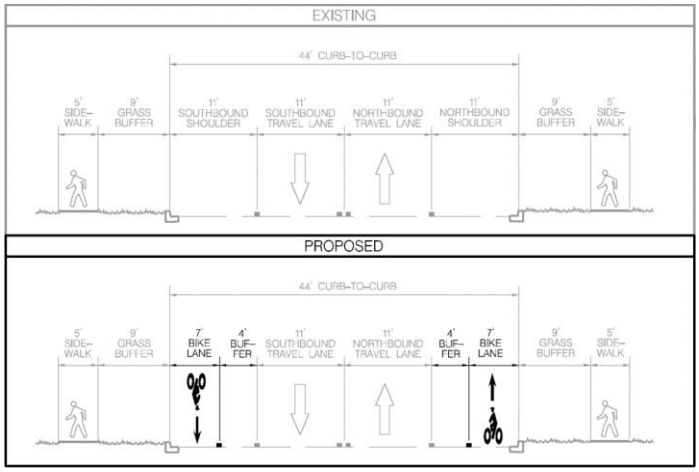
Complete Streets Feasibility Study and 10% Design Plan

for

Columbia Road



HOWARD COUNTY
MARYLAND

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SABRA & ASSOCIATES
A Mead & Hunt Company

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1 Introduction

The purpose of this feasibility study is to determine how to implement a *Complete Streets* design for Columbia Road in Columbia, in order to provide greater pedestrian and bike safety and accessibility while addressing speed, parking, and congestion concern for vehicles, where needed.

Designing for Complete Streets means creating streets that are safe and accessible for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities. In 2019, the Howard County Council passed a Complete Streets resolution, CR 120-2019:

> *To ensure that Howard County is a place for individuals of all backgrounds to live and travel freely, safely, and comfortably, public and private roadways in Howard County shall be safe and convenient for residents of all ages and abilities who travel by foot, bicycle, public transportation or automobile, ensuring sustainable communities Countywide.*

For the purpose of focusing the numerous possible options for redesigning Columbia Road, the assumption was made by the County that the curb-to-curb dimensions would generally remain the same, and that proposed modifications will occur within the roadbed or behind the fixed curbs. This assumption was due to the substantial capital costs associated with altering the width of the roadbed.

1.1 Project Purpose and Goals

The purpose of the feasibility study is to develop conceptual improvements for Columbia Road, coordinate with and obtain “buy-in” from the local community, and develop 10% design plans, with all design assumptions documented for the Final Design phase.

The project evaluated safety, parking needs, vehicle speed, and pedestrian and bike accessibility/connectivity along Columbia Road, while also evaluating congestion-related improvements for the intersection of Old Annapolis Road at Columbia Road. Primary objectives for this feasibility study include:

1. Identifying community needs and vision for Columbia Road, in accordance with community goals and the guidance of *PlanHoward, BikeHoward,* and *WalkHoward.*
2. Conducting traffic counts, speed data, traffic operations, and reviewing crash data.
3. Quantifying safety and operational impacts of possible improvements.
4. Develop cost-effective planning-level concepts for improvements to address community concerns and implementing Complete Streets guidelines.
5. Obtain community concurrence with conceptual plans and develop 10% design drawings, with design assumptions documented.

1.2 Methodology

To achieve the project’s objectives, the following steps were conducted and are documented herein:

1. Collect traffic data at select intersections and roadway segments.
2. Evaluate existing traffic operations, parking occupancy, vehicle speeds, and crash data.
3. Obtain community input prior to and after developing planning level improvements.
4. Analyze planning level improvements for their impacts on safety, congestion, and accessibility.
5. Develop 10% Conceptual Designs and cost estimates, and document design assumptions.

This Technical Memorandum is the summary of the data collection efforts, community input, conceptual design, and design assumptions.

1.3 Study Area

Columbia Road is classified as a major collector for the Dorsey's Search neighborhood of Columbia. It generally parallels US 29, and provides access to MD 108 and Little Patuxent Parkway – both east/west-running arterials. As shown in Figure 1, the study area limits represent a 1 ¼ mile segment of Columbia Road from Old Annapolis Road to ¼ mile east of Hemlock Cone Way. Old Annapolis Road is an east-west major collector that runs parallel to MD 108 and often serves traffic that is trying to avoid MD 108 during times of congestion.

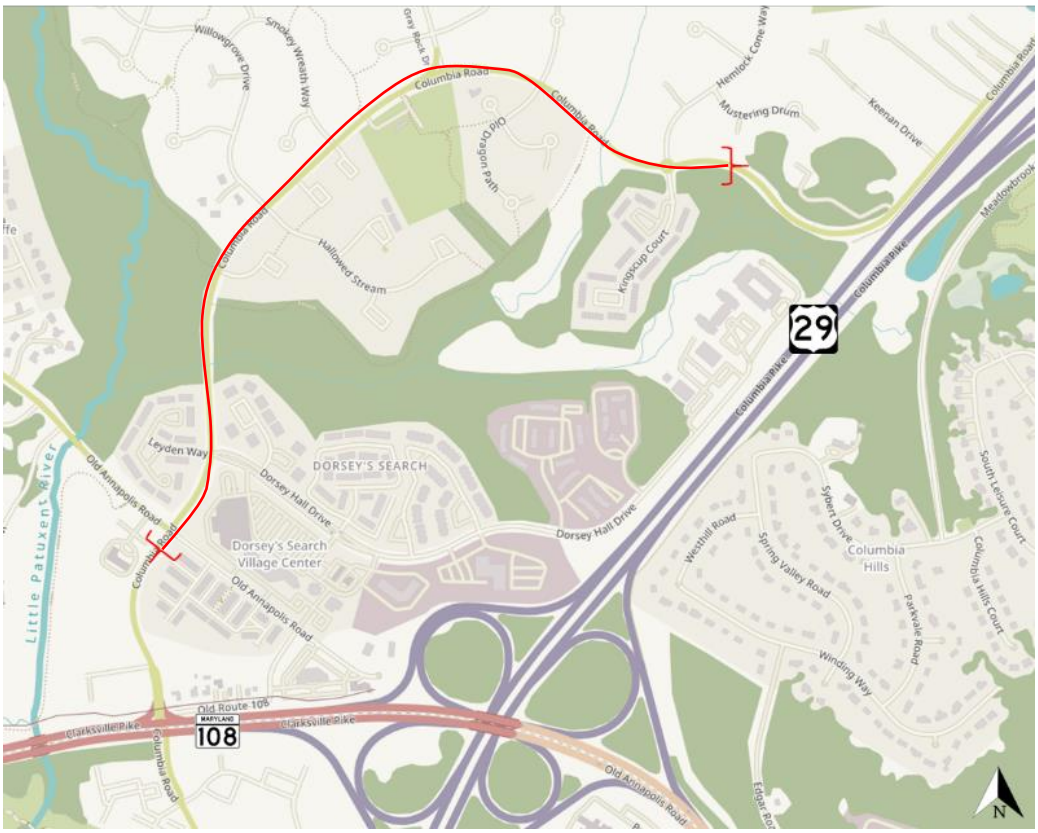

Figure 1: Study Area

2 Existing Conditions

2.1 Roadway Characteristics and Typical Section

Columbia Road is a closed-section (i.e. curbed) major collector that is 44 feet wide curb-to-curb, with sidewalks on both sides, separated by a grass buffer for lighting, trees, and signs. Each direction of the roadway has a single general-purpose travel lane and shoulder for on-street parking. The roadway's typical section is shown in Figure 2.

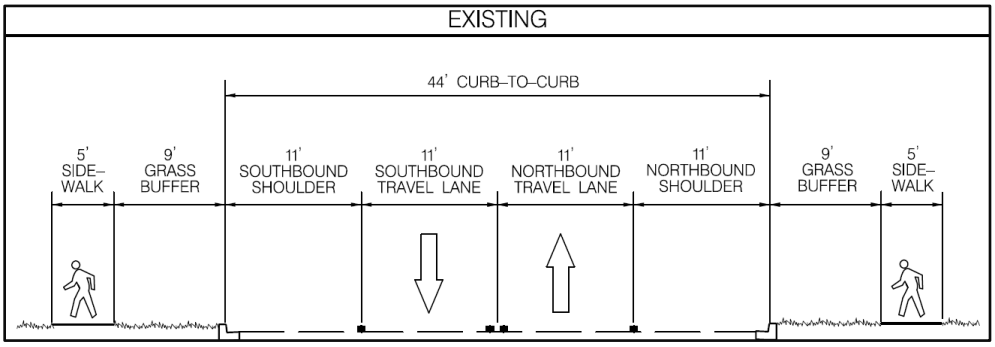

Figure 2: Existing Typical Section for Columbia Road

The speed limit for the roadway varies from 35 mph (between Old Annapolis Road and Willowgrove Drive) to 30 mph for the remainder of the roadway. A short 25 mph advisory speed segment exists near Hemlock Cone Way, due to horizontal roadway curvature there. Speed data was collected during a typical day when County schools were in session. The speed data, as well as overall average daily traffic (ADT) data, is summarized in the following table. Raw speed data and graphs for 48 successive hours can be found in Appendix A.

