Churchmans Road Trail Study

Delaware Department of Transportation

October 2013

CONCEPT DESIGN REPORT

WHITMAN, REQUARDT & ASSOCIATES, LLP
ENGINEERS · ARCHITECTS · PLANNERS
EST. 1915

Location Map

Concept Report

Concept Plan

Public Involvement

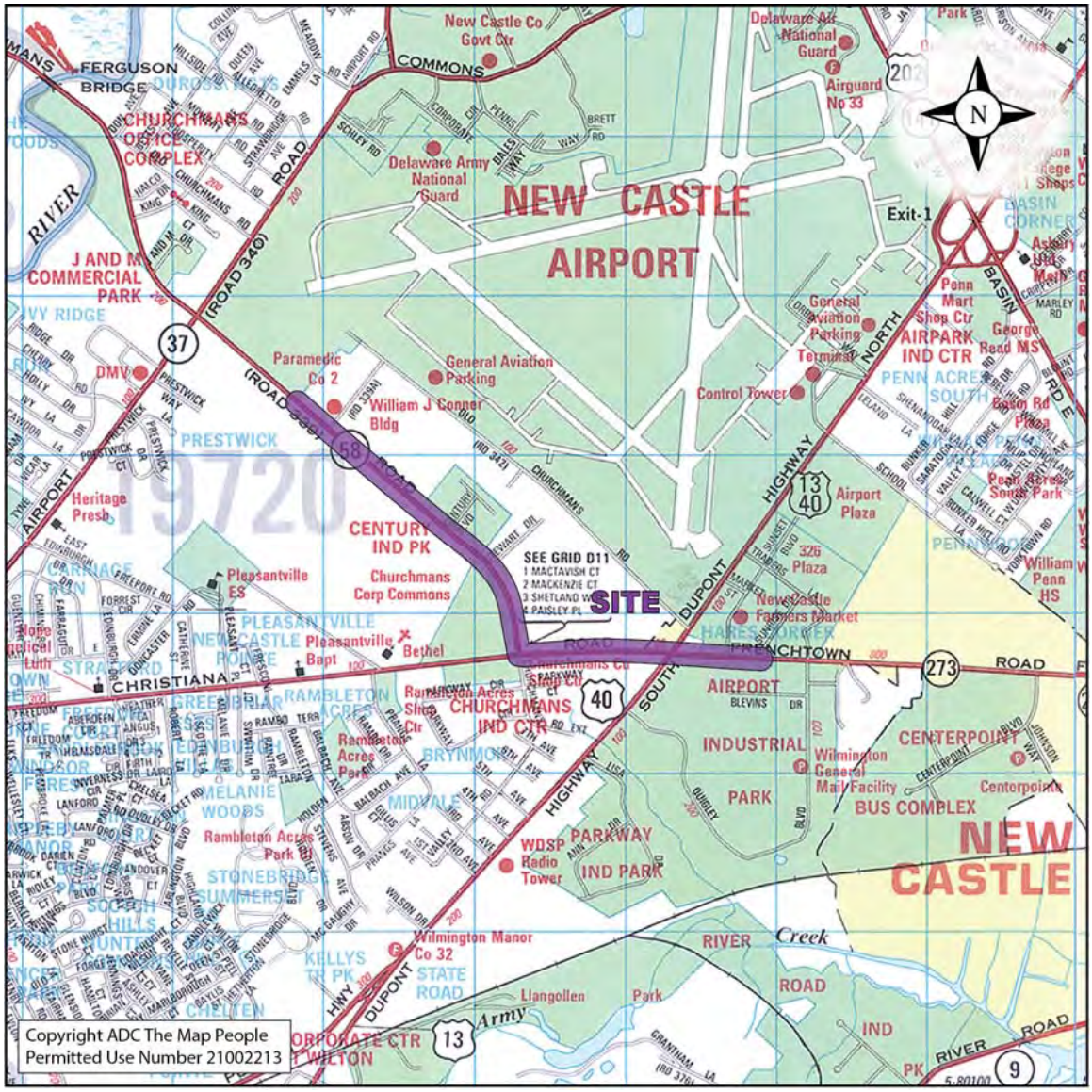
Photo Log

CTP Estimate

Appendix A: Wetland Summary

Appendix B: Traffic Analysis

Tab 1



Location Map

Churchmans Road Trail Study

Not to Scale

Tab 2

CHURCHMANS ROAD TRAIL STUDY
CONCEPT REPORT

WHITMAN, REQUARDT & ASSOCIATES, LLP
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Project Description and Purpose

The First State Trail and Pathway Initiative aims to "establish a world class interconnected network of shared use pathways and trails that will support non-motorized travel and recreational trails opportunities within the State of Delaware for Delawareans and visitors alike."

The Delaware Department of Transportation (DelDOT) has identified the need to close a trail gap just west of the City of New Castle. To the west, an existing trail is found along the north side of Churchmans Road, extending about 1,600 feet east of Airport Road to the limit of a recent DelDOT intersection improvement project. To the east, DelDOT and the Delaware Department of Natural Resources and Environmental Control (DNREC) propose a trail along Frenchtown Road and Delaware Street between Old New Castle and the New Castle Farmers Market.

Existing Conditions

This project includes the following roadways:

- Churchmans Road, from 1,600' east of Airport Road to SR 273
- SR 273, from Churchmans Road to 1,000' east of US 13

Within the project limits, Churchmans Road is primarily an open section, two-lane road with 12-foot travel lanes and 10-foot paved shoulders. Approaching the intersection at SR 273, Churchmans Road has a closed section and lighting is provided. The surrounding development is primarily commercial/industrial and there are no sidewalks along Churchmans Road except for the immediate area surrounding the intersection at SR 273. There is no existing fixed route transit service along this segment of Churchmans Road. Turn lanes and bypass lanes are present throughout the project limits to provide access to adjacent businesses. The signalized intersection at Churchmans Road and SR 273 includes signalized pedestrian crossings of the north, south, and west legs. This section of Churchmans Road is a connector bicycle route and part of the East Coast Greenway.

Within the project limits SR 273 is a closed section, four-lane, divided roadway with 12-foot travel lanes and 10-foot paved shoulders. There are concrete sidewalks along both sides of SR 273 along with multiple access points to commercial development. The signalized intersection at SR 273 and US 13 includes signalized pedestrian crossings of the south, east, and west legs. This segment of SR 273 is served by DART bus route 22. SR 273 is a regional bicycle route and, east of the Churchmans Road intersection, is part of the East Coast Greenway.

