



APPENDIX B: DRAFT CAPACITY ANALYSIS

DEVELOPMENT CAPACITY ANALYSIS

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NOTE: THE INFORMATION CONTAINED IN THIS DOCUMENT IS INTENDED FOR PLANNING ANALYSIS PURPOSES ONLY. THE ANALYSIS OF AVAILABLE LAND IS INTENDED TO ILLUSTRATE POSSIBLE OR THEORETICAL AREAS FOR FUTURE DEVELOPMENT. IT DOES NOT IMPLY THAT DEVELOPMENT IS PROPOSED BY THE COUNTY OR ANY PRIVATE AGENCY IN THESE AREAS, NOR DOES IT PROPOSE A SPECIFIC DEVELOPMENT. GENERALLY, IT IS A BROAD ESTIMATE OF POSSIBLE GROWTH OVER THE COMING DECADES UNDER CERTAIN CIRCUMSTANCES. THIS ANALYSIS IS PART OF THE RESEARCH AND ANALYSIS PHASE OF THE COMPREHENSIVE PLAN 2026 AND IS INTENDED TO ASSIST IN EFFORTS TO PLAN FOR GROWTH, BY ILLUSTRATING POSSIBLE SCENARIOS.

GENERAL NOTE ON ROUNDING:

MICROSOFT EXCEL WAS USED IN THE CALCULATION OF THE NUMBERS PRESENTED IN THIS DOCUMENT. RESULTS ARE PRESENTED IN WHOLE NUMBERS OR ROUNDED TO TWO DECIMAL PLACES WHERE APPROPRIATE, HOWEVER, THE ANALYSIS ITSELF USES FIGURES CARRIED TO THEIR ULTIMATE DECIMAL PLACES; THEREFORE THE SUMS AND PRODUCTS GENERATED IN THE ANALYSIS MAY NOT EQUAL THE SUM OR PRODUCT IF THE READER REPLICATES THE CALCULATIONS WITH THE FACTORS SHOWN IN THE REPORT.

Introduction

The analysis outlined in this document illustrates possible scenarios for development in the County based on land that may be available for possible future development. The purpose of this exercise is to evaluate how current regulations and policies may accommodate growth/development over the planning period of 20 years beginning in 2006. By comparing the physical geographic capacity of land under current land use regulations and policies, to the estimated development demand (as contained in the **Demand Analysis**) it is possible to identify areas for change and improvement for the Land Use Policy portion of the 2026 Comprehensive Plan. This analysis examines the capacity of land in the County under both current zoning (2004) and the 2010 Future Land Use Plan.

Alternative land use scenarios will be developed by the Consultant and County Staff which will explore the potential options for development that may decrease infrastructure and service costs, and make development in the future more sustainable. These alternate land use scenarios will be modeled and tested in various applications against the findings of this Capacity Analysis to establish the costs and benefits of each scenario compared to current development practices in the County.

To identify the future capacity of Henrico County for additional development, it is first necessary to identify "Potential Development Areas" (PDAs). Potential Development Areas are areas of land that are currently undeveloped/vacant or in agricultural uses. It should be recognized that agriculture is a valuable and appropriate land use, however for the purpose of this analysis it is assumed that these areas could be developed or redeveloped with another use. The PDAs included large areas of land identified by the County as residential acreage or vacant land. Once the PDAs are identified, the inventory of PDAs must be calibrated to adjust for idiosyncrasies of the GIS program, natural and man made constraints to development, and the identified analysis areas for the various models/analysis that will be completed for the 2026 Comprehensive Plan.

After establishing the PDAs and the constraints of each PDA, a future land use /zoning designation is applied to the PDAs to determine their "capacity" for development in the County. The land use/zoning will carry with it a development density which will be applied to the area of the PDA to generate either square footage of non-residential building area or number of residential units. These



yields can then be disaggregated into populations, housing types, and subcategories of non-residential uses and jobs. Alterations in the pattern and densities of future land use will establish the basis for various development scenarios which will distribute a growing population and employment over the available land in the County.

The following process describes the methodology used to identify the available land for development (the PDAs), and the constraints of development on the PDAs.

Identifying Developable Land

IDENTIFY EXISTING LAND USE

Staff from Henrico County provided MDC with the most current Existing Land Use inventory available in GIS. This layer was updated in August/September of 2004 by County Staff, and is a fair assessment of the current land use pattern in the County. The existing land use is shown on Map 1.