Table 1: Speed and ADT Data along the Columbia Road Corridor

Location	ADT	Posted Speed Limit	Average Speed	% of Traffic Exceeding Posted Speed Limit by 10+ mph
Columbia Road at Dorsey Hall Pool	8,000	30 MPH	32 MPH	1% Eastbound Drivers and 3% Westbound Drivers
Columbia Road at Old Dragon Path	5,200	30 MPH	36 MPH	20% Eastbound Drivers and 12% Westbound Drivers
Columbia Road East of Hemlock Cone*	5,200	30 MPH (Advisory Speed of 25 mph	30 MPH	2% Eastbound Drivers and 24% Westbound Exceed Posted Speed Limit by 10 MPH. 27% Eastbound Drivers and 71% Westbound Exceed Advisory Speed Limit by 10 MPH

* A roundabout was constructed at this intersection after Speed Data was collected.

Vehicle Classification data was also collected; this data showed that over 98% of all traffic to be FHWA Class 1, 2, or 3 vehicles, i.e., passenger vehicles.

2.2 Crash Data

Five years of crash data (2013 thru 2017) were obtained for the study area in order to determine if there were any recurring crash types or locations with a large number of overall crashes. Figure 3 shows where along Columbia Road these crashes occurred.

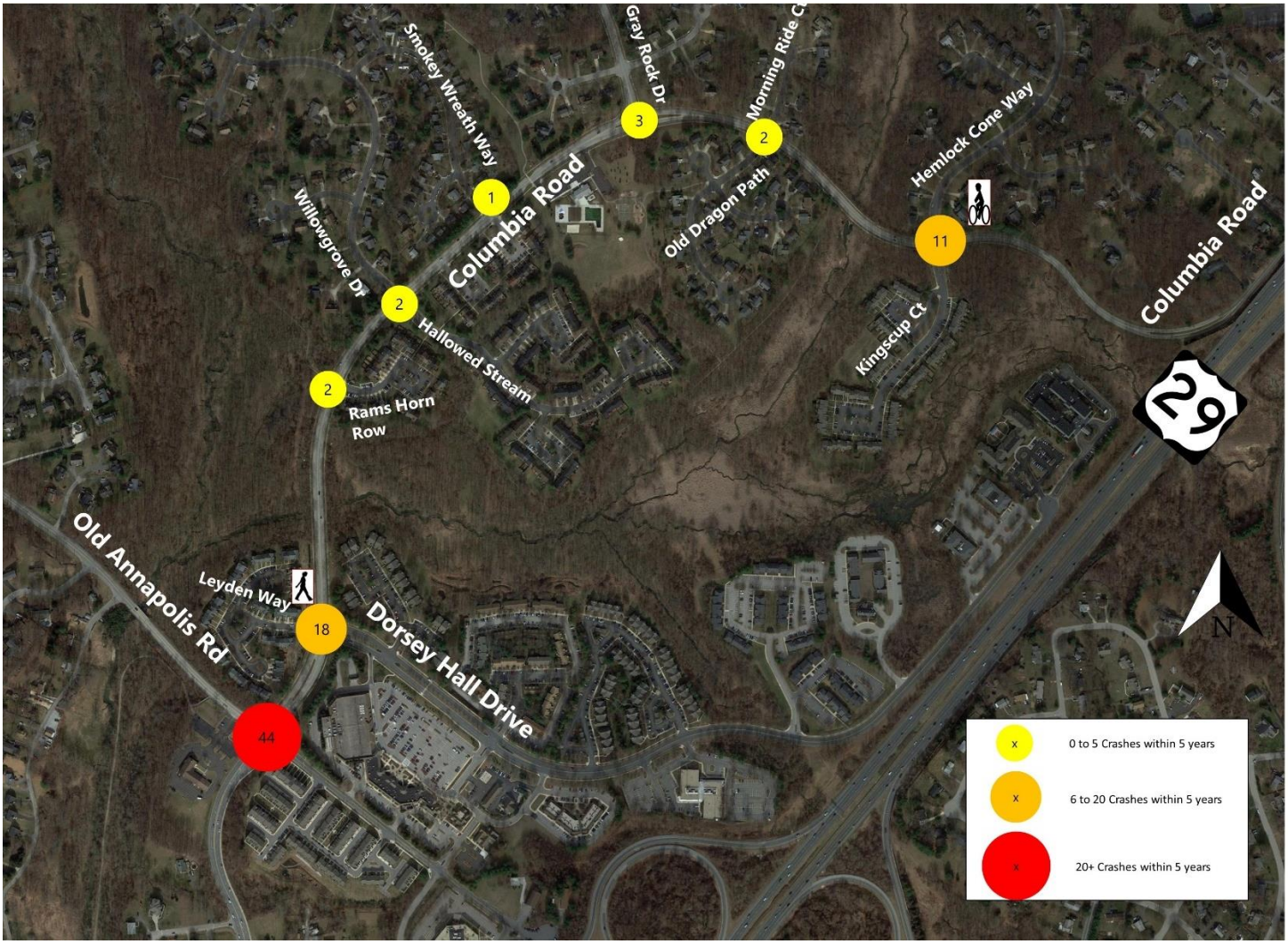

Figure 3: Location and number of crashes within the Study Area, 2013-2017.

A summary of crash types for the higher-incident locations – Dorsey Hall Drive, Hemlock Cone Way, and Old Annapolis Road – is shown in Figure 4, Figure 5, and Figure 6, respectively.

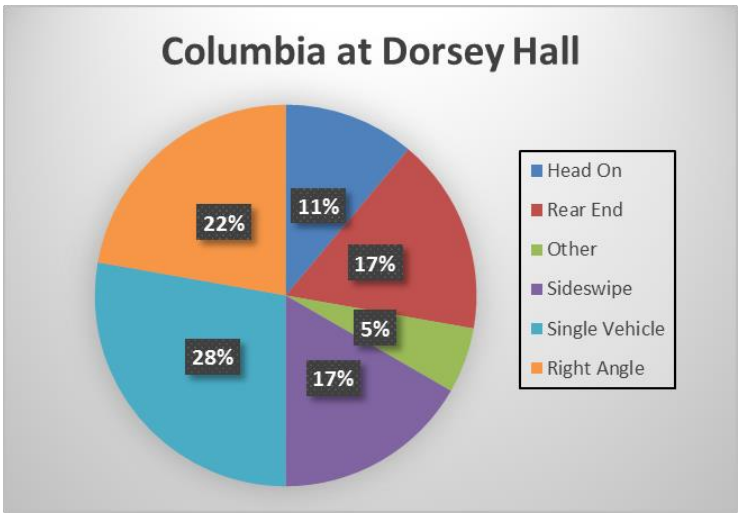

Figure 4: Distribution of Crash Type at Near Dorsey Hall Drive

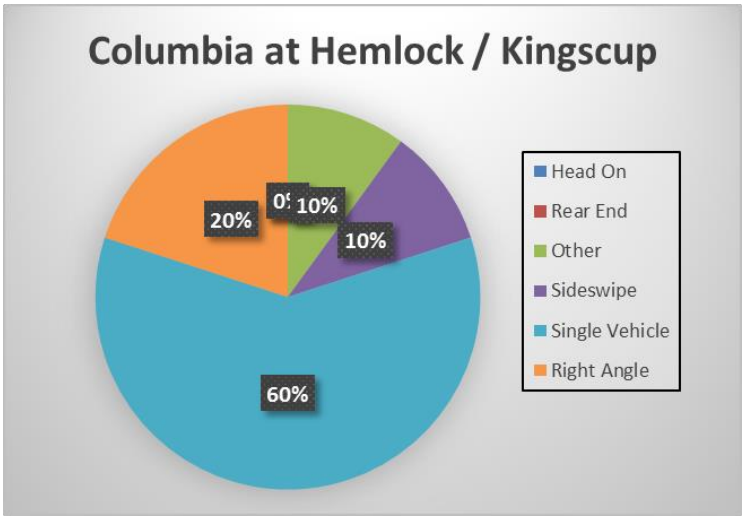

Figure 5: Distribution of Crash Type at Near Hemlock Cone Way

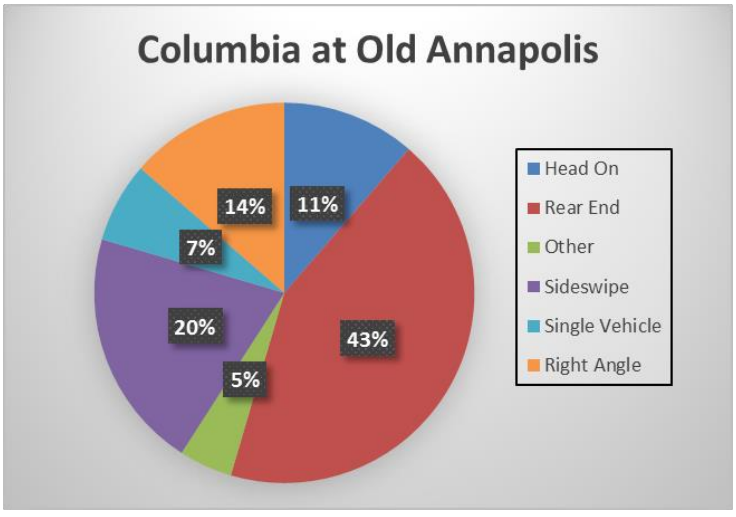

Figure 6: Distribution of Crash Type at Near Old Annapolis Road

2.3 Existing Pedestrian and Bicycle Infrastructure

Columbia Road has buffered sidewalks along both sides within the study area, as well as in integrated paved trail network, as shown in Figure 7. Cyclists may use the general-purpose travel lane; however the prevailing vehicle speeds are typically twice that of casual riders. Cyclists may also use shoulders when curbside parking is not in use. Finally, cyclists are legally allowed to utilize sidewalks in Howard County; however, the sidewalks are not wide enough to share with pedestrians simultaneously.

