APPENDIX E: TRANSPORTATION SYSTEM MANAGEMENT STRATEGIES

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Transportation Systems Management Strategies – Technical Memorandum

Introduction

The overall long range transportation plan will identify major investments required to address existing and forecast deficiencies in the transportation system. In many cases, the identified projects will take significant time to assemble funding and will require lengthy processes to plan and to obtain proper permitting. In most transportation networks, however, there are opportunities to make small scale capacity enhancements which can achieve near term improvements in network capacity and safety. These improvements can include adding a left-turn pocket, making investments in operations such as signal coordination, or creating policy changes such as limiting the proximity of site driveways to intersections. In many cases, these initiatives do not require lengthy implementation periods nor do they present significant barriers such as environmental consequences or neighborhood opposition. These investments can result in significant near term and medium term benefits for the traveling public. Whether they are intelligent transportation system (ITS) applications, policy, or operations enhancements, these efforts are known broadly as transportation systems management (TSM) strategies. More information about Transportation Systems Management Strategies can be found in the Transportation Research Board's *Access Management Manual* (2003) and Institute of Transportation Engineers *A Toolbox for Alleviating Traffic Congestion and Enhancing Mobility* (1997).

This section of the report presents several TSM strategies and is followed by an assessment of how these might be applied to corridors within Henrico County. (It should be noted this document was originally created in February 2006. Since that time several of the recommendations in this report have been addressed. In those instances, a parenthetical update has been provided.)

General Solutions for Relieving Congestion

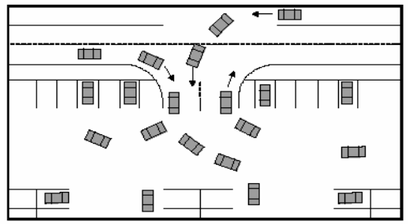
Depending on the causes of congestion, various strategies are available to mitigate it and its effects. These strategies apply operational and geometric improvements, and they can be used independently or in combination to provide congestion relief.

Traffic Signal Coordination and Computerized Traffic Signal Systems

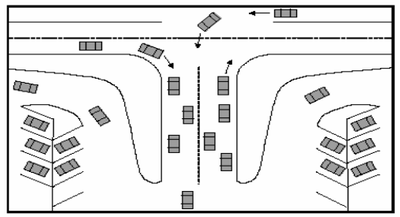
Traffic signal coordination and improvement of traffic signal operations are widely regarded to be among the most cost-effective measures for reducing delay on signalized arterial roadways. Coordination involves synchronizing traffic signals on a corridor to minimize through traffic delay. Benefits from these types of improvements include typical decreases in delay and travel time of 10-20%, typical decreases of fuel consumption and emissions of 5-20%, and typical increases in travel speed of 10-25%. The magnitude of the benefits yielded depends on many factors, including signal spacing, traffic patterns, capabilities of the equipment installed, traffic growth experienced in the study area, and ability of the implementing jurisdiction to develop and maintain signal timing plans. Most benefits are typically exhibited on corridors with ½- to ¾-mile signal spacing, since beyond this spacing, vehicles no longer remained grouped in platoons and their arrival at intersections is no longer uniform. Typically, signal coordination/signal system implementations exhibit a benefit-to-cost ratio from 10:1 to in excess of 40:1.

Costs to coordinate signals vary widely and are contingent upon the ultimate goals of the jurisdiction engaging in the project. At its lowest level, time-based coordination can be implemented effectively for a group of signals along a corridor; signal timing is optimized to allow a maximum number of vehicles to be serviced typically in the peak direction of travel. For the time-based coordination case, the coordination timing is input manually to individual controllers in the field. This method has the lowest capital cost, but because the controllers are not connected to a common time source, their internal time clocks tend to drift, causing the coordinated timing plans to become unsynchronized. Another issue that occurs with time based coordination is that the field equipment often comes from a variety of manufactures. In this case, some of the coordination parameters may be incompatible, or all of the functionality of some of the equipment may not be able to be utilized.

Often, jurisdictions connect the field equipment with a communications system, upgrade equipment so that the units in the field are compatible with one another, and connect the field equipment to a central traffic control center. In this configuration, timing plan updates may be made from a central office and field equipment may be monitored to determine if it is malfunctioning. Also, controller inputs such as vehicle detectors are monitored to help determine if traffic conditions are changing. More advanced implementations contain advanced detection schemes, advanced timing approaches and the use of closed circuit television to enhance the ability to identify incidents and unusual conditions.



Before traffic signal circulation improvements



After traffic signal circulation improvements

Source: Policy on Street and Driveway Access to North Carolina Highways, NCDOT 2003

On-Site Traffic Circulation

One way to reduce traffic congestion is to promote improved on-site traffic circulation, particularly at traffic signals. Pushing back the throat of an entrance, as shown in the figures to the right, helps to avoid spillback onto the arterial. This measure improves both the safety and

efficiency of the roadway. Another method of enhancing on-site traffic circulation involves limiting access points into a development by considering developments with multiple lots and land uses as one property for the purposes of access regulation.

In Henrico County the addition of right-in/right-out access points on many of the newer developments may help to disperse traffic from some of the more saturated locations. *(Approximate cost: $150,000 per application)*

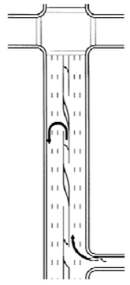
Non-Traversable Median Treatment

One means of improving safety and reducing conflicting turning movements is the use of non-traversable medians. A non-traversable median treatment is a raised or depressed barrier that physically separates opposing traffic flows. Advantages include increased safety due to separation of opposing flows, pedestrian refuge, and restricting left turns to designated locations. Where sufficient storage bays are provided, the removal of left-turning vehicles from through lanes can increase safety and reduce delay to through vehicles. Disadvantages include slowed response time for emergency vehicles, increased travel distance for left turns, and public opposition due to the possibility of detrimental effects on the business community.

A non-traversable median

Non-traversable median treatments should be considered for multi-lane urban arterials with average daily traffic (ADT) volumes greater than 20,000 vehicles per day (VPD) and all multi-lane roadways with high pedestrian volumes, high collision rates, or where aesthetics are a priority. Consideration should be given to providing sufficient space for u-turning vehicles at median openings when non-traversable median treatments are used. Divided roadway facilities are generally safer than undivided facilities or roadways with a two-way left turn lane (TWLTL). Many sections of roadways in Henrico County make good use of non-traversable medians, such as Parham Road, Gaskins Road, and portions of West Broad Street. In older sections, right-in/right-out limitations inhibit the use of non-traversable medians. *(Approximate cost: $600,000 per mile)*

Median U-Turn Treatment



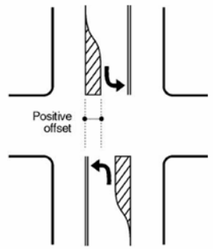
Median u-turn treatment

Median u-turn treatments involve the prohibition of minor street direct left turns at signalized intersections in favor of right turns followed by median u-turns, as shown in the figure to the left. Advantages of this treatment include reduced delay, improved progression, and fewer stops for through traffic as well as fewer and more separated conflict points for vehicles and pedestrians along the arterial. Disadvantages include increased delay, travel distances, and stops for left-turning traffic as well as the potential for driver confusion. These treatments can increase the safety and efficiency of arterials with high through volumes. However, they should only be used where sufficient space and storage is available for u-turning maneuvers at median openings.