Project Need

This trail will provide a connection for pedestrians and bicyclists along recently and soon to be constructed trail alignments throughout New Castle County, including the New Castle Industrial Track Trail that will connect the cities of New Castle and Wilmington.

Proposed Improvements

This study evaluated two alternatives to connect the two existing trails: one east of US 13 and the other east of Airport Road. Both alternatives would begin at the existing trail along the north side of Churchmans Road, east of Airport Road, and continue east to the intersection of Churchmans Road at SR

273. The trail would continue east along the north side of SR 273 to the intersection of SR 273 at US 13, at which point the two alternatives diverge. Alternative 1 would cross along the north leg of US 13 at SR 273 and continue east along the north side of SR 273 to connect to the proposed Frenchtown Road trail at the New Castle Farmers Market. Alternative 2 would continue north along the west side of US 13, cross US 13 at the intersection of School Lane, and continue east along School Lane. The trail would continue along the old alignment of School Lane, between William Penn High School and Penn Farm, tying into the proposed Frenchtown Road trail approximately a quarter of a mile east of Centerpoint Boulevard.

After the study began, the New Castle County Airport replaced the chain link fence surrounding their property, including the area along the west side of US 13. The existing width between the edge of pavement along US 13 and the recently installed fence is limited to approximately ten feet. The fence can't be moved due to air field restrictions; therefore, to construct a 10-foot wide trail would require removal of a portion of the existing 14-foot paved shoulder and barrier installation to protect trail users. Due to the high volume and speed of traffic along US 13, there is concern that constructing a trail so close to the roadway could present safety issues for drivers and trail users. Alternative 1 is the recommended alignment because of this safety concern and the additional 1.5 miles of trail construction associated with Alternative 2.

The proposed improvements associated with Alternative 1 and shown in the concept plan are summarized as follows. Some of these improvements are within the boundaries of the proposed New Castle Town Center development at the corner of Churchmans Road and SR 273. DelDOT is working with the developer to ensure that as much of the trail is built by the developer as possible and that it complies with appropriate design guidelines.

Churchmans Road:

- Construct a ten-foot asphalt shared use path along the north side of Churchmans Road with a typical five-foot grass buffer. A closed section with the installation of concrete curb is recommended to help reduce right-of-way impacts.
- Install crosswalks at Old Churchmans Road and Century Boulevard.
- Construct a bridge to minimize potential wetland impacts approximately 500 feet east of Century Boulevard.
- Install ADA accessible crossings at all business entrances where the proposed trail crosses.
- Construct a new storm drainage system to convey roadway and trail runoff.
- Adjust or relocate existing utilities within the limits of the proposed trail as needed. An initial field view identified several utility features that will obstruct the trail. The trail alignment will be shifted as much as possible to avoid utility and tree impacts.

SR 273:

- Construct a ten-foot asphalt shared use path along the north side of SR 273 from Churchmans Road to approximately 1,200 feet east of US 13 with a typical five-foot grass buffer.
- Remove the existing concrete sidewalk. However, it is assumed the existing concrete curb and storm drainage system will remain.
- Relocate the existing overhead sign pole located approximately 370 feet west of the US 13 intersection.

- Reduce the grass buffer to three feet and maintain a ten-foot shared use path along the frontage of Burger King to minimize impacts to the existing parking lot and drive through. Construction of the trail will require the removal of one parking space, reconstruction of a portion of the drive through curb line, and relocation of a drainage inlet along the existing drive through curb line. Reconstruct the Burger King access along SR 273 to meet ADA requirements.
- Remove the existing concrete sidewalk and install a ten-foot shared use path with three-foot grass buffer along the frontage of Verizon Wireless and Gambacorta Pre-Owned along the north side of SR 273, and reconstruct the driveways to meet ADA requirements.
- Adjust or relocate existing utilities within the limits of the proposed trail as needed. It is assumed that several existing light and utility poles along the north side of SR 273 will need to be relocated.
- All curb ramps within the project limits will be reconstructed to comply with current ADA standards and DelDOT construction details.

US 13 at SR 273:

- Install a crosswalk and signalized pedestrian crossing on the north leg of US 13 at SR 273. Signal timing adjustments will be made as needed.
- Modify the three existing concrete channelizing islands on the north leg of US 13 at SR 273 to provide ADA accessibility.
- Relocate an existing light pole in the concrete island between the southbound US 13 through and left-turn lanes. This pole is owned by the Delaware River and Bay Authority and holds runway approach lighting for the New Castle County Airport.

Traffic

Weekday peak hour turning movement traffic count data was used to analyze traffic operations using Synchro at three signalized intersections within the project limits:

- SR 273 at Churchmans Road (count data from January 2011)
- US 13 at SR 273 (count data from January 2011)
- US 13 at School Lane (count data from November 2012)

The Synchro analyses demonstrated the following:

Intersection	AM Peak Hour LOS (avg delay)	PM Peak Hour LOS (avg delay)
SR 273 at Churchmans Road	C (27.4 sec)	D (50.3 sec)
US 13 at SR 273	F (150.6 sec)	F (129.5 sec)
US 13 at School Lane	B (17.0 sec)	C (30.4 sec)

It is anticipated that the trail construction will not affect signal operations at SR 273 and Churchmans Road. The existing signal operates acceptably and the pedestrian signals provide adequate time for each crossing.

The proposed trail crossing will require some modifications to the signal operations at US 13 and SR 273. Based on field observations, crossing US 13 using the existing pedestrian signals at the west, south, and east leg will result in a travel time that ranges from about 5 minutes to 8.5 minutes. To help reduce this delay, a new pedestrian crossing of the north leg of US 13 is recommended with the trail improvements.

It is anticipated that an actuated pedestrian crossing will have little effect on traffic operations and will provide a much shorter crossing for trail users. Refer to Appendix B for additional details regarding traffic analysis.

Safety

A total of 348 crashes were reported within the study area during the three-year study period between November 2009 and November 2012. A total of 31 crashes were reported along Churchmans Road, 60 crashes were reported along SR 273, 242 crashes were reported along US 13, and 15 crashes were reported along School Lane. Among the reported crashes, three involved pedestrians, with one occurring along Churchmans Road and two along US 13. None of the three pedestrian related crashes involved a pedestrian using a marked crosswalk and they all occurred at night. One of the crashes along US 13 involved a pedestrian fatality that occurred on Sunday, March 7, 2010 at 11:51 PM along southbound US 13.