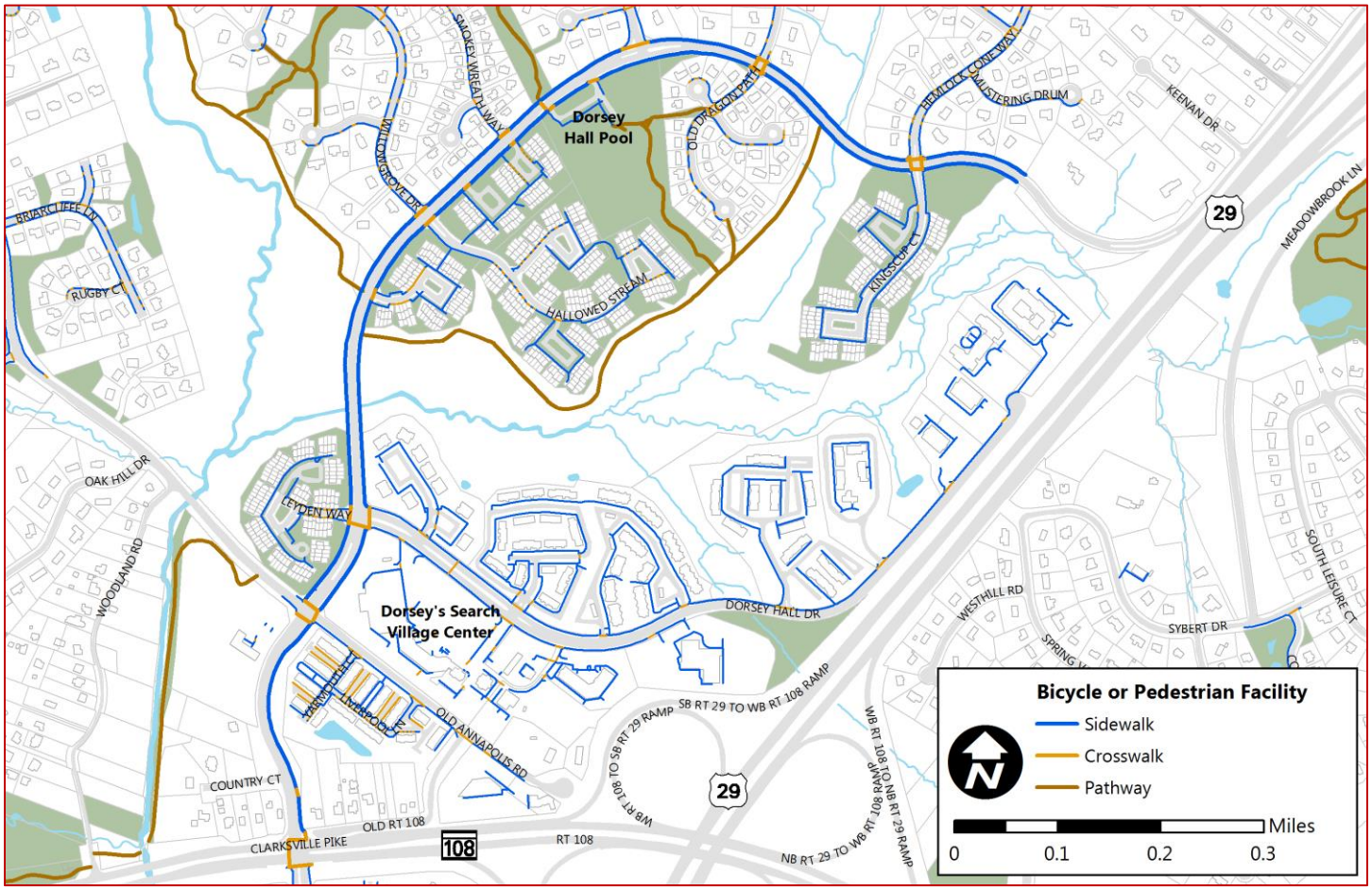

Figure 7: Locations of Sidewalk and trails within the Study Area

Marked crosswalks to cross Columbia Road are located at:

- Old Annapolis Road (signalized)
- Dorsey Hall Drive (signalized)
- In front of the Dorsey Hall Pool (narrowed crossing with curb bump outs)
- Roundabout at Hemlock Cone Way (installed during the study in 2019)

2.4 Capacity Analysis

The following three study area intersections were identified for potential capacity constraints:

1. Columbia Road at Old Annapolis Road
2. Columbia Road at Dorsey Hall Drive
3. Columbia Road at Gray Rock Road

Turning movement counts were conducted in the spring of 2018 for these three intersections; cyclists, pedestrians, and vehicle were all counted during the AM and PM peak commuting periods. The raw count data can be found in Appendix B.

All study intersections were coded into a Synchro network to perform capacity analysis. Synchro is a deterministic and macroscopic intersection analysis computer software program that models street networks and traffic signal systems. Geometric data such as number of lanes, lane configuration, storage lengths, tapers, and distances between intersections were inputted into Synchro. Existing signal timings and phasing were obtained from the Maryland Department of Transportation State Highway Administration and Howard County Department of Public Works and coded into the Synchro traffic model along with existing traffic volumes.

The Synchro model representing *Existing Conditions* was validated via field observations and modifications to parameters such as link speeds and headway factors were made, where necessary, to ensure the model represented field-observed delays and queue lengths.

Signal operations during the AM and PM peak period are summarized below:

- Columbia Road at Dorsey Hall Road
  - AM – Free with a max cycle length of 98 seconds
  - PM – Coordinated with a cycle length of 110 seconds
- Columbia Road at Old Annapolis Road
  - AM and PM – Coordinated with a cycle length of 110 seconds

Intersection capacity analyses were performed using the industry standard National Academy of Sciences Transportation Research Board's Highway Capacity Manual (HCM) methodology for all study intersections. Performance measures of effectiveness include level of service (LOS), volume-to-capacity (v/c) ratio, and average vehicle delay. Key performance measures are defined as follows:

Level of Service (LOS) is a qualitative measure describing vehicle traffic conditions of an intersection or any other transportation facility. At intersections, LOS is a letter designation that corresponds to a certain range of average vehicle delay caused by the traffic control device or conflicting traffic movements. The LOS range from 'A' to 'F', with 'A' indicating limited average delay for vehicles at an intersection and 'F' indicating significant delay. Table 2 shows each Level of Service and their corresponding delay values, as measured in seconds of wait time, for signalized and unsignalized intersections. LOS is typically calculated for peak commuting hours in the AM and PM. Different approaches to an intersection can have different wait times to clear it. The overall intersection LOS is a weighted average, by traffic volume, of each approach's delay.

Table 2: Intersection Level of Service Delay Ranges

Level of Service	Delay Range (sec)	
	Signalized intersections	Unsignalized intersections
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

Delay (Control delay) is the portion of delay attributed to traffic signal operation for signalized intersections. Control delay (overall delay) can be categorized into deceleration delay, stopped delay, and acceleration delay.

The *volume-to-capacity ratio (v/c ratio)* is the ratio of current flow rate to the capacity of the intersection. This ratio is often used to determine how sufficient capacity is on a given roadway. Generally speaking, a ratio of 1.0 indicates that the roadway is operating at capacity. A ratio of greater than 1.0 indicates that the facility is operating above capacity as the number of vehicles exceeds the roadway capacity.

Table 2 shows each Level of Service and their corresponding delay values for signalized and unsignalized intersections.

Synchro implements Highway Capacity Manual 2000 (HCM) methods of analysis to determine LOS. Table 3 summarizes the HCM analysis performed under existing traffic conditions.

The results of the static *existing conditions* capacity analysis indicate that all study intersections operate with overall intersection LOS of D or better during both the AM and PM peak hours. Additionally, all movements at study intersections operate with acceptable LOS except for the northbound left turn at Columbia Road and Old Annapolis Road during the PM peak hour. Detailed HCM reports are in Appendix C.

In addition to capacity analysis, queuing was assessed using SimTraffic, Synchro's companion software. Estimated queue 95th % queue lengths were based on the average of five 60-minute model runs in SimTraffic. Estimated queue lengths are shown in Table 4.

As shown in the table, all queues are contained within their respective storage bays except for the northbound left movements at Columbia Road and Old Annapolis Road during the PM peak hour. The excessive queuing for these movements is due to the insufficient capacity for the northbound left which spills out of the turn bay into the innermost through lane. Detailed queuing reports are in Appendix C.

