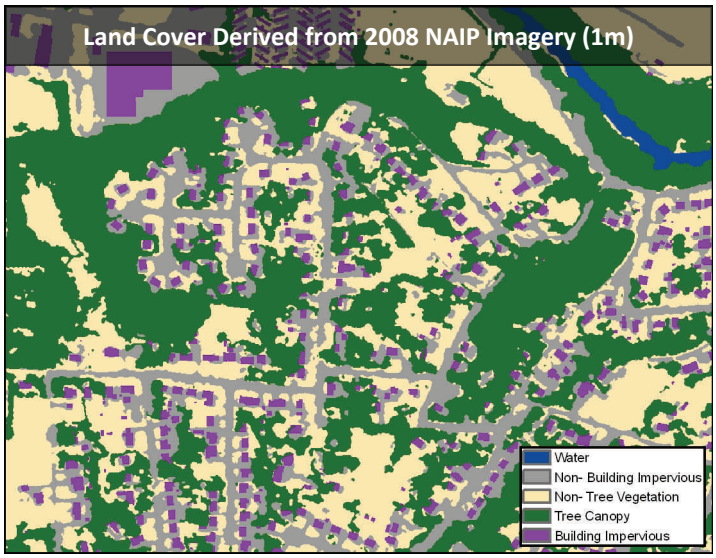


Figure 2a, 2b: Comparison of 2008 NAIP imagery to the resulting high-resolution land cover.