Installing median u-turn treatments at multiple locations along a corridor can help to alleviate driver confusion. Much consideration should be given to locations of median openings in order to provide adequate weaving space without creating excessive travel distances for left-turning vehicles. *(Approximate cost: $50,000 per median opening)*

Advanced Left Turn Treatment

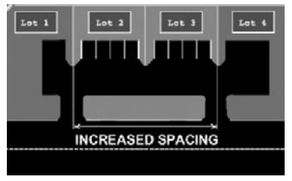
Traditional exclusive left turn lanes at signalized intersections are usually aligned to the left of one another, so the vision of a left-turning vehicle is obstructed by vehicles in the opposing left turn lane. Advanced left turn treatment, also known as positive offset left turn treatment, involves shifting exclusive left turn lanes toward the center of the intersection and past the opposing left turn lane to provide better sight lines. Where permissive left turn phasing is used, this treatment can improve the efficiency of an intersection by reducing the crossing time for left-turning vehicles and allowing them to see and take advantage of all adequate gaps in the opposing traffic stream. The disadvantage of this treatment is that, where existing median widths are not sufficient, the roadway may need to be widened and additional right-of-way may need to be acquired. *(Approximate cost: $170,000 per mile)*



Advanced left turn treatment

Consolidated Driveways

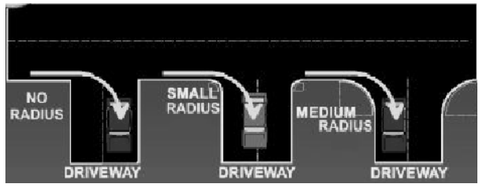
Consolidating adjacent driveways using shared access easements can increase the safety and efficiency of corridors by reducing the number of access points and thus conflict points, as illustrated in the image to the right. Additionally, trips between adjacent land uses are then possible without using the arterial. While driveway consolidation is advantageous for traffic safety and circulation, local business owners should be involved early in the planning process in order to gain consensus and build support for such improvements.



Source: Policy on Street and Driveway Access to North Carolina Highways, NCDOT 2003

Relocated Driveways

Driveways that are located too close to an intersection can cause operational, safety, and capacity problems resulting from traffic backing up across the driveway entrance or into the intersection from the driveway. Additionally, the distance between the driveway and the intersection may not provide a sufficient weaving distance. Relocating driveways that are too close to an intersection can improve the safety and efficiency of the intersection by separating conflict points and lengthening weaving distances.



Source: Policy on Street and Driveway Access to North Carolina Highways, NCDOT 2003

Improved Intersection Turning Radii at Intersection/Driveways

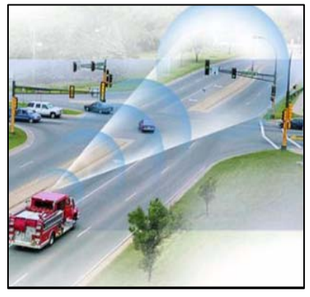
Driveways with short turning radii force vehicles to encroach on adjacent lanes when entering or exiting the driveway. Intersections with short radii may also force vehicles onto the roadside, causing potential damage to curb and gutter and sidewalks. Longer turning radii allow drivers to make turning maneuvers more easily, which enhances the operations and safety of the roadway.

Left Turn Storage Bays at Major Driveways

Left turn storage bays can be used at high volume retail driveways in order to remove left-turning vehicles from the through lanes. Adequate storage bays enhance the safety of a corridor and decrease delay to through vehicles. Additional right-of-way and roadway widening may be needed in order to provide storage bays.

Exclusive Left Turn Lane on Minor Approach

At signalized intersections where left turns from a minor approach are significant, an exclusive left turn lane can promote more efficient signal phasing.



Source: 3M

Emergency Vehicle Preemption

Emergency vehicle preemption involves changing the indication at traffic signals to favor the direction of detected emergency vehicles. Preemption improves emergency vehicle response time and the safety of the responders by stopping conflicting movements. For corridors that experience a high level of emergency preemptions, sustaining signal co-ordination can be challenging. *(Approximate cost: $1,500 per vehicle and $6,000 per intersection*)

Henrico County Transportation Systems Management Strategies

Overall, Henrico County has utilized several of the TSM techniques described. In particular, the County and the Virginia Department of Transportation (VDOT) have increased their use of non-traversable medians, have consolidated site driveways, and have generally improved site access and located site access points away from intersections when possible.

To identify additional opportunities for the use of TSM measures, Kimley-Horn consulted Henrico County staff and identified the following seven corridors that experience congestion and delay during the AM, Mid-day, and or PM peak periods:

1. Laburnum Avenue
2. West Broad Street
3. Gaskins Road
4. Parham Road
5. Brook Road
6. Woodman Road
7. Nuckols Road

Once identified, Kimley-Horn staff studied available traffic count and crash data for the corridors as well as the available corridor geometrics. Kimley-Horn staff also drove the corridors during congested conditions. As a part of this process, the roadway improvement projects in the County's Capital Improvements Program (CIP - FY 2005-06 to FY 2009-10) and VDOT's Six-Year Improvement Program (SYIP) along the study corridors were identified and mapped.

Transportation corridors are typically evaluated by measuring the ratio of vehicular demand to the corridor's available capacity. This ratio is referred to as the vehicle-to-capacity (V/C) ratio, where vehicular volume is measured in average daily traffic (ADT) and capacity is determined by the roadway corridor's characteristics (such as number of lanes, frequency of intersections or traffic signals). Acceptable V/C ratios are typically less than 1.0, meaning that the daily traffic demand does *not* exceed the capacity of the roadway. Unacceptable V/C ratios are typically 1.0 or greater, where the volumetric demand is greater than the roadway's capacity. Roadways with acceptable V/C ratios typically experience infrequent delays and congestion, while roadways with unacceptable V/C ratios experience significant delays and congestion.

Based on existing vehicle-to-capacity (V/C) ratios, each of the seven corridors was found to be operating below an acceptable level of service during the AM peak period, the PM peak period, or both peak periods. Furthermore, each is expected to experience further deterioration in performance in the future due to anticipated increases in traffic growth. Also, it was determined that these corridors held little or no opportunity for widening to increase capacity in the near term due to surrounding land use, existing terrain, or expected funding.

Following is a more detailed description of the corridors studied and a discussion of our findings and recommendations. In general, the most common TSM opportunity identified was signal coordination.

Corridor 1 — Laburnum Avenue

Laburnum Avenue is a county road that runs predominantly north/south just east of the city limits of Richmond. Within the county limits, this corridor extends from New Market Road to North Avenue and is a four lane facility with a landscaped median. The surrounding land use is mainly residential with pockets of industrial and commercial development. The average daily traffic along this corridor ranges from 5,300 vehicles per day (VPD) at Darbytown Road to 34,000 VPD at Williamsburg Road. The existing road way has a number of closely spaced signals with an overall signal density of 2 signals per mile. This corridor consistently operates below acceptable levels during peak hours. **Figures 1A**, **1B**, and **1C** depict the existing corridor and display transportation systems management recommendations.

Recommendation #1 — The Laburnum Avenue corridor would greatly benefit from signal coordination. It is expected that stops could be decreased, travel times decreased, and some collision types reduced. (NOTE: Signals in this corridor are included in the County's Automatic Traffic Management System project which is under design with anticipated implementation beginning in 2010.)

Corridor 2 — West Broad Street (Route 250)

Within the county limits, West Broad Street is a major commercial corridor which runs northwest/southeast from Staples Mill Road past North Gayton Road to the Goochland County line. This corridor is approximately 10 miles long and is six lanes, median divided throughout. West Broad Street is maintained by VDOT and the majority of the facility currently operates below acceptable levels during peak hours. The average daily traffic along this corridor ranges from 11,000 VPD around North Gayton Road to 52,000 VPD near the I-64 interchange (Exit 178) east of the Short Pump area. **Figures 2A** and **2B** depict the existing corridor and display transportation systems management recommendations.

Recommendation #1 — The portion of this corridor located between North Gayton Road and the I-64 interchange (Exit 178) is surrounded by recently built "big box" commercial development. In such an environment, numerous driveways along the mainline typically tend to slow and impede traffic flow. For this stretch of road, however, additional limited movement (right-in/right-out) access points may be beneficial. By providing additional right-in/right-out access, concentration of traffic at a limited number of points may be eased, allowing for improved signal operations at the full movement commercial driveways. (NOTE: All current and future access points along this corridor must meet both VDOT and County standards. The opportunity to provide additional access points is limited by these standards as well as internal circulation design and proffered conditions. Additional right-in/right-out access points will be implemented through new site development and/or redevelopment.)