Natural Resources

On November 12, 2012, an initial site visit was conducted by WR&A environmental staff to identify environmental features that may require permitting as a result of potential trail impacts. During that site visit, two potential wetland areas were identified: one along the north side of Churchmans Road east of Century Boulevard, and a second location along the abandoned section of School Lane adjacent to the William Penn High School athletic fields.

The wetlands were delineated on April 9, 2013 and a follow-up site visit was conducted with DelDOT Environmental staff to review the delineation. The wetland along the north side of Churchmans Road is associated with both alignment alternatives. Although a Jurisdictional Determination has not been scheduled, it was suggested that a small bridge along the trail could minimize wetland impact and avoid the need for mitigation. It is likely that the second wetland along School Lane is not jurisdictional, but it will not be a factor with Alternative 1. Refer to Appendix A for additional details regarding the existing wetlands.

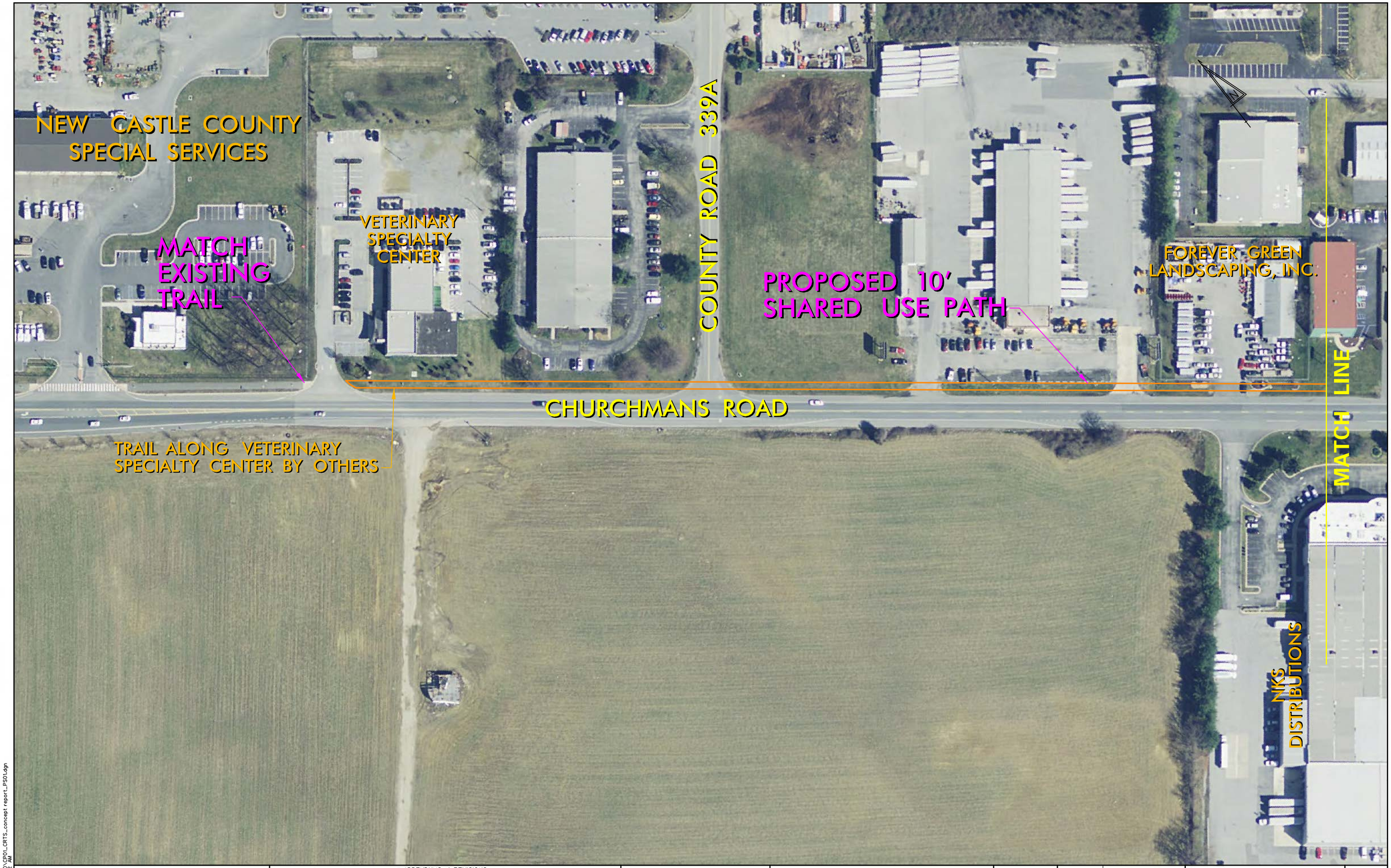
Cultural Resources

After an initial review by the Environmental Studies section of DelDOT, it was determined that there are no National Register historic properties in the project area. It also does not appear that any of the potentially affected properties are eligible for the National Register. Potential archaeology impacts are not known at this time. No cultural resources impacts are anticipated for this project.

Conclusion

It appears that no significant impacts to social, economic, and environmental resources will occur as a result of this project. A public workshop was held at William Penn High School on January 15, 2013 to present the Route 273 Multi-Use Trail Facility and Churchmans Road Trail Study. The project is supported by the community and will improve the safety and mobility for pedestrians and cyclists.