Figure 3: UTC metrics summarized at the property parcel level

Urban Tree Canopy Analysis Summarized by Parcels - Salem, VA

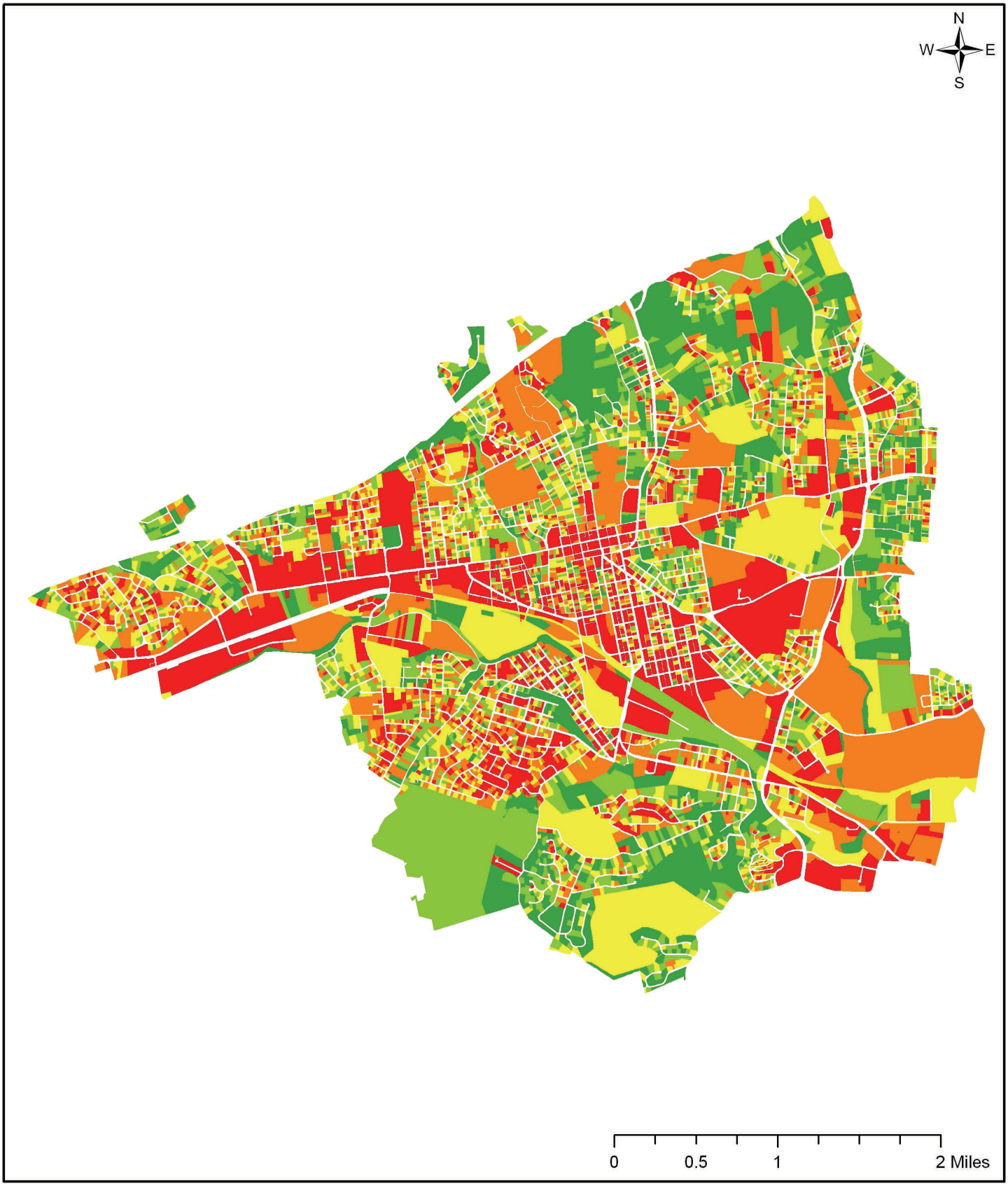


Figure 4: UTC metrics summarized by property parcel.

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Urban Tree Canopy Summarized by Property Parcels

Using the parcel data provided by the City of Salem, Existing and Possible UTC were summarized by property parcels. This summary excludes any area outside of property parcel boundaries and areas covered by water. Salem has 43.5% (3517 acres) Existing UTC and 47.6% (3853 acres) Possible UTC. Possible UTC has two components, Possible UTC - Vegetation and Possible UTC - Impervious. 29.9% (2421 acres) of parcel land area is associated with Possible UTC - Vegetation. 17.7% (1432 acres) of parcel land area is associated with Possible UTC - Impervious (Figure 5). Figure 4 shows Existing UTC throughout the City of Salem.

Urban Tree Canopy Summarized by Zoning

Using the zoning data provided by the City of Salem, Existing and Possible UTC were summarized by zoning category (page 5). The zoning category RSF (Residential Single Family) has the largest amount of land area with 4717 acres (Table 3). The RSF category also contains 69.4%of the Existing UTC in the city. Zoning Categories AG (Agricultural) and HM (Heavy Manufacturing) are 2nd (10.1%) and 3rd (6.6%) in Existing UTC respectively. Figure 6 compares zoning categories with greater than 20 acres by the amount of land area within the categories. Figure 7 shows the spatial distribution of Possible UTC by Zoning category for the City.

UTC Parcel Metrics	Acres	% Parcel Land Area
Parcel Land Area	8095	100%
Existing UTC	3517	43.5%
Possible UTC	3853	47.6%
Possible UTC - Vegetation	2421	29.9%
Possible UTC - Impervious	1432	17.7%
Not Suitable for UTC	763	9.4%

*Table 2: Acres and percent land area from UTC metrics summarized by property parcels. *Not Suitable for UTC includes all water areas some of which may lay outside of parcel boundaries.*

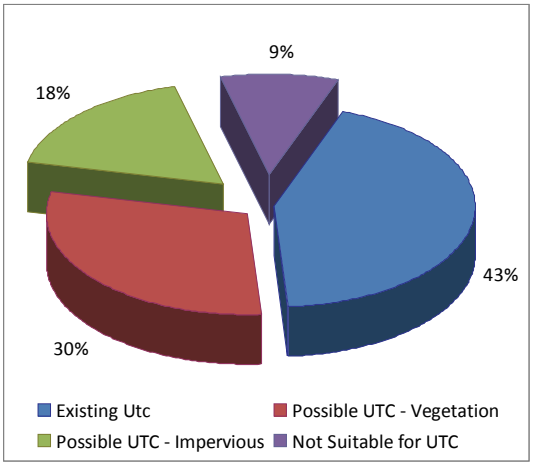


Figure 5: Pie chart showing Salem UTC distribution.