Recommendation #2 — It is also recommended that on-site circulation be improved in this area to reduce driver confusion about access and circulation. This would improve safety and ease congestion. (NOTE: On-site circulation is reviewed and approved through the Plan of Development process. Implementation of this recommendation will occur with new site development and/or redevelopment.

Recommendation #3 — The intersection at West Broad Street and Pouncey Tract/Pump Road currently offers little green time to the minor legs (Pouncey Tract and Pump Road). The current timing plans do not clear the queues along these approaches, which leads to red light running and unsafe conditions. Therefore, it is recommended that the current timing plans be modified to provide additional passage time for the longer queues occurring during peak conditions. (NOTE: Additional timing modifications at this intersection are part of an on-going effort by VDOT based on prevailing traffic patterns.)

Recommendation #4 — The West Broad Street corridor has closely spaced signals with a density of four signals per mile. This portion of the corridor would greatly benefit from signal coordination. (NOTE: Signals along this corridor have been coordinated.)

Corridor 3 — Gaskins Road

Gaskins Road is a county road that runs predominantly north/south and has full interchange access to I-64 at Exit 180. This corridor serves as an important connector road which extends from Patterson Avenue in the south to West Broad Street in the north. This corridor is a four lane median divided facility from West Broad Street to Quioccasin Road and a four lane facility with a two-way left turn lane from Quioccasin Road to Patterson Avenue. This corridor currently operates at an unacceptable level of service during peak hours and is expected to worsen in the future. The surrounding land use is mainly residential. The average daily traffic along this corridor ranges from 21,000 VPD at Patterson Avenue to 36,000 VPD at Three Chopt Road. **Figure 3** depicts the existing corridor and displays transportation systems management recommendations.

Recommendation #1 — This corridor has closely spaced signals with a density of two signals per mile that are currently not operating in coordination. The Gaskins Road corridor could greatly benefit from signal coordination and signal operations enhancements. (NOTE: Signals in this corridor are included in the County's Automatic

Traffic Management System project which is under design with anticipated implementation beginning in 2010.)

Corridor 4 — Parham Road

The Parham Road corridor generally runs north/south from Chamberlayne Avenue to River Road and has major connections to I-95 (Exit 83), West Broad Street, and I-64 (Exit 181). Parham Road is a four lane median divided facility maintained by the County, and this corridor currently operates at an unacceptable level of service during peak hours. The surrounding land use is primarily residential with pockets of industrial and commercial development. The average daily traffic along this corridor ranges from 16,000 VPD at US Highway 301 to 33,000 VPD at Brook Road. **Figures 4A**, **4B**, and **4C** depict the existing corridor and display transportation systems management recommendations.

Recommendation #1 — This corridor has closely spaced signals from Woodman Road to River Road with a density of 2.5 signals per mile that are currently not operating in coordination. This corridor should benefit from signal coordination. (NOTE: Signals in this corridor are included in the County's Automatic Traffic Management System project which is under design with anticipated implementation beginning in 2010.)

Recommendation #2 — The intersection of Parham Road and Lawndell/ Bronwood Road presently operates as permissive only. It is recommended that this intersection be timed to allow a protected and permissive left-turn phase on the mainline. This recommendation is made primarily because of the limited sight distance for drivers turning left from northbound Parham Road onto Lawndell Road. (The limited sight distance is caused by the vertical and horizontal curvature in the opposing southbound approach.) This should have the effect of improving safety as well as improving congestion that is being caused by queuing left turning movements at the intersection. (NOTE: This intersection has been reviewed by the Department of Public Works and the determination has been made that phase changes should not be implemented due to safety and operational considerations.)

Recommendation #3 — Similarly, the intersection of Parham Road and Quioccasin Road presently operates as protected only on the mainline. It is recommended that this intersection be considered for re-timing to allow a protected and permissive left-turn phase on the mainline. Allowing permissive left turns should allow the intersection to process additional left turns while allowing for a long through movement phase. The provision of a permissive left-turn phase might benefit the northbound left-turn movement the most, as that movement provides good visibility of the opposing traffic along southbound Parham Road. This would improve congestion that is being caused by left turning movements at the intersection. (NOTE: This intersection has been reviewed by the Department of Public Works and the determination has been made that phase changes should not be implemented due to safety and operational considerations.)

Corridor 5 — Brook Road (US Route 1)

Within the county limits, the Brook Road corridor runs from the Henrico/Hanover County line south to Azalea Avenue (at the Henrico County/City of Richmond line), and is predominantly a north/south facility. Brook Road is maintained by VDOT. Brook Road runs parallel and to the west of I-95 and has an interchange with I-295 (Exit 43) with collector-distributor roads tying it to the I-295/I-95 interchange (Exit 84) to the east. Because it runs parallel to I-95, Brook Road serves as an alternate route for I-95 traffic during incidents which cause traffic congestion along I-95. This corridor is a six lane median divided facility from The Henrico/Hanover County line to Parham Road and a four lane median divided facility from Parham Road to Azalea Avenue. The corridor currently operates at an unacceptable level of service and is expected to worsen in the future. The surrounding land use is a mix of residential and commercial uses, with a major commercial shopping center located along its east side, just north of I-295. The average daily traffic along this corridor ranges from 20,000 VPD at Dumbarton Road to 28,000 VPD at Francis Road. **Figures 5A** and **5B** depict the existing corridor and display transportation systems management recommendations.

Recommendation #1 — The Brook Road corridor has closely spaced signals with a density of three signals per mile that are currently not operating in coordination. Coordination of signals in the section both north and south of I-295 should yield travel time savings and congestion reduction on the segment. (NOTE: Signals along this corridor have been coordinated.)

Recommendation #2 — The I-95 corridor has existing intelligent transportation system (ITS) monitoring equipment in place (closed-captioned television (CCTV) and dynamic message signs (DMS)) in the vicinity of this section of Brook Road. Because Route 1 is frequently used as a diversion route for I-95 traffic (during incidents) and because ITS instrumentation exists in this area, the Brook Road corridor is recommended for consideration to receive CCTV and DMS coverage in order to provide arterial management in conjunction with existing ITS TSM efforts along I-95. (NOTE: This recommendation has not yet been implemented by the Virginia Department of Transportation.)

Corridor 6 — Woodman Road

The Woodman Road corridor evaluated herein consists of the segment extending from I-295 (Exit 45) south to Parham Road. Woodman Road is a county-maintained roadway with a north/south orientation. This corridor is a two lane undivided facility from I-295

to Ramsey Road, a two lane road with a two-way left turn lane from Ramsey Road to Hungary Road, and a four lane section with a divided median from Hungary Road to Parham Road. Some sections of this corridor currently operate at an acceptable level of service during peak hours while other sections do not. The surrounding land use is primarily residential. The average daily traffic along this corridor ranges from 12,000 VPD at Terry Drive to 19,000 VPD at Parham Road. **Figure 6** depicts the existing corridor and displays transportation systems management recommendations.

Recommendation #1 — The southern two signals along the Woodman Road corridor (at Parham Road and at Hungary Road) are closely spaced and are currently not operating in coordination. Coordination of these two signals should result in reduced localized travel times. (NOTE: Signals in this corridor are included in the County's Automatic Traffic Management System project which is under design with anticipated implementation beginning in 2010.)

Corridor 7 — Nuckols Road

The Nuckols Road corridor runs from Springfield Road to Pouncey Tract Road and is predominately an east/west facility that is maintained by the County. This corridor is a four lane median divided facility from Pouncey Tract Road to Cox Road, a two lane facility from Cox Road to Fort McHenry Road, and a two lane section with a divided median from Fort McHenry to Springfield Road. Nuckols Road has a full interchange with I-295 (Exit 51) just west of Cox Road. This corridor currently operates at an unacceptable level of service during peak periods and is expected to worsen in the future. The surrounding land use is mainly residential with a major commercial development (Innsbrook) nearby along Cox Road. The average daily traffic along this corridor ranges from 18,000 VPD at Springfield Road to 28,000 VPD at I-295. **Figure 7** depicts the existing corridor and displays transportation systems management recommendations.