ISOLATE VACANT AND LARGE RESIDENTIAL PARCELS LAND

For this analysis, land areas designated in the existing land use inventory as either “vacant” or “residential acreage” were considered to be potentially available for future development. Identification of residential acreage as potentially available land allows for the future chance that larger parcels of residential land may be subdivided and yield additional residential units or even convert to a non-residential use¹. Isolation of these land areas yielded 4,764 features in GIS. These features include contiguous areas of the same land use and many features include multiple parcels. Map 2 shows the vacant and underutilized land.

Although the County staff prepared a clean data set, fragments are created during the geoprocessing². Any fragment polygons or features with no area were removed from the pool of PDAs. Any fragment feature less than 5,625 square feet (the minimum lot size permitted in county) was also removed because it was assumed that a piece of land this size would not be a “buildable” lot and therefore would not yield viable results as part of the analysis. To further check the geography of the PDAs, MDC overlaid them with the parcel layer, and removed from the pool of developable land any polygon fragments or features located outside of a parcel. This may have been land in a right-of-way or other non-parcel land.

MDC recognizes that there are areas of land, such as parking lots, that offer potential for future development or expansion of existing uses through infill. However, these instances are assumed to be site or area specific and are too specialized to assess in a countywide land capacity analysis. These areas should be addressed in any future Special Area Plan Recommendations.

¹ MDC included the residential acreage category from the existing land use inventory in the pool of potentially developable land, and then identified the number of residential units which currently exist in these areas. In most cases, this land includes single family homes. To adjust for existing development in the PDAs for the capacity analysis, an existing inventory of 1,418 single-family homes will be accounted for in the final capacity calculation.

² Geoprocessing is the analysis of various layers of data in a GIS program by combining features of multiple layers into one layer.



MAP 1: EXISTING LAND USE



MAP 2: VACANT AND RESIDENTIAL ACREAGE LAND

ALLOCATION OF PDAS INTO ANALYSIS ZONES

The data generated by this Capacity Analysis will later be applied to several “models” to identify the effects the quantity and location of development will have on the County. These models include a transportation and traffic volume model, a fiscal analysis model/tool, and a sewer/water demand model; the fire department and schools administration will also use the data to determine geographic needs in their respective fields.

To best accomplish this universal application of the data, the PDAs were divided or disaggregated into the zones preliminarily identified for each of the analysis tools. Each PDA is located entirely within a single Traffic Analysis Zone (TAZ) (based on existing zones), and a Single Utility Basin. Therefore, a summary can be completed of total developable area within any given zone. Because Land Use and Zoning are not limited by these geographies, PDAs adjacent to one another but located in a different TAZ will be assessed based on their Zoning or Land Use designation and not based on the TAZ. This allocation is for output rather than assumption purposes. The different Analysis Zones are shown in Maps 3 and 4.

THE FINAL PDAS

Once the PDAs were disaggregated, 4,759 PDA geographies were identified. These geographies will act as the basis for further analysis of development constraints and development scenarios. The data from these PDAs can be assembled and summarized in a number of ways. The table below shows the total available land (in PDAs) by existing land use category.

TABLE 1: PDA SUMMARY BY EXISTING LAND USE

Existing Land Use	Number of PDAs	Total Area (Acres)
Residential-Single Family Acreage	731	11,061
Vacant	4,028	62,489
Total Potentially Developable Land	4,759	73,550



MAP 3: TRAFFIC ANALYSIS ZONES



MAP 4: SEWER PUMP BASINS

CALCULATING NET AREA

CATEGORIZING THE PDAS FOR ANALYSIS PURPOSES BY GROSS AREA

Before the capacity is calculated, the net or buildable area must be calculated. MDC categorized the PDAs by size based on their gross area because we assume that development will occur on larger greenfield sites in a different fashion than on small suburban infill lots. For example, a PDA in category 1 (which is less than one acre) will likely not require as much roadway as a PDA in category 2 or 3 because there is less land and fewer lots will be subdivided in order to develop the land. This is important in determining the net area of the PDA in relationship to road area necessary for development. This assumption will play an important role in the calculation of the net area, and therefore the capacity of each PDA. The size categories shown are used in this analysis only to calculate the net area of the PDAs. The categories and percentage of the area considered for development capacity are listed below in Table 2 and illustrated in Map 5.

TABLE 2: PDA SUMMARY BY SIZE CATEGORY

Size Range Category	Gross Acreage	Percent to be Removed for Right-of-Way	Net Area (% of Gross)
A. Less than 1 acre	939	0%	100%
B. 1 to 10 acres	6,200	10%	90%
C. Greater than 10 acres	66,446	15%	85%

The next step in identifying the Net or Buildable area of each PDA is identification of natural constraints to development.