Table 3: Existing Conditions Capacity Analysis Summary

Node	Intersection	Approach	Movement	Existing Conditions AM (PM)		
				Delay	LOS	V/C
1	Columbia Road & Old Anapolis Road	**Control Type**		**Signal**		
		Overall		**40.9 (44.3)**	**D (D)**	**0.75 (0.96)**
		Eastbound	left-through	20.8 (48.4)	C (D)	0.15 (0.42)
			right	49.2 (45.3)	D (D)	0.92 (0.12)
		Westbound	left	51.1 (56.6)	D (E)	0.39 (0.74)
			through-right	47.8 (44.4)	D (D)	0.08 (0.40)
		Northbound	left	**26.6 (81.0)**	**C (F)**	**0.41 (1.06)**
			through	32.2 (16.3)	C (B)	0.36 (0.44)
			right	28.9 (13.2)	C (B)	0.07 (0.14)
		Southbound	left	31.0 (27.4)	C (C)	0.05 (0.05)
			through-right	43.9 (43.2)	D (D)	0.70 (0.84)
2	Columbia Road & Dorsey Hall Road	**Control Type**		**Signal**		
		Overall		**14.5 (29.2)**	**B (C)**	**0.42 (0.49)**
		Eastbound	left-through-right	28.6 (52.8)	C (D)	0.14 (0.07)
		Westbound	left	29.3 (38.1)	C (D)	0.59 (0.58)
			left-through	30.5 (39.4)	C (D)	0.61 (0.62)
			right	22.7 (31.5)	C (C)	0.03 (0.13)
		Northbound	left	11.8 (21.2)	B (C)	0.01 (0.02)
			through	12.2 (27.4)	B (C)	0.09 (0.32)
			right	13.3 (31.7)	B (C)	0.21 (0.48)
		Southbound	left	6.4 (11.1)	A (B)	0.17 (0.19)
			through-right	7.7 (11.2)	A (B)	0.34 (0.16)
3	Columbia Road & Gray Rock Drive	**Control Type**		**Stop (T Int)**		
		Overall		**11.7 (19.4)**	**B (C)**	**0.11 (0.09)**
		Eastbound	left	11.7 (19.4)	B (C)	0.11 (0.09)
			right	10.8 (9.6)	B (A)	0.26 (0.12)
		Northbound	left	7.7 (8.2)	A (A)	0.04 (0.19)
			through	0.0 (0.0)	A (A)	0.10 (0.22)
		Southbound	through-right	0.0 (0.0)	A (A)	0.12 (0.10)

Table 4: Existing Conditions Queueing Analysis Summary

#	Cross-Street	Approach	Movement	Existing Conditions AM (PM)
1*	Old Annapolis Road	Eastbound	LT	325 (100)
			R	275 (100)
		Westbound	L	75 (225)
			TR	50 (175)
		Northbound	L	100 **(350)**
			T	200 **(1450)**
			R	100 (150)
		Southbound	L	25 (50)
			TR	200 (350)
2*	Dorsey Hall Road	Eastbound	LTR	50 (50)
		Westbound	L	50 (200)
			LT	100 (225)
			R	25 (50)
		Northbound	L	25 (50)
			T	75 (225)
			R	125 (125)
		Southbound	L	75 (75)
			TR	100 (75)
3	Gray Rock Drive	Eastbound	L	50 (50)
			R	0 (0)
		Northbound	L	50 (75)
			T	0 (0)
		Southbound	TR	0 (25)

*Signalized intersection

L-Left
T-Through
R-Right

2.5 On-street Parking

Columbia Road has shoulders available for on-street parking generally between Dorsey Hall Drive and Dorsey Hall Pool; shoulders north of Dorsey Hall Pool are narrower – 6' wide as opposed to 11' wide south of the Pool. Full-time parking is allowed in the shoulders along Columbia Road with the exception of the area generally between Willowgrove Drive and Gray Rock Drive, where curbside parking is restricted full time.

Observations of curbside parking showed extremely low parking utilization rates during typical evenings. Additional observations were conducted during the summer when the pool was open: 1) late afternoon on a weekday; and 2) during a Saturday morning swim meet – June 27 and June 29, 2019, respectively. On a weekday afternoon, only 3 cars were parked on-street, all directly in front of the pool. During a swim meet, however, on-street parking was heavily utilized along Columbia Road and on several of the local residential streets, as shown in Figure 9.

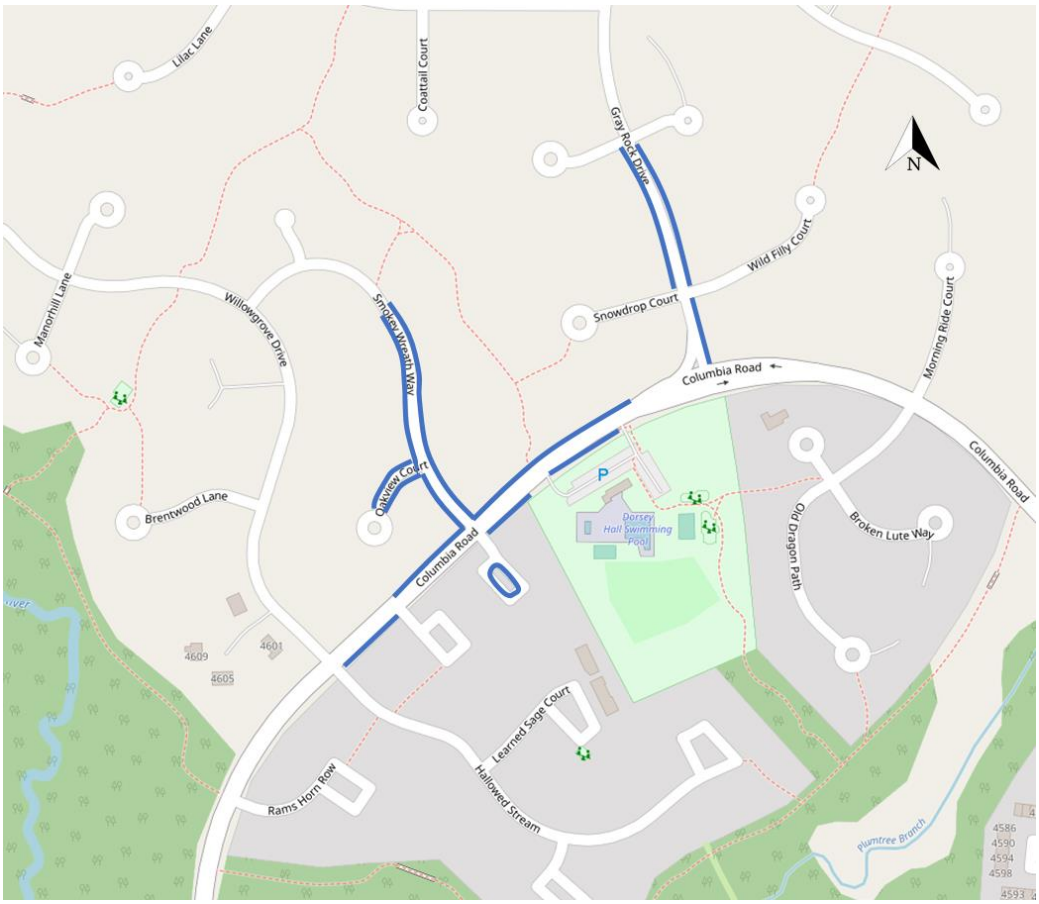

Figure 9: On-street parking occupancy during a Summer swim meet at Dorey Hall Pool

2.6 Community Feedback prior to Concept Development

A public meeting was conducted on December 10, 2018 to discuss the project goals and solicit feedback from the community on specific transportation-related needs. A summary of the comments received include:

- Discussion of a pending roundabout at Kingscup – constructed in 2019 *after* this existing conditions meeting.
- Concerns about changing the roadway; speeding was not widespread.
- There is a feeling that the traffic signals are not coordinated along Columbia Road.
- Desire to connect the shopping center to the Woodland Nature Path.
- Visibility for cyclists is poor at Columbia/Old Annapolis
  - Consider a diagonal dedicated pedestrian/bike-only crossing phase.
- The speed feels too fast around Willowgrove, where kids are dropped off and picked up.
- There is heavy congestion in the peak hours at:
  - The weaving area along westbound MD 108 with the US 29 SB off-ramp, heading toward Columbia Road.
  - Columbia Road north and south of: MD 108, Old Annapolis, and Dorsey Hall.

Figure 8: Existing Conditions Meeting

3 Road Diet Alternative

A road diet involves reducing the number of general travel lanes along a roadway segment through the use of re-striping – often when it gets re-surfaced. Common road diets involve reducing a four-lane roadway to a three-lane roadway, with the remaining space repurposed for parking or bike lanes. Road diets provide traffic calming on streets that have extra vehicle capacity. This extra capacity often results in aggressive driving and speeding. Road diets can also reduce the crossing distance for pedestrians and provide opportunity for midblock pedestrian refuge island that break up a crossing for added safety.

For more information, see https://safety.fhwa.dot.gov/road_diets/.

3.1 Alternatives Development and Preferred Option Design Elements

Based on the infrastructure needs and community responses, the following specific objectives were incorporated into the conceptual design:

- Increase pedestrian crossings across Columbia Road.
- Increase access to the Woodland Nature Path.
- Provide dedicated bike facilities – either marked on-road bike lanes or a wide side path.
- Maintain a minimal amount of curbside parking where needed.
- Calm traffic along select locations of Columbia Road.
- Develop short-term congestion mitigation for northbound Columbia Road traffic turning left onto Old Annapolis.

Three preliminary cross sections were discussed internally among Planning and Engineering Staff, shown in Figure 10:

A. Addition of a Columbia Road side path, while retaining existing lane/shoulder configurations.
B. Reconfiguring the lane striping to provide a traditional on-road bike lane one side of Columbia Road and a parking-protected bike lane on the other side. All shoulders would be eliminated.
C. Reconfiguring the lane striping to provide a two-way on-road bike lane one side of Columbia Road and a curbside parking on the other side. All shoulders would be eliminated.