Recommendation #1 — The Nuckols Road corridor has closely spaced signals with a density of 2 signals per mile that are currently not operating in coordination. Coordination of signals on this corridor should result in reduced corridor travel times.

(NOTE: Signals in this corridor are included in the County's Automatic Traffic Management System project which is under design with anticipated implementation beginning in 2010. Additionally, Nuckols Road has been widened to a four lane median divided facility from Cox Road to Springfield Road to help address level of service issues.)

Summary of Recommendations

The table below gives a summary of identified issues and recommended transportation systems management strategies for the study corridors.

Corridor	Identified Issues	Recommended Strategies
Laburnum Avenue	• Closely spaced signals	• Signal coordination
West Broad Street	• Restricted access to commercial sites • Poor on-site circulation • Lack of side street green time at Pouncey Tract/Pump Road approaches • Closely spaced signals	• Additional right-in/right-out access • Improved on-site circulation • Improved signal phasing/timing to provide increased green time for Pouncey Tract/Pump Road approaches • Signal coordination
Gaskins Road	• Closely spaced signals	• Signal coordination
Parham Road	• Closely spaced signals • No mainline protected signal phasing at Lawndell/Bronwood Road intersection • No permissive signal phasing at Quioccasin Road intersection	• Signal coordination • Conversion to protected/permissive signal phasing at Lawndell/Bronwood Road intersection • Conversion to protected/permissive signal phasing along mainline at Quioccasin Road intersection
Brook Road	• Closely spaced signals • I-95 reliever route	• Signal coordination • Arterial management w/ITS technologies (CCTV and DMS)
Woodman Road	• Closely spaced signals	• Signal coordination
Nuckols Road	• Closely spaced signals	• Signal coordination

Planned Transportation Projects

The table below shows a list of planned projects in the vicinity of the study corridors as identified in the Virginia Department of Transportation's Six-Year Improvement Program (SYIP) and Henrico County's proposed Capital Improvement Program FY 2005-06 through FY 2009-10. The projects included in VDOT's SYIP are identified with their Universal Project Codes (UPC). (*Note: A UPC is a unique number assigned to each project by VDOT at its inception and remains with the project until completion.*)

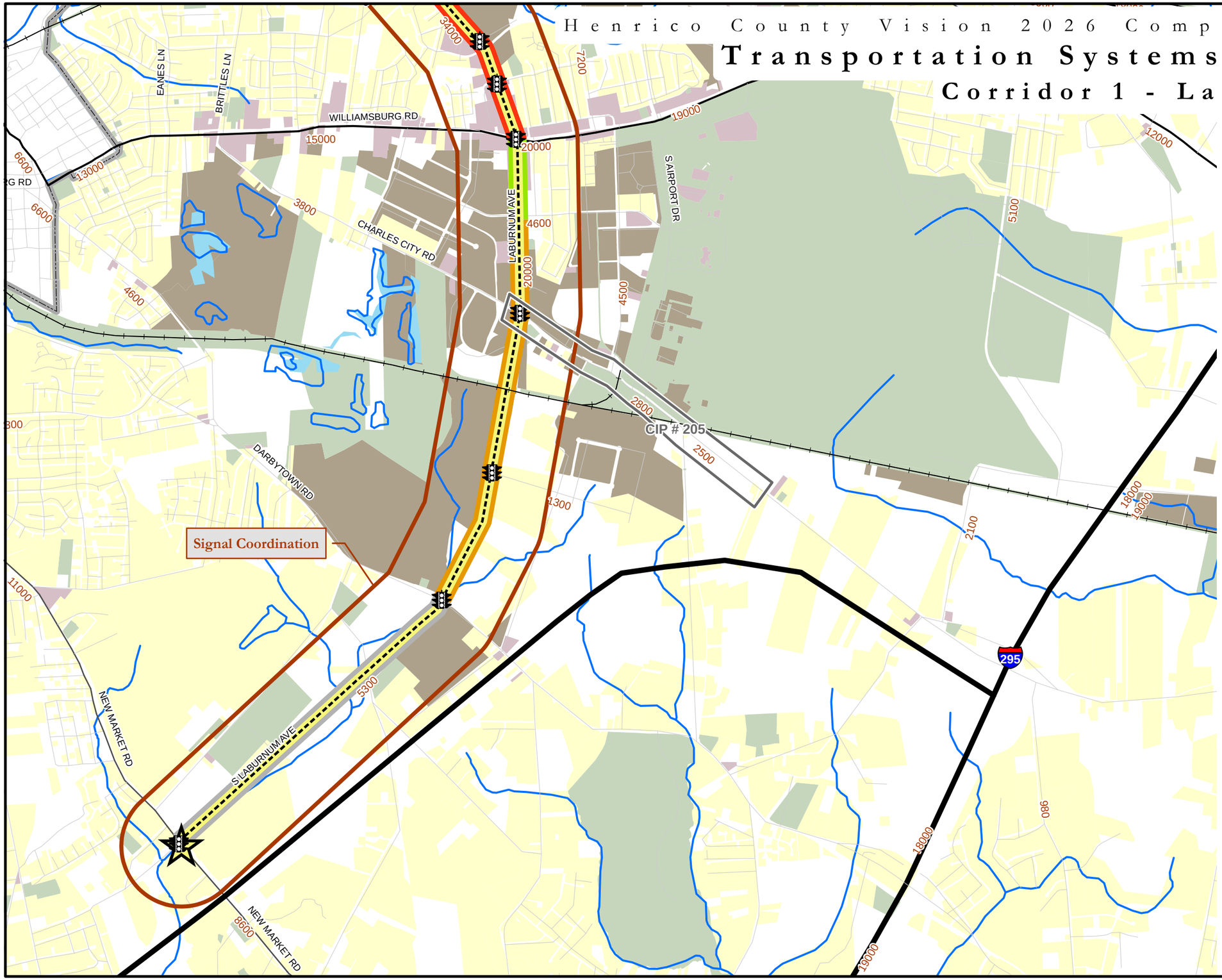
Project #	Description
UPC 50021	Signal modification on Brook Road at Ridge Road
UPC 50528	Widening of Three Chopt Road from Barrington Hills Drive to Gaskins Road
UPC 53314	Widen Nuckols Road between Cox Road and Springfield Parkway
UPC 53315	Construct new road (John Rolfe Parkway)
UPC 53317	Extend Cox Road from northern terminus north of Ridgefield Parkway to Church Road and install traffic signals at Ridgefield Parkway and Church Road.
UPC 72199	Modify I-295 interchange at Nuckols Road
UPC 77074	Modify Broad Street and Parham Road intersection; install right turn lane on westbound Broad Street and extend right turn lane on southbound Parham Road
CIP 205	Widen Charles City Road from Laburnum Avenue to Seven Hills Boulevard extended
CIP 399	North Gayton Road extension from Broad Street to Pouncey Tract Road/Shady Grove Road
CIP 463	Construct new road (John Rolfe Parkway)

Henrico County Vision 2026 Comprehensive Plan

Transportation Systems Management

Corridor 1 - Laburnum Avenue

Figure 1A



Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Improvement Areas

Existing Land Use

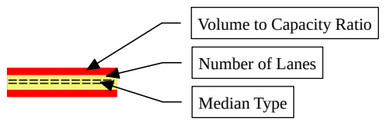
- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

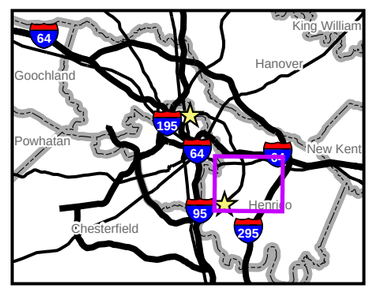
Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2
- ## Average Daily Traffic





0 1,000 2,000 Feet

February 2006

N W E S

Kimley-Horn and Associates, Inc.