Tab 3



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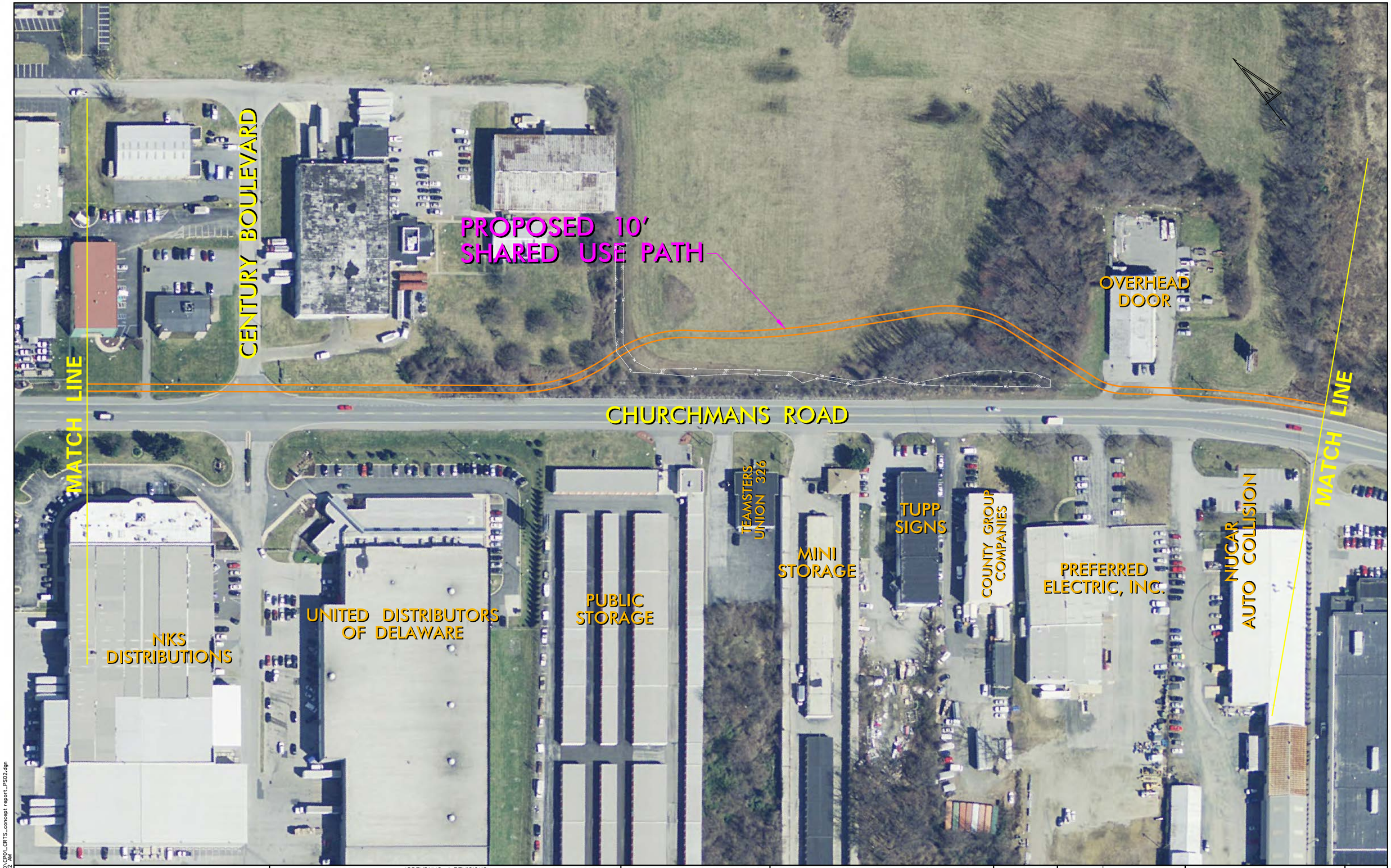
					CHECKED BY: WRA		



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DELAWARE
DEPARTMENT OF TRANSPORTATION

ADDENDUMS / REVISIONS	

SCALE
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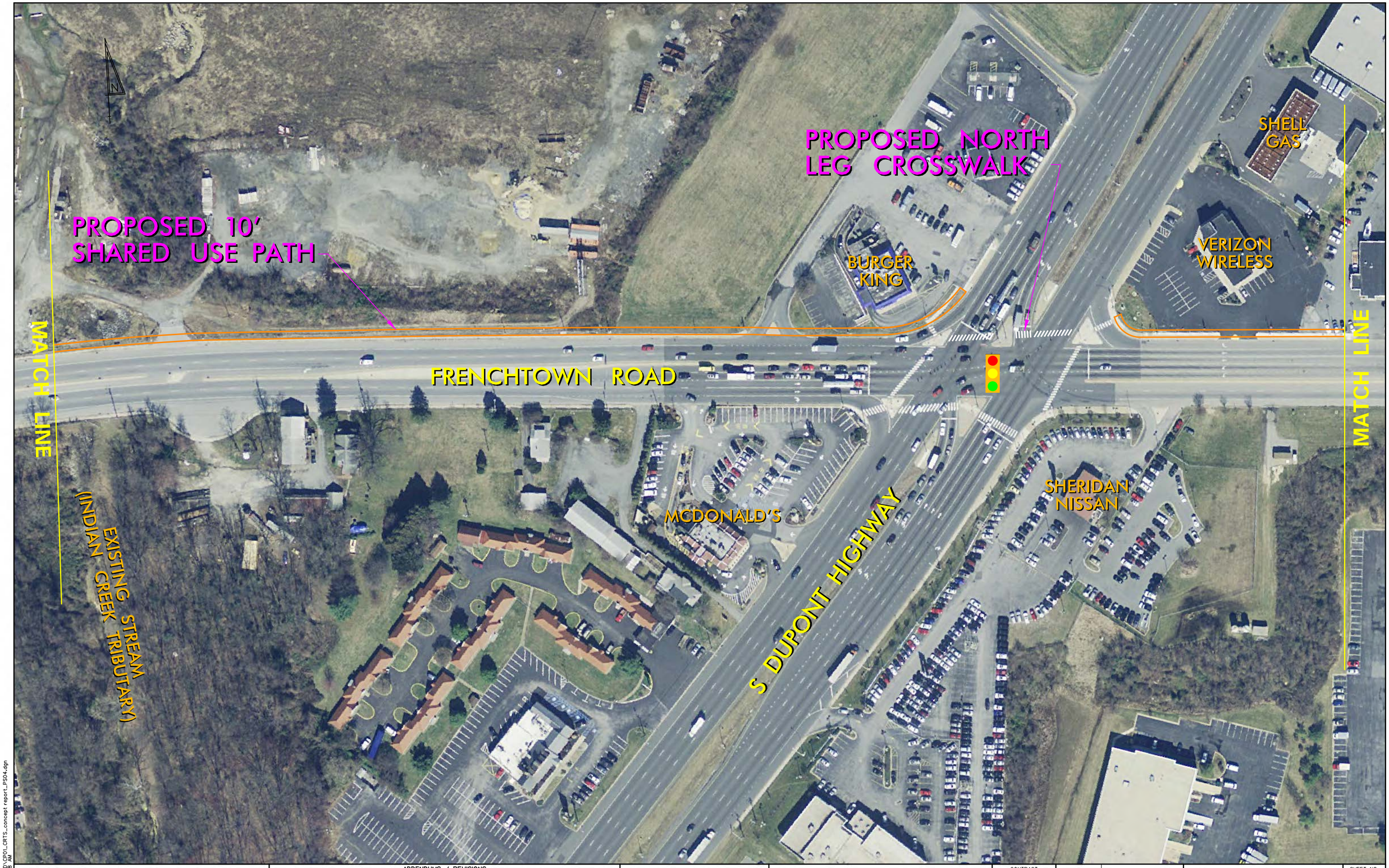
FEET