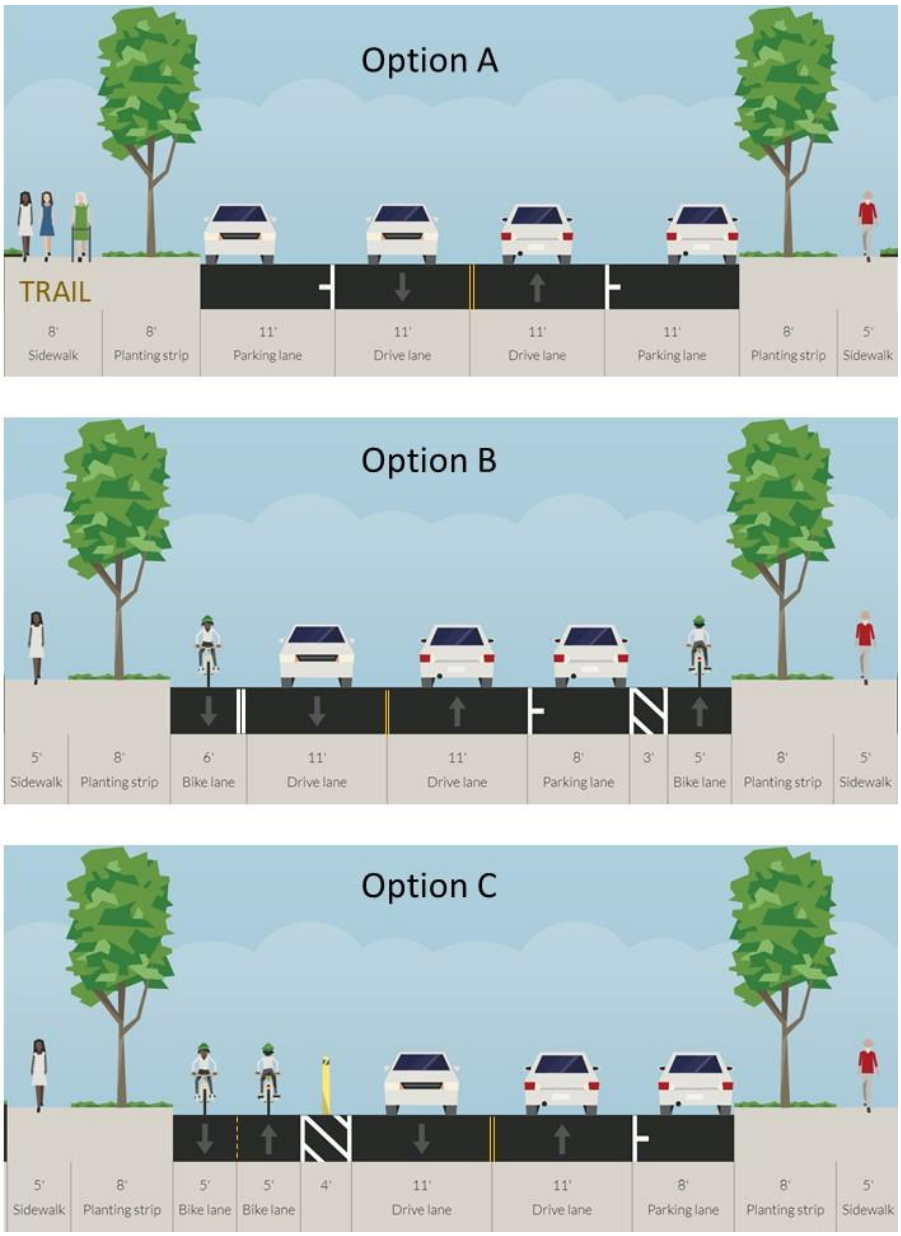

Figure 10: Three preliminary cross-sections considered for Complete Streets

Based on internal discussions between the County Department of Transportation and the Department of Public Works, a modified version of Option B was chosen as the typical cross section. This modified configuration removed the shoulder lane and associated curbside parking, and then replaced them with buffered bike lanes as shown in the following cross-section.

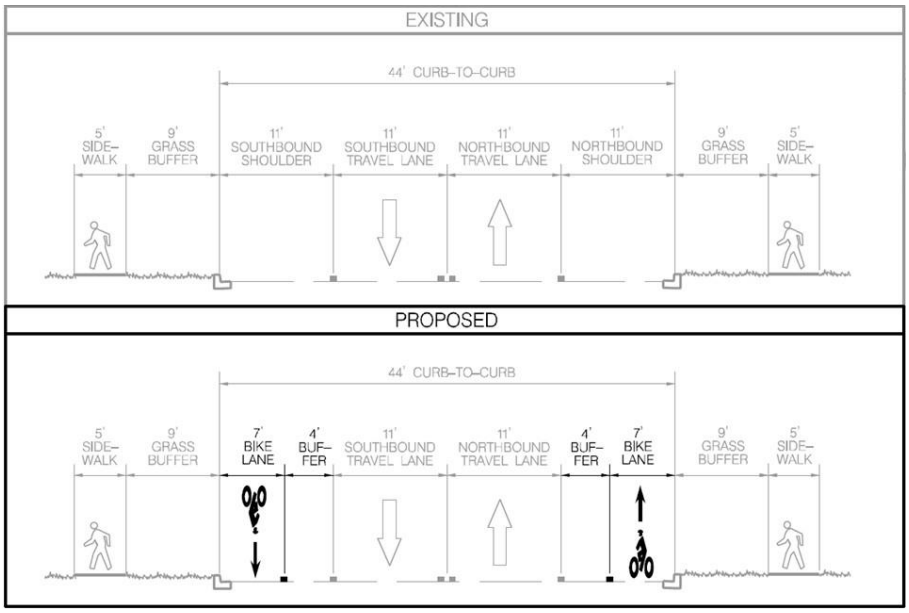

Figure 11: Proposed Typical Cross-section for Columbia Road

A conceptual plan (10% Design) was developed utilizing this cross section. These conceptual plans can be found in Appendix E. Additional design elements included in these conceptual plans include:

A. Signal phase changes to the intersection of Old Annapolis Road at Columbia Road, in order to reduce congestion for northbound left-turning vehicles in the PM peak period.
B. New crosswalk and widened pedestrian path from the entrance to the Woodland Nature Path to the intersection of Old Annapolis Road at Columbia Road.
C. New pedestrian crossings, with median refuge, at:
    a. Rams Horn Row
    b. Old Dragon Path
    c. Gray Rock Drive
D. Retention of about 12 parking spaces along the north side of Columbia Road at Rams Horn Row.
E. Retention of the traffic calming chokers along Columbia Road at the Dorsey Hall Pool, while maintaining bike lanes.

The following subsections of this report provide additional details and design assumptions

3.1.1 Congestion Mitigation at Old Annapolis Road

Heavy PM commuting-hour congestion currently exists along the northbound approach of Columbia Road at Old Annapolis Road. A field review of this congestion showed that the northbound left turn movement is over capacity, resulting in spillbacks out of the left turn bay and corresponding long queues on the inside northbound travel lane – occasionally, reaching as far back as MD 108.

An analysis was conducted to evaluate improvements that could alleviate this congestion during the PM peak hour. Improvements considered included:

- Removing east/west split phasing to reduce the cycle length and/or provide additional green time to the northbound left turn movement; and
- Dual-cycling the protected northbound left turn movement (e.g., creating both a leading *and* lagging protected phase within each signal cycle).

Split phasing occasionally creates a condition of inefficient use of green time when side street volumes are relatively low and pedestrian clearance intervals are long. Removing split phasing and running phases concurrently allows for both pedestrian clearances and vehicular phases from both approaches to be served simultaneously and can allow for under-utilized green time to be repurposed for other critical movements. Although preliminary analysis showed that side street split phase removal would be an effective tool to mitigate failing movements, geometric considerations indicated a potential sight distances concern between left turning vehicles and opposing through traffic. Therefore, split phasing removal for the eastbound and westbound approaches was not included in the analysis and is not recommended at Columbia Road and Old Annapolis Road.

Dual-cycling creates both a leading and lagging phase for the same movement within one cycle. While dual cycling generates additional lost time by serving yellow and all-red clearance intervals twice within a single cycle, it can result in a more efficient flow of vehicles as queues can re-establish themselves within the turn bay prior to each phase.

Dual-cycling and signal timing optimization were analyzed for the northbound left turn movement at Old Annapolis Road during the PM peak only. The capacity and queuing analyses comparing the build conditions to the build improved are summarized in Table 5 and Table 6, respectively. In both tables, “build” refers to the preferred street design without any signal changes, and “improved” refers to the preferred design *with* signal changes.