IDENTIFY NATURAL CONSTRAINTS TO DEVELOPMENT IN EACH PDA

MDC mapped 15% or greater slopes⁷, identified wetlands, and preliminary FEMA flood zones⁸, to determine if these naturally occurring constraints to development affect the identified PDAs. By overlaying the GIS layers which contain an amalgam of the three constraints, MDC was

TABLE 3: PDA SUMMARY BY CONSTRAINED PERCENTAGE CATEGORY⁵

Constrained Percentage Category	Percentage Range (portion of site constrained)	Number of PDAs in Category	Total Area of PDAs in Category (Acres)	Total Constrained Area in Category ⁶ (Acres)
1	0-10%	3,233	20,012	711
2	11-31%	561	29,299	5,994
3	32-56%	348	9,247	3,607
4	57-83%	208	2,591	1,781
5	84-100%	409	12,401	11,892
Total		4,759	73,550	23,984

able to identify the combination of constraints in each PDA. Table 3 summarizes the PDAs by the percentage of the area which is constrained by one or more of the natural constraints. Map 6 illustrates the PDAs by the amount of land constrained.

⁵ For the purpose of this analysis, all constraints or combination of constraints were weighed equally.

⁶ The total constrained area represented in table 3 includes areas affected by slope as well as floodplain and wetlands. The total constrained area represented in table 4 only includes land in the floodplain and wetlands accounting for the discrepancy in the numbers.

⁷ The areas affected by a slope of 15% or greater were identified by Henrico County.

⁸ Areas affected by a flood zone include A and AE ratings for the FEMA flood hazard ratings which are areas identified within the 100 year floodplain, where mandatory flood insurance purchase requirements apply.



MAP 5: PDA BY SIZE CATEGORY



MAP 6: PDA BY PERCENTAGE OF AREA WITH NATURAL CONSTRAINTS

After review with County Planning Staff, it was determined that any area affected by slope should remain in the pool of developable land because there are no regulations preventing development of slopes and they do not impose a measurable constraint to development. Floodplains on the other hand, are a significant constraint to development and will be removed entirely from the pool of developable land. Wetlands are often present on the same land as floodplains, and in these cases have been removed from the pool of land. However, because mitigation measures are possible, wetlands not in a floodplain have been reduced by 50% in the calculation of capacity. Table 4 shows how the net area was calculated. Map 7 shows the land in the PDAs that is constrained by floodplain and wetlands.

TABLE 4: GROSS TO NET

Size Range Category	Percent to Account for Net Area	Gross Area in Category (Acres)	100% Constrained Area (Acres)	50% Constrained Area (Acres)	Unconstrained Area Acres	Adjusted Gross Area ¹ (Acres)	Net Area ² (Acres)
Less than 1 acres	100%	904	77	6	821	824	824
1 to 10 acres	90%	6,200	843	126	5,220	5,283	4,755
Greater than 10 acres	85%	66,446	16,538	2,771	47,133	48,518	41,241
Total		73,550	17,458	2,903	53,174	54,626	46,820

NOTES FOR TABLE 4

1. The adjusted Gross Area is equal to the sum of the Unconstrained Area and fifty-percent of the 50% Constrained Area.
2. The Net Area is equal to the Adjusted Gross Area multiplied by the Percent to Account for Net Area.



MAP 7: FLOODPLAIN AND WETLAND CONSTRAINED LAND IN PDAS

Applying Development Densities

Applying development densities to the PDAs is the key in developing the alternative scenarios for capacity. In this analysis MDC applied densities from existing Zoning and the 2010 Future Land Use Plan. Both of these scenarios are a “buildout” scenario or assume that all of the available land will be developed with the recommended maximum density. This first application of densities does not take into consideration estimated market demand for development or when development may occur.

SCENARIO 1: EXISTING ZONING DENSITIES

The PDAs were overlaid with the existing zoning designations. Many of the larger PDAs had more than one zoning district and were subdivided to find the area zoned in each district. Then the Net Area of each sub geography was multiplied by the recommended maximum density for the specified zoning district. The residential units were subdivided by single-family, single-family attached, and multi-family to reflect the categories in the demand analysis, and non-residential floor area was subdivided by land use/employment categories of commercial/retail, office, and industrial/flex. The calculations were then summarized by PDA and totaled for the inventory of available land. Map 8 shows the existing zoning for the PDAs.

Table 5 shows the density used for this analysis in each zoning district and the breakdown of the land uses within each zoning district.