CHURCHMANS ROAD
TRAIL STUDY

CONTRACT	BRIDGE NO.	N/A
N/A	DESIGNED BY: WRA	
COUNTY		
NEW CASTLE	CHECKED BY: WRA	

CONCEPT PLAN

SHEET NO.
3
TOTAL SHTS.
5



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DELAWARE DEPARTMENT OF TRANSPORTATION

ADDENDUMS / REVISIONS

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FEET

CHURCHMANS ROAD TRAIL STUDY

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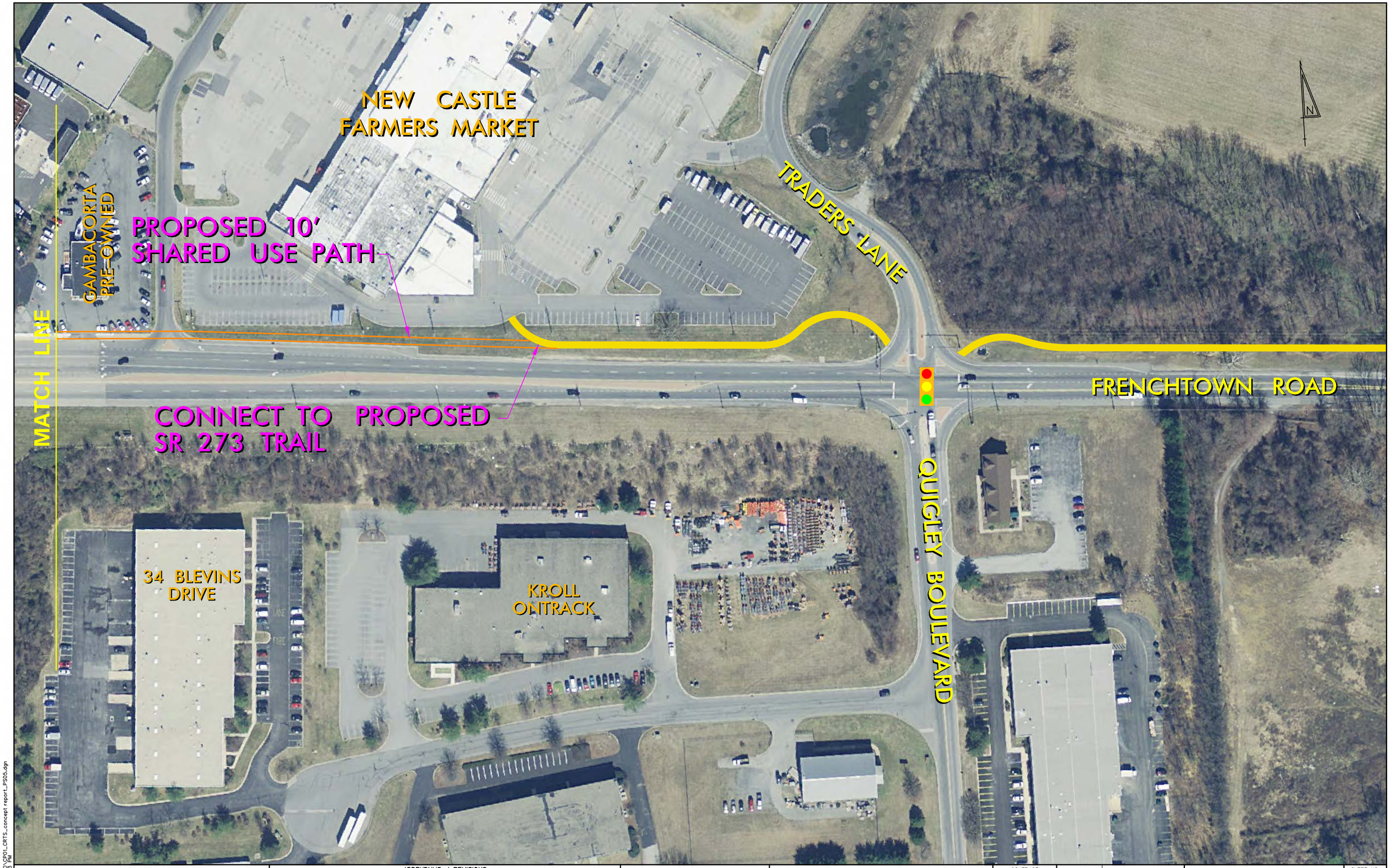
N/A	DESIGNED BY: WRA	
COUNTY		
NEW CASTLE	CHECKED BY: WRA	

CONCEPT PLAN

SHEET NO.
4
TOTAL SHTS.
5



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				COUNTY NEW CASTLE	DESIGNED BY: WRA		TOTAL SHTS. 5
					CHECKED BY: WRA		

Tab 4

Public Involvement

This project was initiated by DelDOT and the Delaware Department of Natural Resources and Environmental Control (DNREC). A public workshop was held at William Penn High School on Tuesday, January 15, 2013 for the Route 273 Multi-Use Trail Facility and the Churchmans Road Trail Study. The 27 attendees were presented with display plans that demonstrated existing conditions and proposed improvements for each project. DelDOT received 12 comment forms and one letter that was written in advance of the workshop. In general, the attendees supported both projects. Several attendees voiced concern about crossing US 13 and indicated that crossing at School Lane would be preferred over crossing at SR 273. This opinion was also reflected in the written public survey response forms, with two votes in support of Alternative #1 (crossing at US 13) and eight votes in support of Alternative #2 (crossing at School Lane).

Copies of the workshop summary and sign-in sheet are attached.

WR&A also met with representatives from New Castle County Airport, Senior Airport Manager Benjamin Clendaniel and Project Engineer Gregory Suchanoff, on January 8, 2013. Display plans of the two proposed alignments were presented to the attendees. Mr. Clendaniel informed WR&A that the airport owns and has future development plans for the undeveloped property containing wetlands along the north side of Churchmans Road to the west of Overhead Door. The proposed New Castle Towne Center parcel was sold to another developer in December 2012 and the Delaware River and Bay Authority is exploring its options to purchase the property. The airport representatives also stated that the airport owns the undeveloped parcel of land to the west of Burger King.