Mapping prepared by Kimley-Horn and Associates, Inc. for the Henrico County Vision 2026 Comprehensive Plan

Data Sources: KHA, Henrico County

Henrico County Vision 2026 Comprehensive Plan

Transportation Systems Management

Corridor 1 - Laburnum Avenue

Figure 1B

Signal Coordination

Intersection of Laburnum Ave and Gay Ave

Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Improvement Areas

Existing Land Use

- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

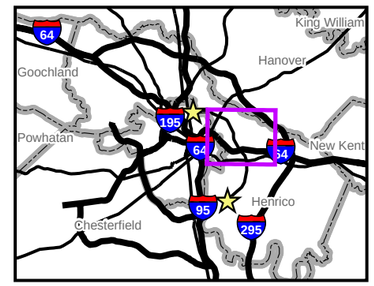
Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2
- ## Average Daily Traffic

Volume to Capacity Ratio
Number of Lanes
Median Type



0 1,000 2,000 Feet

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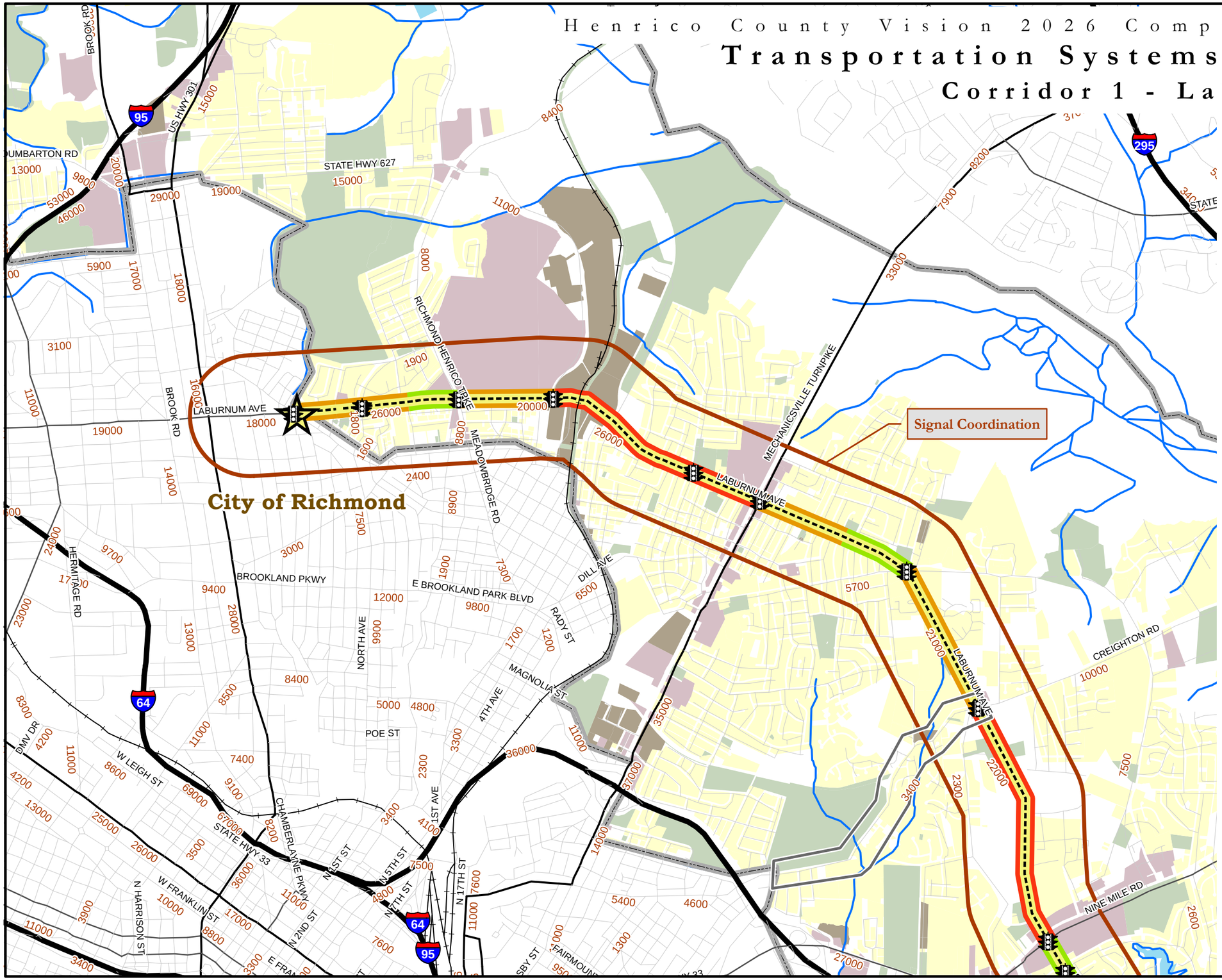
Data Sources: KHA, Henrico County

Henrico County Vision 2026 Comprehensive Plan

Transportation Systems Management

Corridor 1 - Laburnum Avenue

Figure 1C



Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Improvement Areas

Existing Land Use

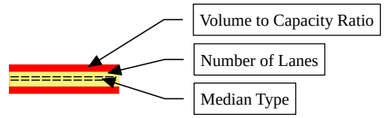
- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

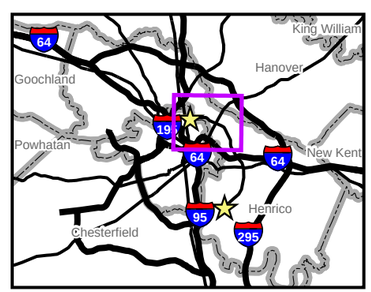
Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2
- ## Average Daily Traffic





0 1,000 2,000 Feet

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Transportation Systems Management

Corridor 2 - Broad Street

Figure 2A

Intersection of Broad St and Pouncey Tract/Pump Rd

Provide additional Right-in/Right-out access

Signal Coordination

Signal Coordination

Improve On-Site Circulation

Provide more side street green time at intersection of Broad St and Pouncey Tract/Pump Road

Exit 178

CIP # 399

UPC # 53315
CIP # 463

UPC # 50528

UPC # 53317

UPC # 72199

UPC # 53314

NUCKOLS RD
SHADY GROVE RD
TWIN HICKORY RD
POUNCEY TRACT RD
N GAYTON RD
PUMP RD
THREE CHOPT RD
CHURCH RD
COX RD
GASKINS RD
SPRINGFIELD RD
HUNGARY RD
BROAD ST
PEMBERTON RD
E PARHAM RD
LAUDER
GAYTON RD

64
295
95

Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Improvement Areas

Existing Land Use

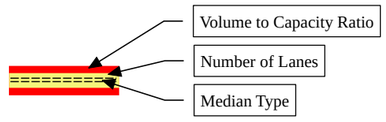
- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

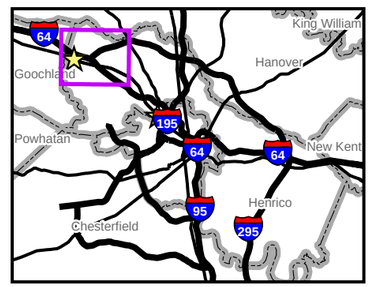
Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2
- ## Average Daily Traffic





0 1,000 2,000 Feet

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Data Sources: KHA, Henrico County

Henrico County Vision 2026 Comprehensive Plan

Transportation Systems Management

Corridor 2 - Broad Street

Figure 2B

Improve On-Site Circulation

Signal Coordination

Exit 183

Intersection of Broad St and Glenside Dr

City of Richmond

UPC# 77074

UPC# 50021

BROAD ST

E PARHAM RD

STAPLES MILL RD

HUNGARY SPRING RD

HILLIARD RD

HERMITAGE RD

BROOK RD

GLENSIDE DR

SKIPWITH RD

FOREST AVE

THREE CHOPT RD

HORSEPEN RD

CHARLES ST

RIDGE RD

OLD MILL RD

TOWANA RD

GAMBLES MILL RD

RIVER RD

RIDGE RD S

LIBBIE AVE

WESTMORELAND ST

WILLOW LAWN DR

THALBRO ST

JACQUE ST

MONUMENT AVE

WESTWOOD AVE

DUMBARTON RD

HERMITAGE RD

US HWY 301

64

95

195

295

Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Improvement Areas

Existing Land Use

- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

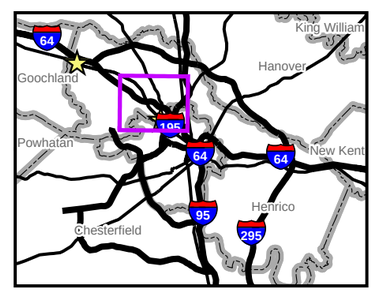
- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2