MAP 8: SCENARIO 1 PDAS BY ZONING DISTRICT

TABLE 5: ZONING DENSITIES AND LAND USE PERCENTAGES

		Residential Density (Units/Acre)	Nonresidential FAR	Percentage of Capacity to Each Land Use/Employment Category					
				% SF	% SFA	% MF	% Com	% Off	% Ind
A-1	Agricultural district	1.0		100					
B-1	Business district		0.2				70	30	
B-2	Business district		0.2				70	30	
B-3	Business district		0.15				70	20	10
C-1	Conservation district								
I-1	Institutional district								
M-1	Light Industrial district		0.25				10	20	70
M-2	General industrial district		0.25				10	20	70
M-3	Heavy Industrial district		0.25					20	80
O/S	Office services district		0.25				10	20	70
O/S-2	Office services district		0.25				10	20	70
O-1	Office district		0.25					100	
O-2	Office district		0.25					100	
O-3	Office district		0.25				10	70	20
PMD	Planned industrial district		0.25				10	20	70
R-1	One-family residence district	1.74		100					
R-1A	One-family residence district	2.03		100					
R-2	One-family residence district	2.42		100					
R-2A	One-family residence district	3.23		100					
R-3	One-family residence district	3.96		100					
R-3A	One-family residence district	4.59		100					
R-4	One-family residence district	5.45		100					
R-4A	One-family residence district	5.62		100					
R-5	General residence district	14.52				100			
R-5A	General residence district	7.74			100				
R-6	General residence district	12				100			
RMP	Residential manufactured home park	8.00		100					
R-O	One-family residence district	1.00		100					
R-OA	One-family residence district	1.24		100					
RTH	Residential townhouse district	9.00			100				

NOTES FOR TABLE

FAR-Floor Area Ratio

Floor Area Ratios (FAR) were based on assumptions used in the NW Study based on existing development

SF-Single Family Housing, SFA-Single Family Attached Housing, MF-Multi-Family Housing, COM-Commercial Building Area, OFF-Office Building Area, IND-Industrial Building Area

General Note: Densities will be applied to Net Acreage or the Gross Acreage minus the land needed for right-of-way and land removed for constraints. Residential densities are based on minimum lots size per residential unit as published in the official zoning code. Non-Residential FAR is an estimated average of the ratio of building area to site area based on existing development and carried forward from assumptions made in the Northwest Plan.



Once the densities were applied to the net area in the sub geographies of the PDAs, the calculations were summarized by PDA, then summarized for the entire area of developable land in the County. Table 6 shows the estimated capacity based on these assumptions in Scenario 1.

TABLE 6: SCENARIO 1 CAPACITY ANALYSIS SUMMARY

Residential New Units	61,999
Single-Family New Units	51,931
Single Family Attached New Units	4,365
Multi-family New Units	5,703
Non Residential Building New SF	59,987,869
Commercial Building New SF	8,902,407
Office Building New SF	16,359,119
Industrial Building New SF	34,726,343

NOTES FOR TABLE 6

All residential units include both owner and renter occupied units.
Single Family units adjusted for existing residential development. See footnote 1, pg. 2.

Source: MDC Capacity Analysis, 2004.

SCENARIO 2: THE 2010 FUTURE LAND USE PLAN

Scenario 2 was completed with a similar method as Scenario 1 except recommended densities associated with the Future Land Use Plan were used. Because the plan recommends a range of densities a high and low version of Scenario 2 was analyzed. Scenario 2A assesses the capacity under the lower range of the recommended densities and Scenario 2B assesses the capacity under the higher range of the densities. Floor area ratios for non-residential land uses were estimated based on trends and other studies conducted in the County. Table 7 shows the densities and breakdown by land use/employment category for each of the land use designations in the *2010 Future Land Use Plan*.