Additionally, Mr. Clendaniel stated the airport had plans to replace the fencing along US 13. [The fence replacement subsequently occurred in summer 2013.] This fence is placed in a location needed to ensure appropriate aviation clearances and generally cannot be moved further from US 13. The airport supports pedestrian and beautification projects in the area, but the trail alignment along their property line is not their preferred alternative.

Churchmans Road Trail Study
Public Workshop – January 15, 2013

On Tuesday, January 15, 2013, the Delaware Department of Transportation (DelDOT) and the City of New Castle County conducted a public workshop for two multi-modal trail projects within and near the City of New Castle. The Route 273 Multi-Use Trail Facility project proposes to construct a bicycle and pedestrian trail along Route 273 (Frenchtown Road and Delaware Street) from the New Castle Farmers Market to near 10th Street in the City of New Castle. The proposed improvements will connect to the existing New Castle Heritage Trail and the existing Industrial Track Trail.

The Churchmans Road Trail Study will examine alternatives for extending the existing trail along Churchmans Road (near Airport Road) farther east along Churchmans Road and Route 273 and connecting to the SR 273 trail near the New Castle Farmers Market.

There were a total of 27 attendees who were presented with display plans that demonstrated existing conditions and proposed improvements for each project. There were a total of 12 comment forms received and one letter, which was written in advance of the workshop. In general, the public attendees supported both projects. Several attendees voiced concern about crossing US 13 and indicated that crossing at School Lane would be preferred over crossing at SR 273.

Following the workshop, DelDOT will complete final design plans for the SR 273 Trail, which could begin construction as early as April 2013. A final concept design report selecting a preferred alternative for the Churchmans Road Trail is anticipated by June 2013.

The public survey response summary is listed below.

Question – Do you have any general comments or suggestions about the Churchmans Road Trail Study?

- I was opposed to the paving of the trail to Wilmington. I do support a ped/bike trail along Rte. 273 as opposed to riding/walking along the shoulder as it is always helpful. The impact to the natural situation is too great here as it is and my get worse with this trail. I have seen a heaving negative impact already. I walk, bicycle, ride, etc., and feel most people are not courteous. This project helps a few special interest groups. Most cyclists and walkers need to use what is available and usually will! Education as to exercise and obesity is a better key than to just do this project. Please consider the impact to the environment, animals, wildlife, etc. Additionally, there are many others who feel this way! Thank you.
- When a pedestrian/bicyclist presses the crosswalk button, could a visible response (button blinks, time to safe crossing) be visible? At most crossings, there is no way for the p/b to know if the button is even connected to the crossing system. That "encourages" the p/b to take a chance crossing against the light and the crossing lights when finally activated annoy drivers when there is no one using the crossing.

- I like the grass barrier between the shoulder and bike/ped trail.
- (273) Looks very encouraging! A key part of the plan is connecting to existing paths/e.g. Industrial Track Trail, so cyclists and pedestrians don't have to face awkward crossing transitions. (CRTC) Having bike this area and faced some challenges with traffic, a trail would be welcome, especially in crossing Rt. 13.
- Both are well-planned and very welcome.
- (Rte. 273) Yes, add subdivision links to Industrial Track. Work on linkage to historic district and Battery Park..Important! (CRTC) Good idea.
- (Rte. 273) Clarify enforcement responsibility for traffic violations, speed, reckless driving, etc. County Police vs. New Castle City Police which I consider preferable. (CRTS) Provide way finding and security enforcement. Are there plans for lighting and call boxes?
- (Rte. 273) Looks like a great plan to me, but I think I would prefer riding on School House Lane. (CRTS) Churchmans Road trail looks like a pleasant idea also.
- (Rte. 273) I am pleased that this is happening. It is something that I have wanted since moving to New Castle in 2007. (CRTS) I like the Churchmans Road trail.
- (Rte. 273) Great idea – will provide good connection from Industrial Track to Farmers Market. Encourages more walking and biking from New Castle. (CRTS) Hopefully, you will create a safe crossing of Basin Rd. – make sure pedestrian light switch is longer!
- (Rte. 273) Go for it. Looks great.
- (Rte. 273) Very supportive of the project. Think it is very important to be able to connect City of Wilmington and City of New Castle. Are there alternatives to proposed crossing of Christina River especially with estimated costs/timing? Interested in proposed connection to Battery Park. (CRTS) Good idea.

Question – Please indicate your preferred alignment for the Churchmans Road Trail Study. Why?

Alternative #1 = 2 votes
Alternative #2 = 8 votes

- There are pluses and negatives to both it seems to me.
- Alt. #1 - The New Castle Town Center will attract traffic from NCFM even though the crossing at 273 could involve 3 sequential crosswalks.
- Alt. # 1 with improvements to the Hare's Corner Crossing.
- Alt. #2 – I prefer riding in less noisy traffic (School Lane) and riding along the airport as more interesting. On a bike, a rider can enjoy the "scenery."
- Alt. #2 – Straight across route – no zig-zag.
- Alt. #2 – Much safer. Consider on Old Churchmans (off 13) to join Churchmans and avoid busy Rte. 273. Maybe developer would consider bike traffic lane at the back. Tie to Lewden Park trails nearby.

- Alt. #2 – Safety concerns for traffic vs. pedestrian and bicycle.
- Alt. #2 – Hares Corner intersection is very dangerous. It seems a lot safer to cross U.S. 13 at School Lane.
- I prefer the # 2 crossing because it is a less complicated area.
- Hares Corner is too busy and dangerous! School Lane is a safer road. I would also prefer being able to use Old Churchmans Rd. for biking and accessing Churchmans Rd. and eventually hook up to Lewden Park's trail (in Ivy Ridge).
- Alt. #2 – Safer?

Question – Would you be likely to use either of the proposed trail alignment alternatives for the Churchmans Road Trail Study?

- Yes.
- Maybe, but it would have to wait until I retire.
- Yes.
- On occasion, for recreational riding. I live in Hockessin.
- Yes.
- Yes.
- Yes, if demonstrated to be safe for pedestrian and cyclists.
- I prefer alternative # 2.
- Yes, I would use # 2. I bike and hike.
- I would use # 2.
- Yes.
- Yes.

General Information

Question 1 - How would you describe yourself and/or your affiliation?