Average Daily Traffic

Volume to Capacity Ratio

Number of Lanes

Median Type



0 1,000 2,000 Feet

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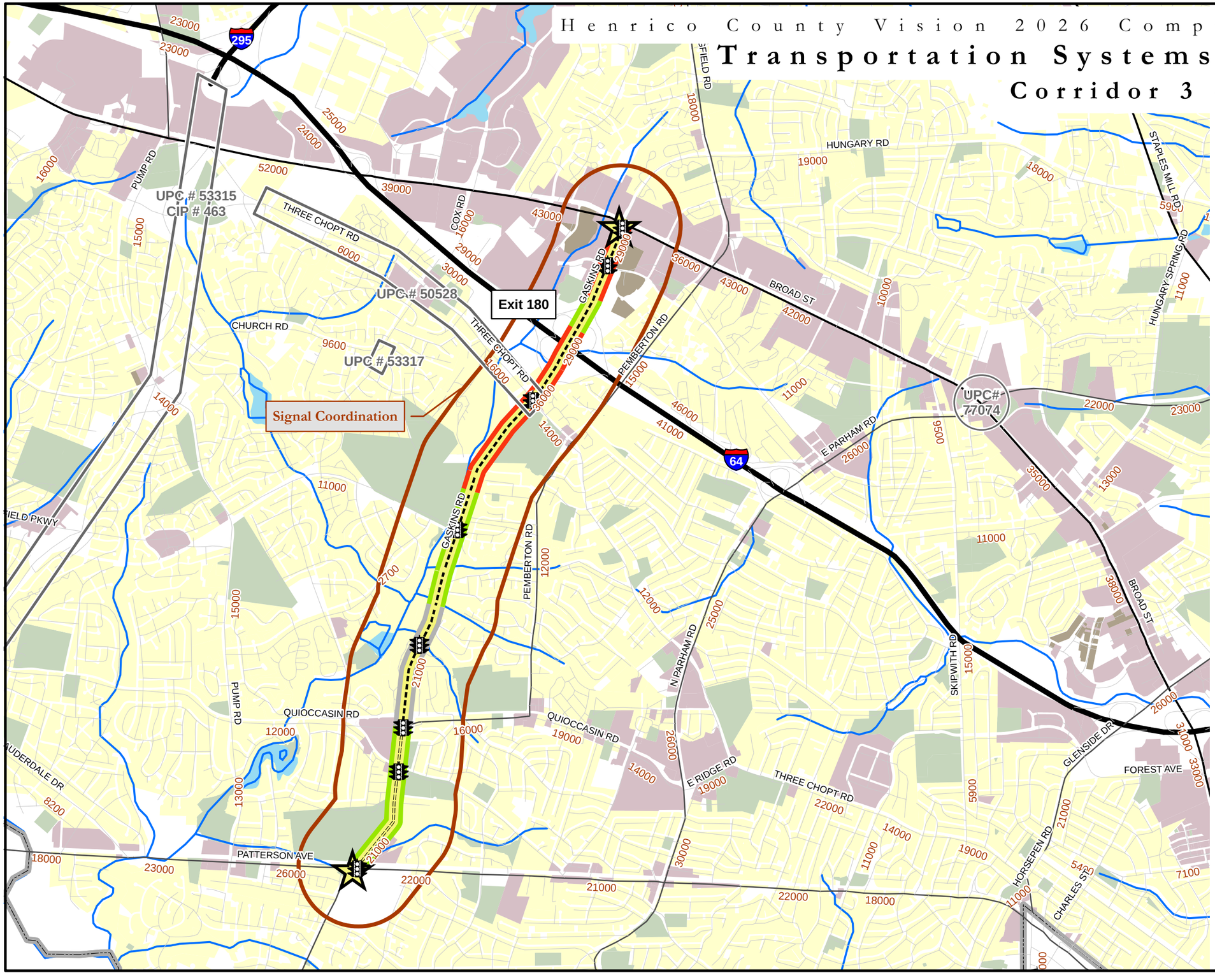
Henrico County Vision 2026 Comprehensive Plan

Transportation Systems Management

Corridor 3 - Gaskins Road

Figure 3



Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Improvement Areas

Existing Land Use

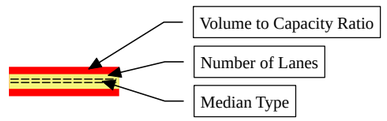
- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

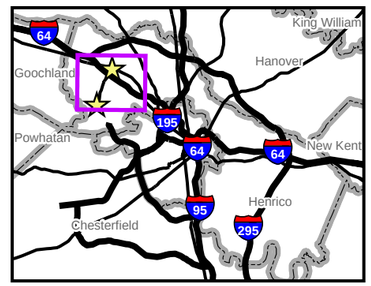
Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2
- ## Average Daily Traffic





0 1,000 2,000 Feet

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Henrico County Vision 2026 Comprehensive Plan

Transportation Systems Management

Corridor 4 - Parham Road

Figure 4A

Signal Coordination

Under Construction

Intersection of Parham Rd and Brook Rd

UPC# 50021

Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Recommended Improvement Areas

Existing Land Use

- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

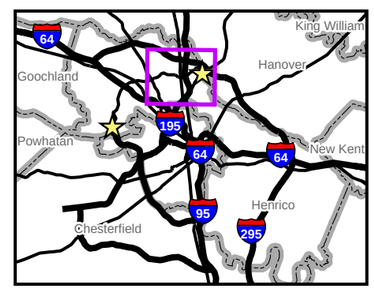
- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2

Average Daily Traffic

Volume to Capacity Ratio

Number of Lanes

Median Type



0 1,000 2,000 Feet

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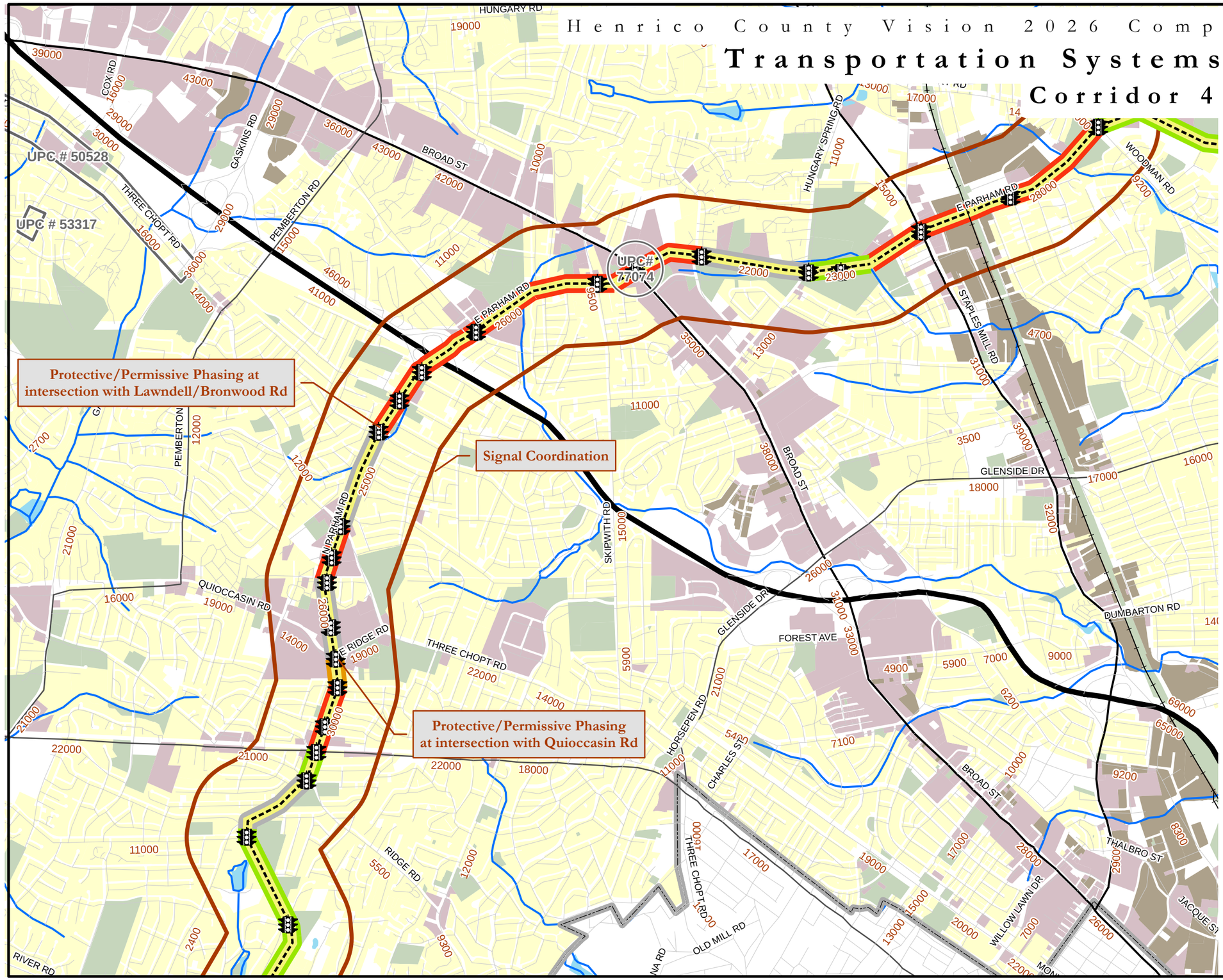
Henrico County Vision 2026 Comprehensive Plan