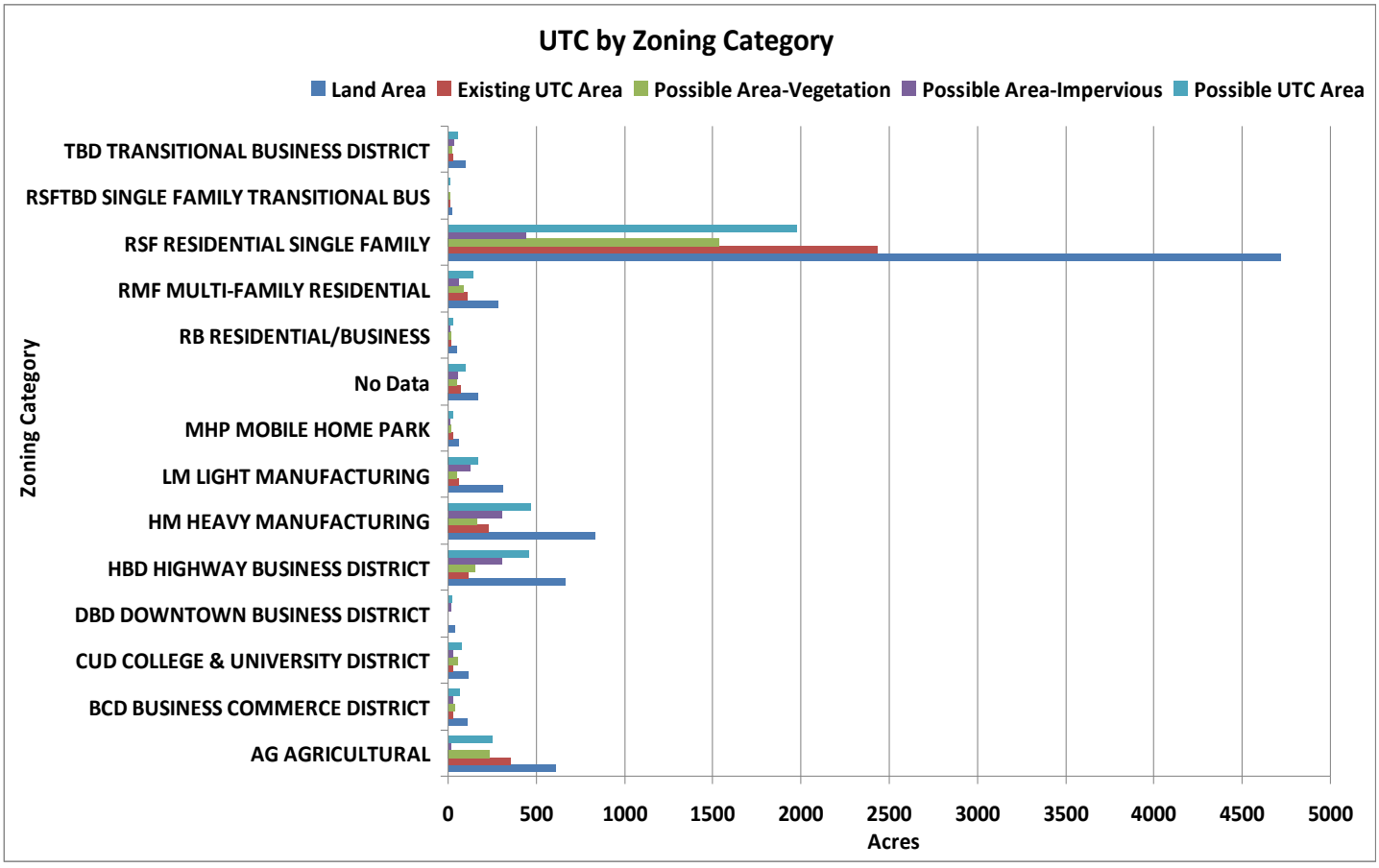


Figure 6a: UTC metrics for zoning categories with more than 100 acres of land area (not including water).