Resident 11
Adjacent property owner..... 0
Community/civic organization..... 9
Business owner 0
Institution (church, school, other) 0
Media 0
Other 3
No comment 0

Other (please explain):

- Historic New Castle Alliance
- New Castle Bike Rangers – casual group.
- Member New Castle Bike Rangers

Question 2 - How did you hear about this workshop?

Notice in the mail.....0
Road sign.....0
Neighborhood/friend.....4
Newspaper 8
No comment 0
Other 2

Other (please explain):

- On the DelDOT e-mail list for NCC notices.
- E-mail – Delaware Greenways.

Question 3 - How helpful and informative were the DelDOT facilitators?

Very helpful.....12
Moderately helpful 0
Not at all helpful 0
No opinion.....0
No comment 0

Question 4 - How effective were the display materials at explaining the project?

Very effective 11
Moderately effective 1
Effective 0
Not at all effective.....0
No opinion.....0
No comment 0

Question 5 – If you have any additional comments relating to tonight's workshop:

- Good idea having several tables with the same material to spread the crowd.
- Looking forward to the Rte. 273 trail to Hares Corner.
- Thanks for providing the information – opportunity for community input.
- The consultants were knowledgeable and courteous.
- Project heading for historic New Castle Alliance, New Castle Way finding project. Project includes trail maps, signage.
- Include Route 9 byways.

- It was nice to network.
- Please reference letter from Michael H. McGrath, AICP, recently retired from DE Dept. of Agriculture.

STATE OF DELAWARE
Department of Transportation

ROUTE 273 MULTI-USE TRAIL FACILITY & CHURCHMANS ROAD TRAIL STUDY

WILLIAM PENN HIGH SCHOOL, JANUARY 15, 2013

	NAME (PLEASE PRINT)	STREET ADDRESS	CITY	STATE	ZIP	PHONE
1	KATE BUCKLEY	132 E 2nd St	New Castle	DE	19720	302-322-9257
2	Owen Robatino	NCC 87 Reads Way	New Castle	DE	19720	
3	Linda Rathford	24 The Strand	New Castle	DE	19720	302 8533677
4	Heather Dunigan	WILMAPCO				
5	Amy Hamilton	1099 PEBBLE HILL	DOYLESTOWN	PA	18901	267-236-3407
6	RICHARD SINEGAR	800 BAY ROAD	DOVER	DE	19903	302-760-4866 RICHARD.SINEGAR@STATE.DE.US
7	Michael McGrath	650 Johns Rd	Smyrna	DE	19977	302.653-4120
8	Joan G Smith	126 W. 8th St	New Castle	DE	19720	302-328-1491
9	Tom Maddux	117 Harmony St	New Castle	DE	19720	302-328-8990
10	Bill Hardam	1914 Thomas Rd	Wilmington	DE	19803	302/654-6577
11	Joanne Oaks	1 The Strand	New Castle	DE	19720	322-2074
12	Bob Fleer					577-5100
13	Bill Lowe	405 E. Marsh Lane Suite 1	Newport	DE	19804	
14	Carol Ireland	106 Hobson Dr	Hockessin	DE	19707	995-9658
15	James Wilson		New Castle	DE	19720	

STATE OF DELAWARE
Department of Transportation

ROUTE 273 MULTI-USE TRAIL FACILITY & CHURCHMANS ROAD TRAIL STUDY

WILLIAM PENN HIGH SCHOOL, JANUARY 15, 2013

	NAME (**PLEASE PRINT**)	STREET ADDRESS	CITY	STATE	ZIP	PHONE
1	DAVID HUNT	DELAWARE GREENWAYS 1910 ROCKLAND ROAD	WILMINGTON	DE	19803	302 655 7275
2	Kathy Tidwell	44 W. 4th St	N.C.	DE	19720	302 328-2532
3	Lois Barth	110 E. 3rd St.	N.C.	DE	19720	302-322-7719
4	Barbara Alfree	203 Harmony St.	N.C.	De	19720	302-324-0829
5	Mike Alfree	" "				
6	Gail Seitz	55 The Strand	N.C.	De	19720	302-325-3359
7	Sally Moriqle	129 Harmony St.	N.C	DE	19720	302-322-3816
8	Marty Drinan	719 Elkton Road	Newark	DE	19711	302-454-7007
9	JOHN BLACKBURN	109 NEW AMSTER AVE	N.C.	DE	19720	302-379-5739
10	FRED TARBUTON	110 EAST 2ND STREET	New Castle	DE	19720	302-322-3561
11	Carol Hickman	304 W. 9th St.	New Castle	DE	19720	302-328-3060
12	IRENE BIGGS	36 W 6TH ST	New Castle	DE	19720	
13	Rick Mickowski	4 Clyde Circle	New Castle	DE	19720	3023281014
14						
15						

Tab 5

Photo 1: Looking west along the north side of Churchmans Road between Airport Road and Old Churchmans Road (end of existing trail)

Photo 2: Looking west along the north side of Churchmans Road between Churchmans Road and Century Boulevard

Photo 3: Looking north along the north side of Churchmans Road at the wetlands east of Century Boulevard

Photo 4: Looking west along the north side of Churchmans Road, west of HSBC / Capital One

Photo 5: Looking west along the south side Churchmans Road, east of HSBC / Capital One

Photo 6: Looking west along the south side of Churchmans Road, east of HSBC / Capital One

Photo 7: Looking east along the north side of SR 273 from the intersection of Churchmans Road

Photo 8: Looking west along the north side of SR 273 between Churchmans Road and US 13

Photo 9: Looking east along the north side of SR 273, west of Burger King

Photo 10: Looking west along the north side of SR 273, west of US 13
(Burger King recently completed renovations at this location)

Photo 11: Looking west from the southeast corner of US 13 at SR 273

Photo 12: Looking east along the north side of SR 273, east of US 13

Photo 13: Looking east along the north side of SR 273 at the entrance to Gambacorta Pre-Owned

Photo 14: Looking west along the north side of SR 273 at New Castle Farmers Market

Tab 6

CAPITAL TRANSPORTATION PROJECT COST ESTIMATE

1. NAME OF PROJECT Churchmans Road Trail Study (Subdivision or Road Name) — New Castle (County)

2. LIMITS

Street Name or Road Number	From	To	Length
Churchmans Road	1,600' east of Airport Road	SR 273	4,310 feet
SR 273	Churchmans Road	east of US 13	3,080 feet

3. ESTIMATE REQUESTED BY: Marco Boyce (Name) for (check one) ☐ Project initiation ☑ Estimate only _____ (Section or Legis. Dist.)