Transportation Systems Management

Corridor 4 - Parham Road

Figure 4B



Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Recommended Improvement Areas

Existing Land Use

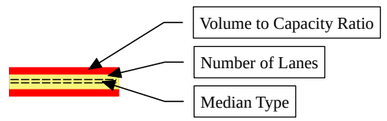
- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

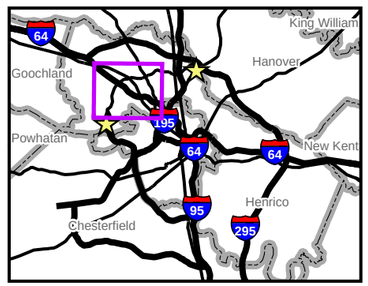
Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2
- ## Average Daily Traffic





0 1,000 2,000 Feet

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Transportation Systems Management

Corridor 4 - Parham Road

Figure 4C

Signal Coordination

Intersection of Parham Rd and Patterson Ave

Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Recommended Improvement Areas

Existing Land Use

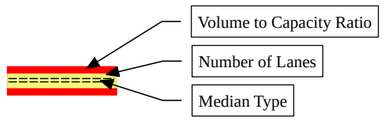
- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

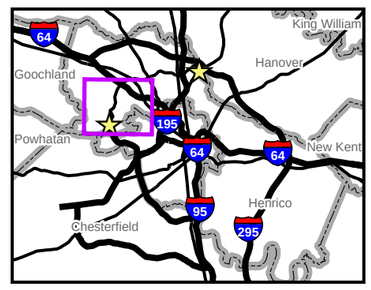
Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2
- ## Average Daily Traffic





0 1,000 2,000 Feet

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Transportation Systems Management

Corridor 5 - Brook Road

Figure 5A

Hanover County

Signal Coordination

STATE HWY 626

STATE HWY 656

MILL RD

GREENWOOD RD

MOUNTAIN RD

WOODMAN RD

HUNGARY RD

STAPLES MILL RD

HUNGARY SPRING RD

E PARHAM RD

BROOK RD

US HWY 1

95

295

870 1800 2000 2500 16000 1600 880 5600 22000 24000 6000 17000 27000 25000 3700 7800 3900 12000 7000 15000 13000 17000 14000 19000 11000 15000 9200 28000 27000 7100 23000 28000 21000 32000 33000 52000 36000 42000 41000 16000 28000 32000 15000 8800

Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Improvement Areas

Existing Land Use

- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

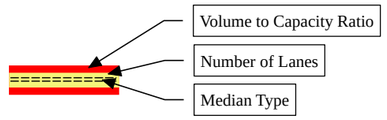
Lanes and Median

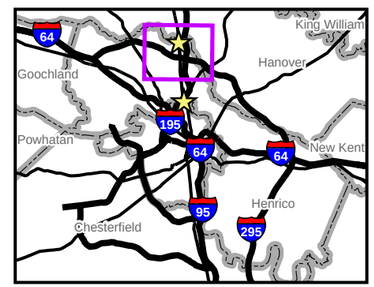
- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2

Average Daily Traffic





0 1,000 2,000 Feet

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Henrico County Vision 2026 Comprehensive Plan

Transportation Systems Management

Corridor 5 - Brook Road

Figure 5B

Signal Coordination

UPC# 50021

Arterial CCTV Surveillance/Arterial Detection

Arterial Dynamic Message Signs (for use in I-295 detour)

City of Richmond

HUNGARY RD
E PARHAM RD
WOODMAN RD
STAPLES MILL RD
HERMITAGE RD
HILLIARD RD
GLENSIDE DR
BROOK RD
US HWY 301
DUMBARTON RD
STATE HWY 627
BROAD ST
THALBRO ST
WILLOW LAWN DR
JACQUE ST
LABURNUM AVE
RICHMOND HENRICO TPKE
MEADOWBRIDGE RD

64 95 195 295

Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Recommended Improvement Areas

Existing Land Use

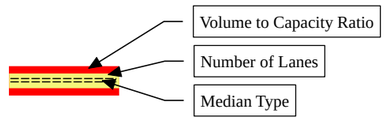
- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

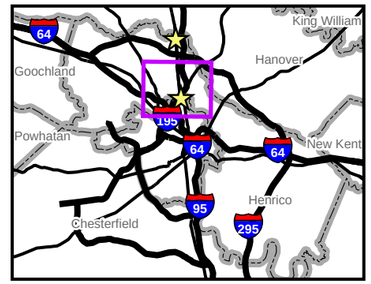
Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2
- ## Average Daily Traffic