Urban Tree Canopy Summarized by Zoning Category

Zoning Category	Land Area (Acres)	Existing UTC			Possible UTC Vegetation			Possible UTC Impervious		
		% Land	% Zoning	% UTC	% Land	% Zoning	% UTC	% Land	% Zoning	% UTC
AG AGRICULTURAL	605	4.4%	58.5%	10.1%	2.9%	38.8%	9.7%	0.2%	2.5%	1.0%
BCD BUSINESS COMMERCE DISTRICT	104	0.4%	28.1%	0.8%	0.5%	36.7%	1.6%	0.3%	25.9%	1.9%
CUD COLLEGE & UNIVERSITY DISTRICT	113	0.3%	24.6%	0.8%	0.6%	45.0%	2.1%	0.3%	22.9%	1.8%
DBD DOWNTOWN BUSINESS DISTRICT	36	0.0%	4.7%	0.0%	0.0%	9.9%	0.1%	0.2%	52.1%	1.3%
HBD HIGHWAY BUSINESS DISTRICT	663	1.4%	16.6%	3.1%	1.9%	22.7%	6.2%	3.8%	46.1%	21.5%
HM HEAVY MANUFACTURING	832	2.8%	27.6%	6.6%	2.0%	19.8%	6.8%	3.8%	36.5%	21.3%
LM LIGHT MANUFACTURING	307	0.8%	19.8%	1.7%	0.6%	15.9%	2.0%	1.5%	40.3%	8.7%
MHP MOBILE HOME PARK	61	0.3%	43.7%	0.8%	0.2%	24.0%	0.6%	0.1%	19.2%	0.8%
No Data	169	0.9%	40.7%	2.0%	0.6%	27.7%	1.9%	0.6%	30.0%	3.6%
RB RESIDENTIAL/BUSINESS	49	0.2%	33.9%	0.5%	0.2%	32.6%	0.7%	0.1%	22.3%	0.8%
RMF MULTI-FAMILY RESIDENTIAL	284	1.3%	37.4%	3.0%	1.0%	29.3%	3.4%	0.7%	20.2%	4.0%
RSF RESIDENTIAL SINGLE FAMILY	4717	30.2%	51.5%	69.4%	19.0%	32.5%	63.5%	5.4%	9.3%	30.8%
RSFTBD SINGLE FAMILY TRANSITIONAL BUS	20	0.1%	47.2%	0.3%	0.1%	44.8%	0.4%	0.0%	6.4%	0.1%
TBD TRANSITIONAL BUSINESS DISTRICT	97	0.4%	30.1%	0.8%	0.2%	20.8%	0.8%	0.4%	34.1%	2.3%

$$\%\ \text{Land} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all land}}$$

The % Land Use value of 0.4% indicates that 0.4% of "Transitional Business district" land is covered by tree canopy.

$$\%\ \text{Category} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all land for specified land use}}$$

The % Category value of 30.1% indicates that 30.1% of Salem's land area is tree canopy in areas where the land use is "Transitional Business district".

$$\%\ \text{UTC Type} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all UTC type}}$$

The % UTC Type value of 0.8% indicates that 0.8% of all Existing UTC lies in areas of "Transitional Business district" land use.

Table 3: UTC metrics by type, summarized by zoning categories. For each category UTC metrics were computed as a percent of all zoned land in the city (% Land Area), as a percent of land area by zoning categories (% Zoning Category) and as a percent of the area for the UTC type (% UTC Type).

Urban Tree Canopy Analysis Summarized by Parcels - Salem, VA

Figure 7: Possible percentage increase of UTC mapped using zoning categories provided by the City of Salem.

Where to Plant Trees?

Decision makers can use GIS to find out specific UTC metrics for a parcel or set of parcels. This information can be used to estimate the amount of tree loss in a planned development or set UTC improvement goals for an individual property.