Table 5: Build Improved Capacity Analysis Summary

Node	Intersection	Approach	Movement	Build Conditions AM (PM)			Build Conditions Improved AM (PM)		
				Delay	LOS	V/C	Delay	LOS	V/C
1	Columbia Road & Old Anapolis Road	Control Type		Signal			Signal		
		Overall		**40.9 (44.1)**	**D (D)**	**0.75 (0.96)**	**40.9 (48.3)**	**D (D)**	**0.75 (0.99)**
		Eastbound	left-through	20.8 (48.4)	C (D)	0.15 (0.42)	20.8 (48.4)	C (D)	0.15 (0.42)
			right	49.2 (45.3)	D (D)	0.92 (0.12)	49.2 (45.3)	D (D)	0.92 (0.12)
		Westbound	left	51.1 (56.6)	D (E)	0.39 (0.74)	**51.1 (101.3)**	**D (F)**	**0.39 (0.96)**
			through-right	47.8 (44.4)	D (D)	0.08 (0.40)	47.8 (49.5)	D (D)	0.08 (0.52)
		Northbound	left	**26.6 (81.0)**	**C (F)**	**0.41 (1.06)**	26.6 (57.4)	C (E)	0.41 (0.99)
			through	32.2 (16.3)	C (B)	0.36 (0.44)	32.2 (14.2)	C (B)	0.36 (0.42)
			right	28.9 (13.2)	C (B)	0.07 (0.14)	28.9 (11.5)	C (B)	0.07 (0.14)
		Southbound	left	31.0 (27.2)	C (C)	0.05 (0.05)	31.0 (30.7)	C (C)	0.05 (0.06)
			through-right	43.9 (42.0)	D (D)	0.70 (0.84)	**43.9 (82.8)**	**D (F)**	**0.70 (1.04)**

Table 6: Build Improved 95% Queue Length (ft) Summary

#	Cross-Street	Approach	Movement	Build Conditions AM (PM)	Build Improved AM (PM)
1*	Old Annapolis Road	Eastbound	LT	535 (100)	535 (100)
			R	290 (100)	290 (100)
		Westbound	L	75 (200)	75 (250)
			TR	50 (150)	50 (150)
		Northbound	L	100 **(350)**	100 **(350)**
			T	200 **(1450)**	200 (1100)
			R	100 (100)	100 (100)
		Southbound	L	40 (50)	40 (50)
			TR	225 (400)	225 (400)

Static HCM results indicate that the dual cycling and signal timing optimization are able to improve operations for the critical northbound left turn movement to just under failing conditions, while the westbound left and southbound through/right degrade to failing levels. However, the dynamic simulation results reveal that although the northbound left turn is projected to spill out of its turn bay, the resulting 95% queuing in the innermost through lane is reduced by approximately 25% and no significant increases are projected for the failing westbound left or southbound through movements.

To remove the "yellow trap," created by dual-cycling, for southbound left-turning vehicles, the southbound left turn movement would have to be changed from protected/permissive, to protected only – concurrent with the northbound left's leading protected phase. This southbound left turn movement has very low volume and is expected to clear the turn bay every cycle. The existing and propose PM signal phasing is shown in Figure 12.

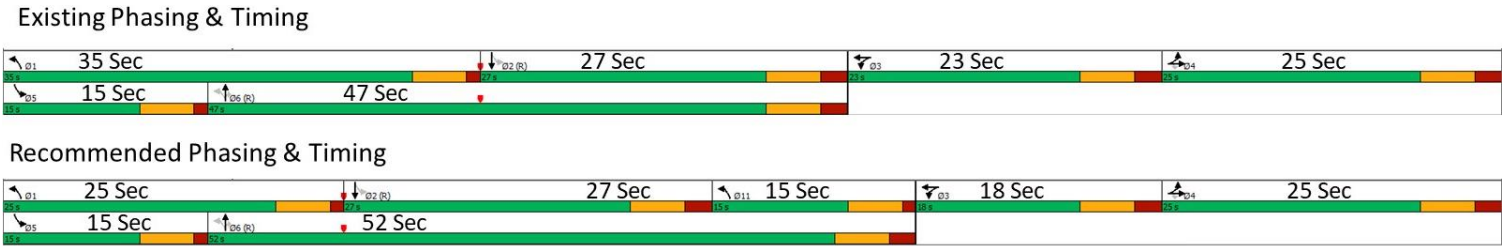

Figure 12: Existing and Recommended PM peak period signal timing

3.1.2 Woodland Nature Path Access Improvements

Comments during the initial public meeting indicated a desire for more direct and accessible connection to the Woodland Nature Path, which connects with Centennial Lake's trail system. To provide a more direct connection to the path, a new crosswalk and pedestrian signal heads were proposed for the west leg of the intersection, as shown in Figure 13. This crosswalk's WALK phase would run concurrently with the southbound permitted through/right movement.

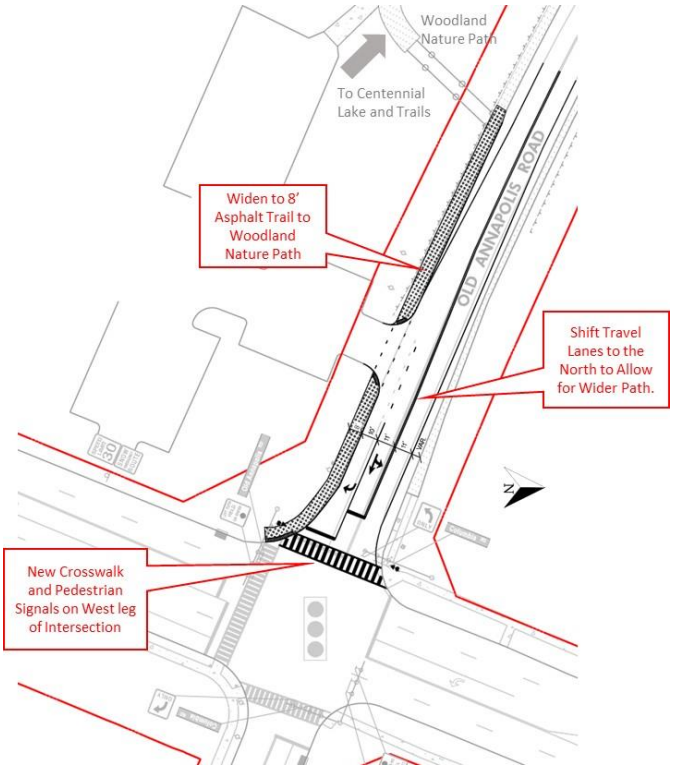

Figure 13: Proposed improvements to increase access to Woodland Nature Path and the Centennial Lake trail network

To improve connectivity and usability for both cyclists and walkers, the existing asphalt sidewalk is proposed to be widened from 4 feet to 8 feet. To accommodate this, the exiting asphalt curb and lane markings on the west leg are to be shifted northward, reducing the width of the westbound shoulder by approximately 4 feet, as shown in Figure 13.

3.1.3 Parking Space Retention at Rams Horn Row

Initial proposed lane configurations replaced the 11' wide outside shoulder/parking lane with a buffered bike lane. However, during presentation of this lane configuration at a public meeting, there were requests for some ancillary curbside parking near Rams Horn Row to serve the existing trail system and guests of the adjacent townhome community. Accordingly, the typical section was modified for a short segment near Rams Horn Row to include curbside parking on one side and unbuffered bike lanes, as shown in Figure 14. As Figure 14 shows, in addition to the new parking, this segment of Columbia Road has a new crossing, protected with a median refuge. This new crossing connects the two offset existing trails in the area and provides a centralized marked crossing between Dorsey Hall Pool and Dorsey Hall Drive.

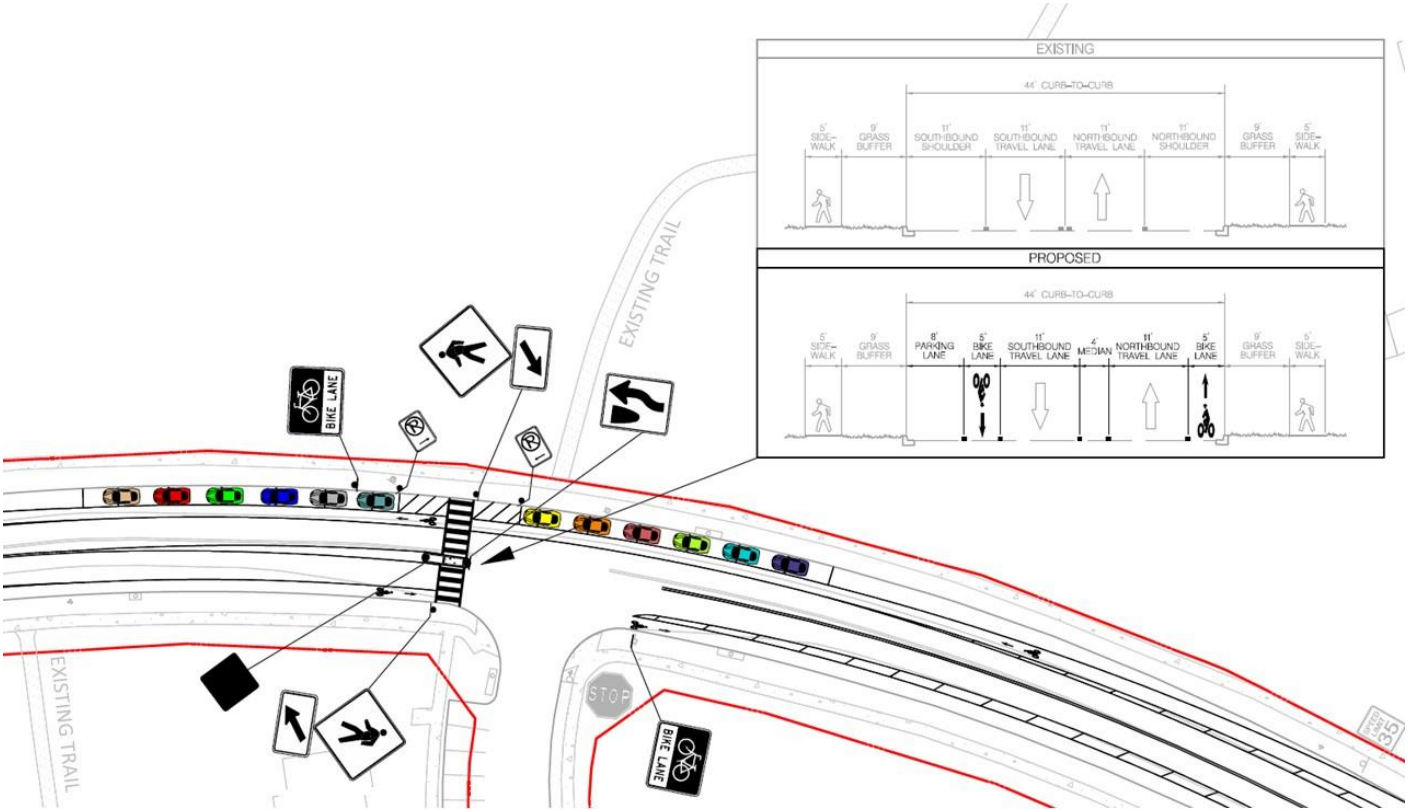

Figure 14: Curbside parking provided near Rams Horn Row

3.1.4 Additional Pedestrian Crossings and Refuge Medians

In addition to the new pedestrian crossing at Rams Horn Row, two new pedestrian crossings were proposed for this corridor:

- at Gray Rock Drive; and
- at Old Dragon Path.