0 1,000 2,000 Feet

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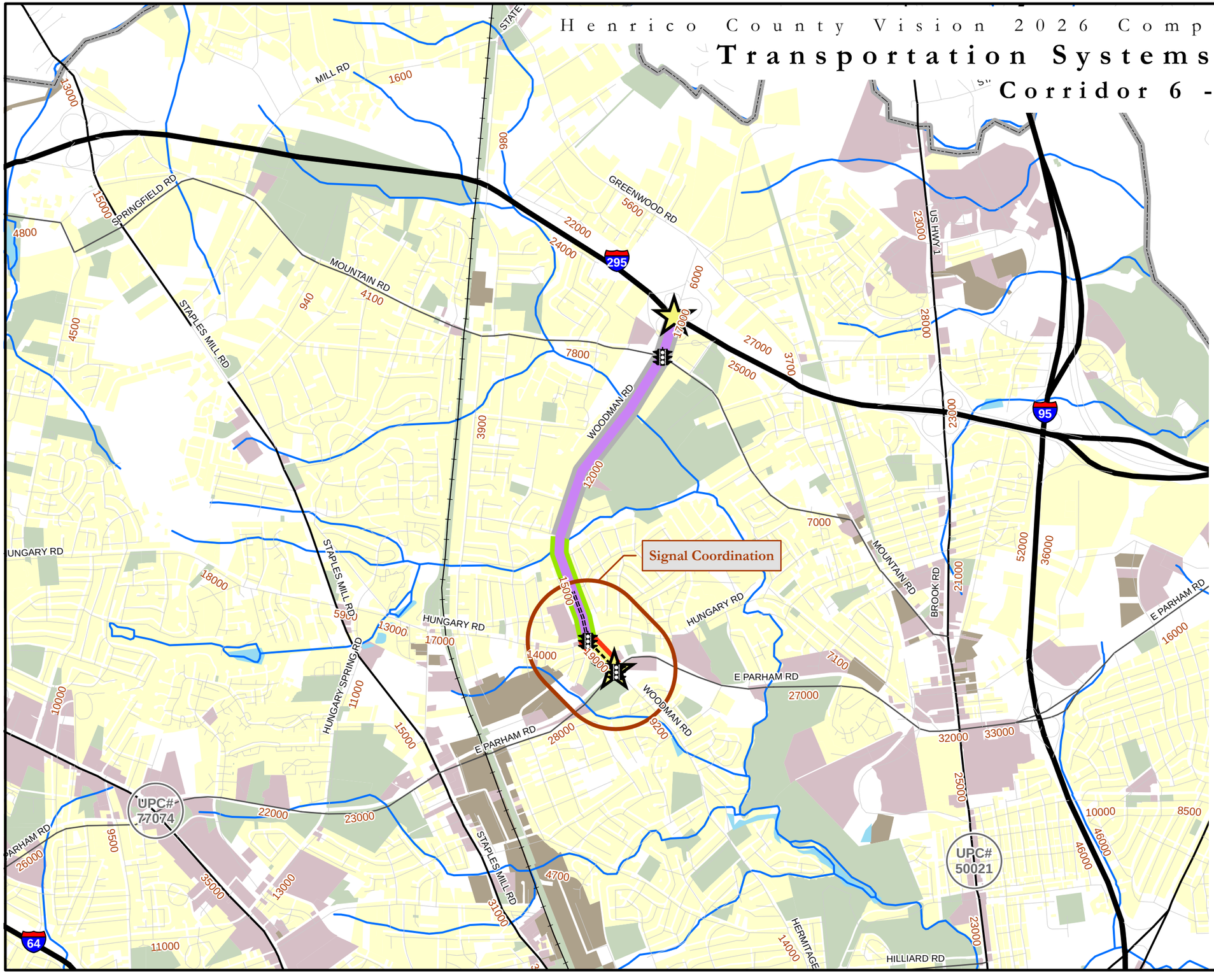
Henrico County Vision 2026 Comprehensive Plan

Transportation Systems Management

Corridor 6 - Woodman Road

Figure 6



Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries

Existing Land Use

- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

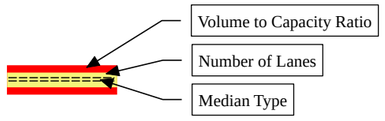
Lanes and Median

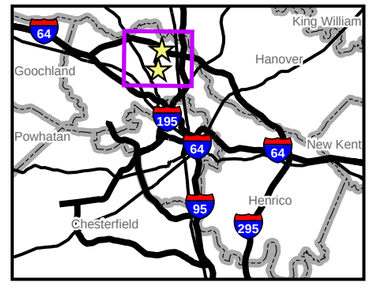
- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2

Average Daily Traffic





0 1,000 2,000 Feet

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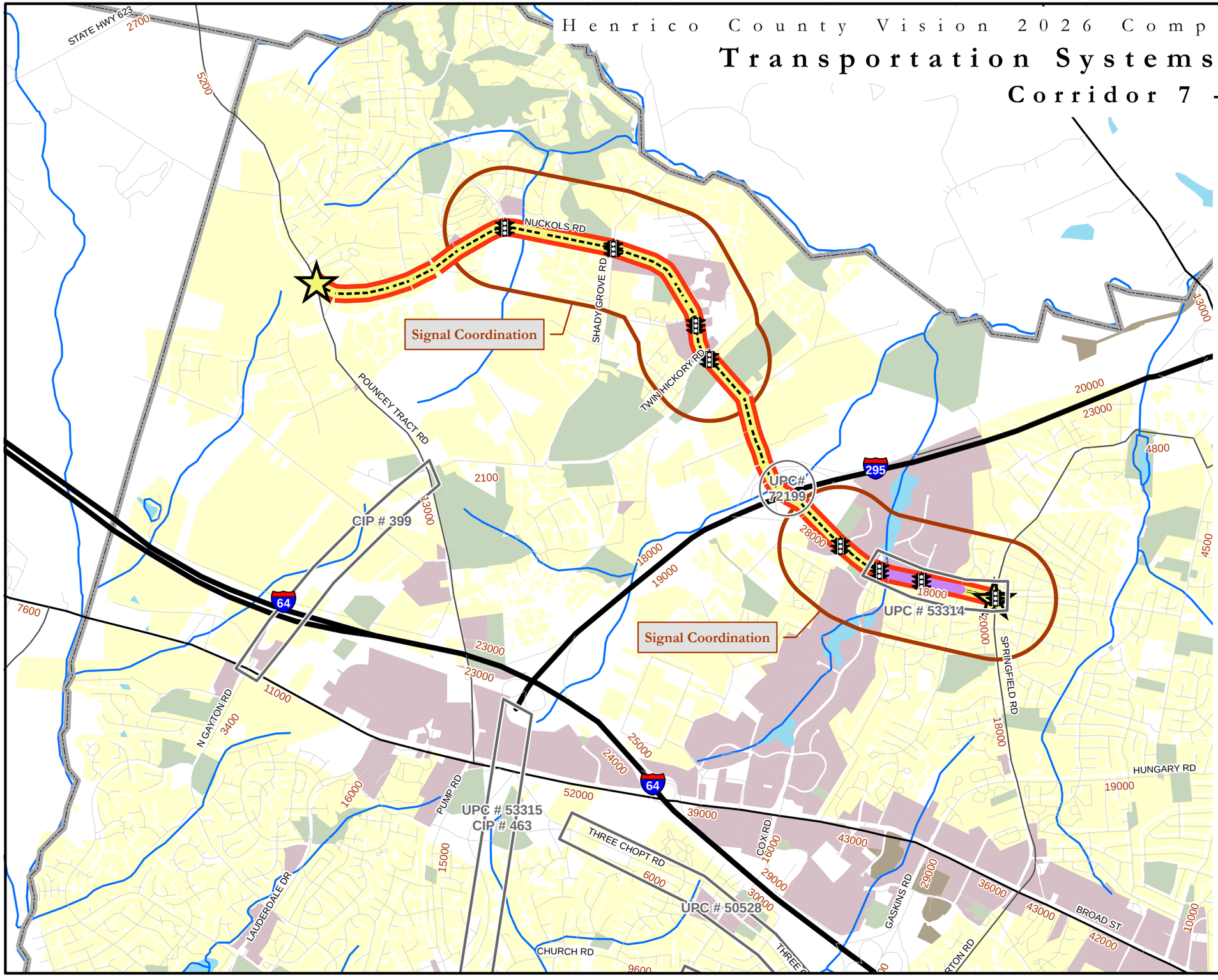
Transportation Systems Management

Corridor 7 - Nuckols Road

Figure 7



Legend

- Corridor Termini
- Signalized Intersections
- County Boundaries
- Recommended Improvement Areas

Existing Land Use

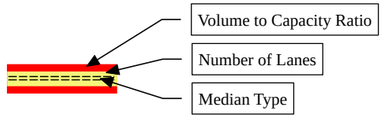
- Commercial
- Industrial
- Open Space Recreation/Public
- Residential

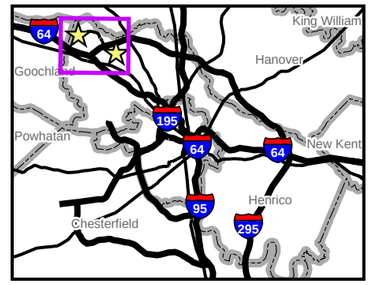
Lanes and Median

- 2 Lanes
- 4 Lanes
- 6 Lanes
- Two Way Left Turn Lane
- Divided Median

Volume to Capacity Ratio

- < 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- > 1.2
- ## Average Daily Traffic





0 1,000 2,000 Feet

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