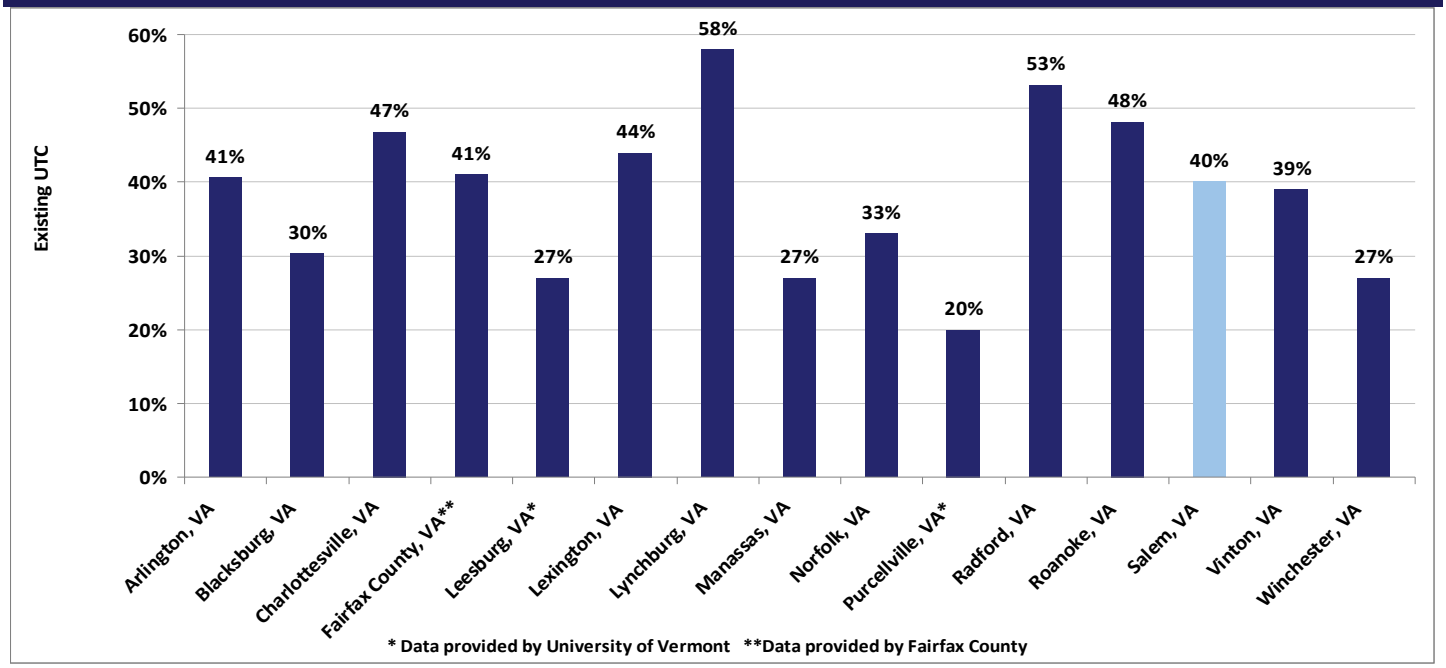
Attribute	Value
Land Use	Exempt Commercial
Owner	St Peter & Paul Catholic Church
Address	320 Cathedral Street
Existing UTC	5%
Possible UTC	72%
Possible UTC—Vegetation	47%
Possible UTC—Impervious	25%

Figure 8: Parcel-based UTC metrics can be used to support targeted UTC.

Conclusions

- Salem's urban tree canopy is a vital community asset, reducing storm water runoff, improving air quality, reducing the city's carbon footprint, enhancing quality of life, contributing to savings on energy bills, and serving as habitat for wildlife.
- With 40% tree canopy cover, Salem has similar coverage to Arlington and Fairfax County. Figure 9 shows how Salem compares to other Virginia localities participating in Urban Tree Canopy Assessments.
- When summarized by parcels, Salem has 43.5% Existing UTC. Almost 37% of all parcels have greater than 50% canopy coverage.
- 63.5% of Salem's Possible UTC is within the Residential Single Family Zoning Category.

Urban Tree Canopy Comparison



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Additional Information

The study was conducted with funding from the VDCR and VDOF. More information on the UTC assessment project can be found at the following web sites:
http://www3.cnr.vt.edu/gep/VA_UTC.html
http://nrs.fs.fed.us/urban/utc/