MAP 9: PDAS BY 2010 LAND USE DESIGNATION



DEVELOPMENT CAPACITY

TABLE 7: LAND USE DENSITIES AND LAND USE PERCENTAGES

	Scenario 2A		Scenario 2B		Percentage of Capacity to Each Land Use/Employment Category						
	UPA	FAR	UPA	FAR	% SF	% SFA	% MF	% Com	% Off	% Ind	% Ag
Rural Residential	0.10		1.00		100%						
Suburban Residential 1	1.00		2.40		100%						
Suburban Residential 2	2.40		3.40		100%						
Urban Residential	3.40		6.80		50%	50%					
Multi-Family Residential	6.80		19.80				100%				
Office		0.25		0.25					100%		
Office/Service		0.25		0.25				10%	20%	70%	
Commercial Arterial		0.15		0.20				70%	30%		
Commercial Concentration		0.15		0.20				70%	30%		
Mixed Use Development	6.80	0.20	19.80	0.25			25%	10%	45%	20%	
Urban Mixed Use	6.80	0.20	19.80	0.30			30%	30%	40%		
Light Industry		0.25		0.25				10%	20%	70%	
Planned Industry		0.25		0.25				10%	20%	70%	
Heavy Industry		0.25		0.25				5%	20%	75%	
Environmental Protection Area											
Open Space/Recreation											
Prime Agricultural	0.10		1.00		75%						25%
Government									100%		
Semi-Public									100%		

NOTES FOR TABLE 7

UPA-Units Per Acre (Residential)

FAR-Floor Area Ratio

Floor Area Ratios (FAR) were based on assumptions used in the NW Study based on existing development.

SF-Single Family Housing, SFA-Single Family Attached Housing, MF-Multi-Family Housing, COM-Commercial Building Area, OFF-Office Building Area, IND-Industrial Building Area, AG-Agriculture

For this analysis it was assumed that the Prime Agricultural land would be reserved for agricultural uses and this would in effect reduce the percentage of land that would develop for residential uses to approximately 75%.

General Note: Densities will be applied to Net Acreage or the Gross Acreage minus the land needed for Right-of-Way and land removed for constraints. Residential densities are based on recommended densities as published in the adopted and amended 2010 Future Land Use Plan Map and text. Non-Residential FAR is an estimated average of the ratio of building area to site area based on existing development and carried forward from assumptions made by MDC.

The application of the densities and breakdowns shown in Table 7 to the net buildable area as described in Table 4 resulted in two capacity scenarios. The calculations have been summarized for all the available land. The summary for these scenarios is illustrated in Table 8.

TABLE 8: SCENARIO 2 CAPACITY ANALYSIS SUMMARY

	Scenario 2A	Scenario 2B
Residential Units	20,726	59,965
Single Family Units	16,706	49,329
Single Family Attached Units	1,171	2,342
Multi-Family Units	2,848	8,295
Non-residential Building Area (SF)	93,569,607	97,169,555
Commercial/Retail (SF)	14,118,593	15,806,155
Office (SF)	37,100,732	39,624,044
Industrial/Flex (SF)	41,350,282	41,739,355

Source: MDC Capacity Analysis 2010 Land Use Plan. 2004. Single Family units adjusted for existing residential development. See footnote 1. All residential units include both owner and renter occupied units.

Comparing Capacity to Demand

With the three scenarios presented above, it is evident that there is a range of possibilities for the way development could occur in the County following current regulations and policies. An additional step in assessing the effectiveness/desirability of these current regulations is to compare them to the demand for new housing and non-residential space as presented in the **Demand Analysis** to assess how well current regulations will meet future needs. Table 9 shows the demand for new development and compares it to each of the three buildout scenarios presented in this document to determine if the current regulations and policies meet, exceed or present a deficit compared to the demand. The demand figures presented are taken from the Demand Analysis and represent new units from 2003. Non-residential demand shown is taken from Demand Scenario 1.

TABLE 9: DEMAND AND CAPACITY COMPARISON (NEW UNITS)

	2026 Demand	SCENARIO 1 (EXISTING ZONING)		SCENARIO 2A (2010 LAND USE PLAN-LOW)		SCENARIO 2B (2010 LAND USE PLAN-HIGH)	
		Capacity	Need/Excess	Capacity	Need/Excess	CAPACITY	NEED/ EXCESS
Residential Units	51,563	61,999	10,436	20,726	(30,837)	59,965	8,402
Single Family Units	31,979	51,931	19,952	16,706	(15,273)	49,329	17,350
Single Family Attached Units	4,015	4,365	350	1,171	(2,844)	2,342	(1,673)
Multi-Family Units	15,569	5,703	(9,866)	2,849	(12,720)	8,295	(7,274)
			-	-	-	-	-
Non-residential Building Area (SF)(37,766,388	59,964,368	22,197,980	93,569,607	55,803,219	97,169,555	59,403,167
Commercial/Retail (SF)	8,974,808	8,893,939	(80,869)	14,118,593	5,143,785	15,806,155	6,831,347
Office (SF)	19,446,220	16,351,685	(3,094,535)	38,100,732	18,654,512	39,624,044	20,177,824
Industrial/Flex (SF)	9,345,360	34,718,744	25,373,384	41,350,282	32,004,922	41,739,355	32,393,995