As shown in Figure 15, the large center median was pulled back along Columbia Road on the east side of its intersection with Gray Rock Drive to provide a direct pedestrian crossing. The existing lane use remains the same, including the westbound right turn which can legally be made from the buffered bike lane. Additionally, green paint was proposed to highlight the westbound bike lane where it is unbuffered from vehicle traffic and also where it crosses a channelized right turn.

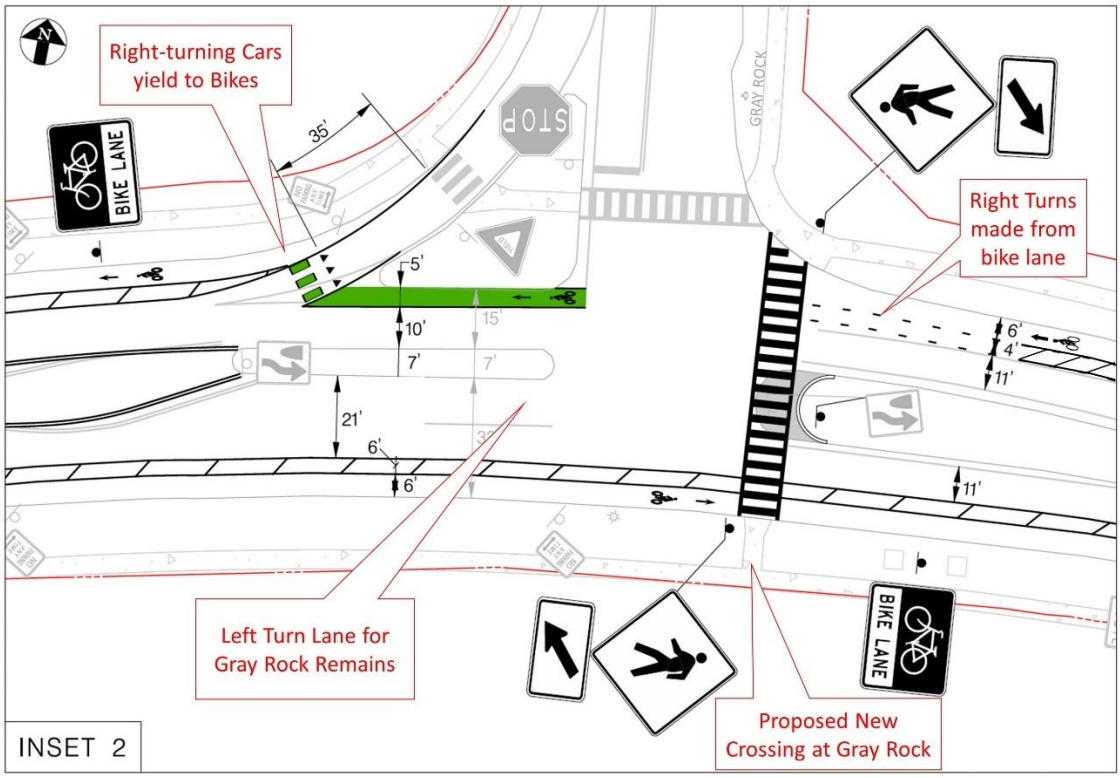

Figure 15: New Crossing and Green Bike Lane at Gray Rock

The last additional crossing proposed was at Old Dragon Path, where a pedestrian refuge and marking crosswalk is shown in Figure 16. A five-foot-wide median refuge is proposed to break up the crossing; this allows for a 10-foot general purpose lane and 5-foot bike lane in each travel direction. Both sides of the crossing will need upgrades pedestrian ramps to comply with the Americans with Disabilities Act (ADA).

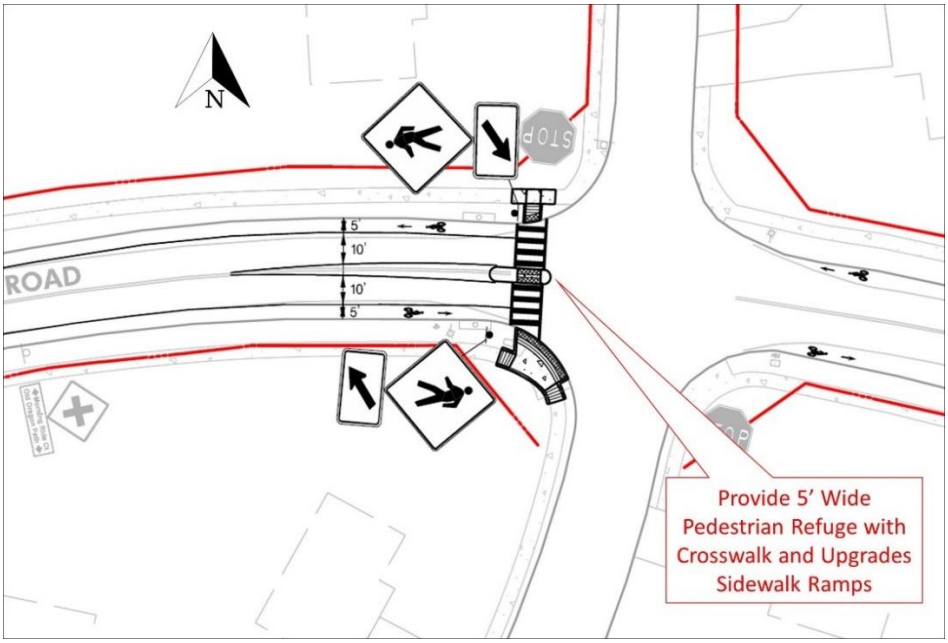

Figure 16: Proposed Pedestrian Refuge and Marked Crossing at Old Dragon Path

3.1.5 Bike Lane Design through Chokers at Dorsey Hall Pool

While Columbia Road is typically 4 lanes wide, there is a location near Dorsey Hall Pool where curb bump outs narrow, the pavement width down to two travel lanes. These bump outs calm traffic in front of the pool and allow for shorter pedestrian exposure time in the roadway when crossing Columbia Road. Retaining these traffic calming elements is an important element of the Complete Streets Design.

In order to retain traffic calming at this location, initial concepts were developed that would require bike lanes to traverse them at sidewalk grade. On the south side of Columbia Road, this was achieved using a bike ramp and curb cut, west of the existing inlet, and widening the sidewalk across the bump out (see Figure 17). On the north side of Columbia Road, ramping up across the bump out was dismissed due to its impact on existing gas line easements. Accordingly, on the north side, the bump out was pulled back 5 feet to allow for an unbuffered bike lane. The existing light pole remains where it is currently located, but the crossing warning signage is relocated (see Figure 17).

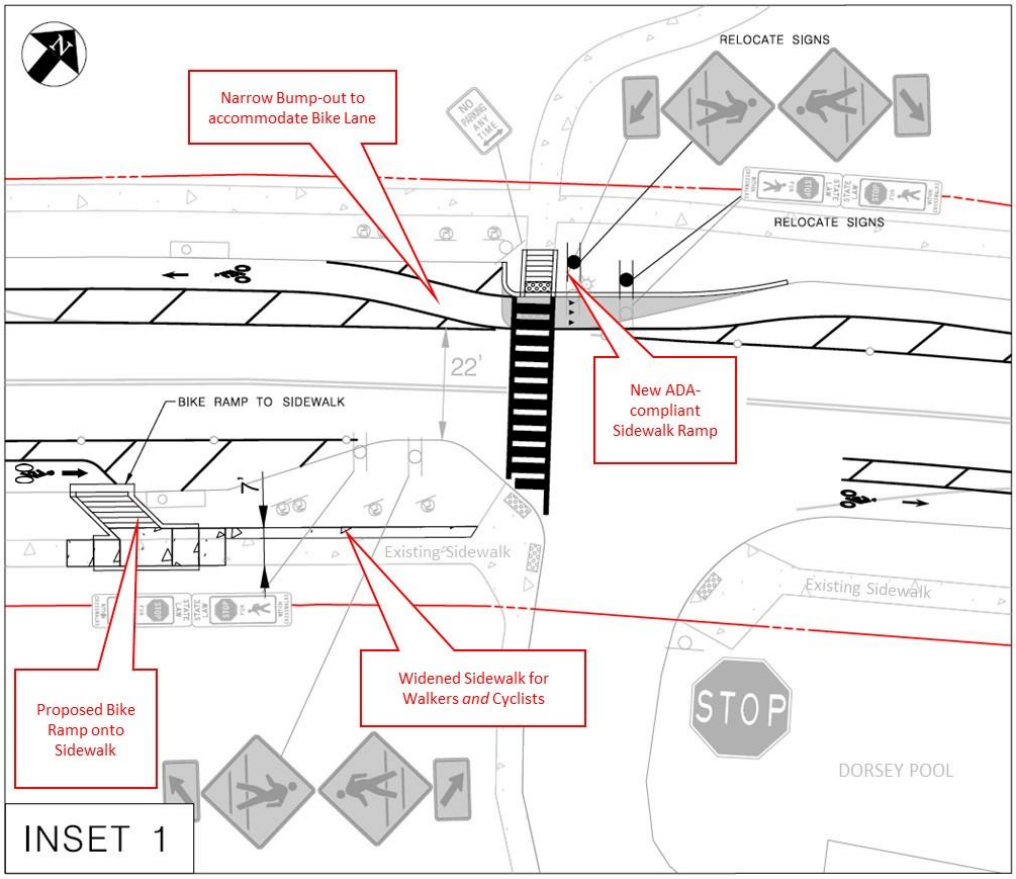

Figure 17: How Bike lanes will progress through Chokers at Dorey Hall Pool

3.2 Traffic Analysis of Preferred Option

Road Diet Analysis

To perform a capacity analysis of the proposed road diet conditions, the existing AM and PM peak Synchro models were update with the proposed geometry and lane configurations to reflect the road diet alternative. No changes to signal timing, signal phasing, or turning movement volumes were assumed under this baseline "build" condition. Table 7 compares the HCM analysis performed under existing traffic conditions to the build conditions.

The results of the static capacity analysis reveal that only marginal differences in delay and capacity are anticipated under the proposed build conditions. These results are to be expected as no lane configuration changes are proposed at the Columbia Road intersections with Old Annapolis Road and Gray Rock Drive. A northbound through lane is proposed to be removed at Dorsey Hall Road under build conditions; however, this movement is well under capacity under existing conditions, and will continue to operate as such under the build condition, so no major increases in delay are projected. Detailed HCM reports of the Build Condition are provided in Appendix D. Note, that this Build Condition does not reflect the recommended phasing change at Columbia Road at Old Annapolis Road, as previously discussed.

Table 7: Build Condition Capacity Analysis Summary

Node	Intersection	Approach	Movement	Existing Conditions AM (PM)			Build Conditions AM (PM)		
				Delay	LOS	V/C	Delay	LOS	V/C
1	Columbia Road & Old Anapolis Road	**Control Type**		**Signal**			**Signal**		
		Overall		**40.9 (44.3)**	**D (D)**	**0.75 (0.96)**	**40.9 (44.1)**	**D (D)**	**0.75 (0.96)**
		Eastbound	left-through	20.8 (48.4)	C (D)	0.15 (0.42)	20.8 (48.4)	C (D)	0.15 (0.42)
			right	49.2 (45.3)	D (D)	0.92 (0.12)	49.2 (45.3)	D (D)	0.92 (0.12)
		Westbound	left	51.1 (56.6)	D (E)	0.39 (0.74)	51.1 (56.6)	D (E)	0.39 (0.74)
			through-right	47.8 (44.4)	D (D)	0.08 (0.40)	47.8 (44.4)	D (D)	0.08 (0.40)
		Northbound	left	**26.6 (81.0)**	**C (F)**	**0.41 (1.06)**	**26.6 (81.0)**	**C (F)**	**0.41 (1.06)**
			through	32.2 (16.3)	C (B)	0.36 (0.44)	32.2 (16.3)	C (B)	0.36 (0.44)
			right	28.9 (13.2)	C (B)	0.07 (0.14)	28.9 (13.2)	C (B)	0.07 (0.14)
		Southbound	left	31.0 (27.4)	C (C)	0.05 (0.05)	31.0 (27.2)	C (C)	0.05 (0.05)
			through-right	43.9 (43.2)	D (D)	0.70 (0.84)	43.9 (42.0)	D (D)	0.70 (0.84)
2	Columbia Road & Dorsey Hall Road	**Control Type**		**Signal**			**Signal**		
		Overall		**14.5 (29.2)**	**B (C)**	**0.42 (0.49)**	**14.6 (31.9)**	**B (C)**	**0.42 (0.57)**
		Eastbound	left-through-right	28.6 (52.8)	C (D)	0.14 (0.07)	29.1 (52.8)	C (D)	0.15 (0.07)
		Westbound	left	29.3 (38.1)	C (D)	0.59 (0.58)	29.8 (38.1)	C (D)	0.59 (0.58)
			left-through	30.5 (39.4)	C (D)	0.61 (0.62)	30.8 (39.4)	C (D)	0.61 (0.62)
			right	22.7 (31.5)	C (C)	0.03 (0.13)	23.0 (31.5)	C (C)	0.03 (0.13)
		Northbound	left	11.8 (21.2)	B (C)	0.01 (0.02)	11.8 (21.4)	B (C)	0.01 (0.02)
			through	12.2 (27.4)	B (C)	0.09 (0.32)	12.9 (35.6)	B (D)	0.18 (0.60)
			right	13.3 (31.7)	B (C)	0.21 (0.48)	13.3 (32.3)	B (C)	0.21 (0.48)
		Southbound	left	6.4 (11.1)	A (B)	0.17 (0.19)	6.3 (13.7)	A (B)	0.17 (0.24)
			through-right	7.7 (11.2)	A (B)	0.34 (0.16)	7.7 (11.2)	A (B)	0.34 (0.16)
3	Columbia Road & Gray Rock Drive	**Control Type**		**Stop (T Int)**			**Stop (T Int)**		
		Overall		**11.7 (19.4)**	**B (C)**	**0.11 (0.09)**	**11.7 (19.4)**	**B (C)**	**0.11 (0.09)**
		Eastbound	left	11.7 (19.4)	B (C)	0.11 (0.09)	11.7 (19.4)	B (C)	0.11 (0.09)
			right	10.8 (9.6)	B (A)	0.26 (0.12)	10.8 (9.6)	B (A)	0.26 (0.12)
		Northbound	left	7.7 (8.2)	A (A)	0.04 (0.19)	7.7 (8.2)	A (A)	0.04 (0.19)
			through	0.0 (0.0)	A (A)	0.10 (0.22)	0.0 (0.0)	A (A)	0.10 (0.22)
		Southbound	through-right	0.0 (0.0)	A (A)	0.12 (0.10)	0.0 (0.0)	A (A)	0.12 (0.10)

Table 8 compares the existing and build condition queuing analysis results. The results of the queuing analysis indicate no major changes in queue length under the proposed road diet conditions. Detailed queuing reports for the Build Condition are in Appendix D.

Table 8: Build Condition Queuing Summary

#	Cross-Street	Approach	Movement	Existing Conditions AM (PM)	Build Conditions AM (PM)
1*	Old Annapolis Road	Eastbound	LT	325 (100)	535 (100)
			R	275 (100)	290 (100)
		Westbound	L	75 (225)	75 (200)
			TR	50 (175)	50 (150)
		Northbound	L	100 **(350)**	100 **(350)**
			T	200 **(1450)**	200 **(1450)**
			R	100 (150)	100 (100)
		Southbound	L	25 (50)	40 (50)
			TR	200 (350)	225 (400)
2*	Dorsey Hall Road	Eastbound	LTR	50 (50)	50 (50)
		Westbound	L	50 (200)	50 (225)
			LT	100 (225)	100 (250)
			R	25 (50)	25 (50)
		Northbound	L	25 (50)	25 (25)
			T	75 (225)	75 (275)
			R	125 (125)	125 (200)
		Southbound	L	75 (75)	50 (75)
			TR	100 (75)	100 (75)
3	Gray Rock Drive	Eastbound	L	50 (50)	50 (50)
			R	0 (0)	0 (0)
		Northbound	L	50 (75)	50 (75)
			T	0 (0)	0 (0)
		Southbound	TR	0 (25)	0 (25)

3.3 Community Feedback

Proposed plans and details were presented to the community at a September 25, 2019 Public Meeting. Comments received during Proposed Conditions Meeting were generally positive toward the plans, except for the desire to retain some on-street parking near the intersection of Rams Horn Row at Columbia Rd to allow parking for trail users and overflow from the adjacent townhouse community.

4 Summary of Findings and Recommendations for Final Design

Based on the County's Complete Streets Policy, along with input from residents, a conceptual plan of improvements was developed for Columbia Road corridor in the Dorsey's Search neighborhood. Highlights of the Conceptual Plan – to be incorporated into Final design are summarized below:

- Conceptual Plans would not generally alter the curb-to-curb width.
- The preferred design has a typical section where existing general-purpose travel lanes remain the same and 11-foot shoulders are restriped for 7 foot wide bike lanes and 4 foot wide hatched shoulders.
    - Where the cross-section only provides 6-foot shoulders, these shoulders should be marked as unbuffered bike lanes.
    - About 12 curbside parking spaces were to remain in a shoulder near Rams Horn Row.
- Congestion for northbound left turn movements at Columbia Road and Old Annapolis Road can be reduced by incorporating a leading and lagging protected phase.
- To address connectivity to the Woodland Nature Path, the existing 4-foot asphalt sidewalk along the south side of Old Annapolis Road is proposed to be expanded to 8 feet wide. Additionally, a new crosswalk and pedestrian signal is proposed for the west leg of Columbia Road at Old Annapolis Road.
- Three new pedestrian crossings and median refuges are proposed at: Rams Horn Row, Gray Rock Drive, and Old Dragon Path.