4. DESCRIPTION OF IMPROVEMENT:

This project was initiated by DelDOT and the Delaware Department of Natural Resources and Environmental Control (DNREC) to close a trail gap just west of the City of New Castle. The proposed trail will connect to an existing trail on the north side of Churchmans Road, east of Airport Road and extend south along Churchmans Road, continue east on SR 273 where it will tie in to the proposed Route 273 Multi-Use Trail Facility project.

4. PROJECT IN C.I.P. Yes ☐ No ☑ If "Yes", indicate year F.Y. _____

5. TYPICAL SECTION

The proposed typical section will include a 10-foot asphalt path with a grass buffer and PCC curb where feasible.

6. STATE MAINTAINED ☑ CITY MAINTAINED ☐ PRIVATE ☐ OTHER ☐ (specify) _____

7. COST ESTIMATE:

		from C.I.P. estimate form	Estimate prepared by:	Date:
a. Location and Environmental Studies (Part I to be included only for class "I" and "III" projects)	$11,000	Part I	WR&A	10/22/13
b. Preliminary Engineering	$330,000	Part II	WR&A	10/22/13
c. Real Estate	$1,100,000	Part III	WRA	10/22/13
d. Construction *	$1,928,040	Part IV	WR&A	10/22/13
e. TOTAL ESTIMATED PROJECT COST	$3,369,040			

* Includes Utilities, Traffic, and C.E.

APPROVED

Valid thru _____ (Date) _____ (Assistant Director, M&O/Transportation Solutions/Planning) _____ (Date)

CAPITAL TRANSPORTATION PROJECT COST ESTIMATE

(Current Dollars)

Contract No. N/A

Project Title: Churchmans Road Trail Study

PART I - LOCATION & ENVIRONMENTAL STUDIES (N/A)

(Part I to be included only for class "I" & "III" projects)

A. ENGINEERING (Includes NEPA)		**E. HISTORIC**	$0
B. ARCHAEOLOGY	$0	1. Phase 1 (study)	
1. Phase I (study)		2. Phase 2 (study)	
2. Phase 2 (study)		3. Mitigation (by loc./env.)	
3. Phase 3 (mitigation)		4. Mitigation (by design)	yes ☐ no ☐
C. WETLANDS	$10,000	**F. NOISE**	$0
1. Delineation (study)	$5,000	1. Studies	
2. Permit preparation	$5,000	2. Mitigation (by design)	yes ☐ no ☐
3. Mitigation (design)		**G. OTHER**	$0
D. HAZARDOUS MATERIAL	$0	1.	
1. Phase 1 (study)		2.	
2. Phase 2 (study)			
3. Phase 3 (remediation)			

TOTAL COSTS FOR PART I (A thru G) ROUNDED $10,000

CONTINGENCY COSTS 10% (% used) $1,000
(normally 5% for large projects and 10% for small projects - to be approved by section head)

TOTAL LOCATION AND ENVIRONMENTAL STUDIES COSTS $11,000
(also total for Construction Project Estimate form line 7a)

Estimator: WR&A

Date: 10/22/13

CAPITAL TRANSPORTATION PROJECT COST ESTIMATE

(Current Dollars)

Contract No. N/A

Project Title: Churchmans Road Trail Study

PART II - PRELIMINARY ENGINEERING

A. SURVEYS	$50,000
1. Inhouse	
2. Consultant	$50,000
B. DESIGN ENGINEERING	$250,000
1. Design	$250,000
a. Inhouse	
b. Consultant	$250,000
2. Traffic	$0
a. Inhouse	
b. Consultant	
3. Real Estate Plan Preparation	$0
a. Inhouse	
b. Consultant	
4. Utilities	$0
a. Inhouse	
b. Consultant	
c. Test Holes	
d. Utility Company	
5. Materials & Research	
6. Borings	
7. Pile Load Tests	
8. Subdivision	$0
a. Inhouse	
b. Consultant	
c. Railroad P.E.	
9. Other (specify)	$0
a.	
b.	
C. ENVIRON. ASSESSMENT (use for class "II" projects only)	$0
1. Wetlands	
2. Hazardous Materials	
3. Noise	
4. Historic	
5. Archaeology	
6. Other	
a.	
b.	
Loc/Environ Estimator:	Date:
D. CONTRACT ADMINISTRATION	
Cont/Admin Estimator:	Date:

TOTAL COSTS FOR PART II (A thru D) ROUNDED		$300,000
CONTINGENCY COSTS (normally 5% for large projects and 10% for small projects - to be approved by section head)	10% (% used)	$30,000
TOTAL PRELIMINARY ENGINEERING (also total for Construction Project Estimate form line 7b)		$330,000

Estimator: WR&A

Date: 10/22/13

CAPITAL TRANSPORTATION PROJECT COST ESTIMATE

(Current Dollars)

Contract No. N/A

Project Title: Churchmans Road Trail Study

PART III - REAL ESTATE

A. REAL PROPERTY	$1,000,000	**C. ASBESTOS PROGRAM**	$0
1. Total acquisitions		1. Testing	
2. Partial acquisitions	$1,000,000	2. Abatement	
3. Permanent easements		**D. DEMOLITION**	
4. Temporary easements		**E. APPRAISAL FEES**	
5. Wetland mitigation		**F. STAFF**	
Other (specify)			
6.		**G. SETTLEMENT**	
7.		**H. REAL ESTATE ENG.**	$0
B. RELOCATION	$0	1. Consultant survey	
1. Residential		2. As acquired plans	
2. Business		**I. CONDEMNATION**	
Other (specify)			
3.		**J. OTHER (specify)**	$0
4.		1.	
		2.	

TOTAL COSTS FOR PART III (A thru J) ROUNDED $1,000,000

CONTINGENCY COSTS 10% (% used) $100,000

(normally 5% for large projects and 10% for small projects - to be approved by section head)

TOTAL REAL ESTATE COSTS $1,100,000

(also total for Construction Project Estimate form line 7c)

Estimator: WRA

Date: 10/22/13

CAPITAL TRANSPORTATION PROJECT COST ESTIMATE

(Current Dollars)

Contract No. N/A

Project Title Churchmans Road Trail Study

PART IV -CONSTRUCTION

A. ROADWAY/APPROACH CONSTRUCTION	$515,000
1. Grading	
a. Excavation (includes SWM pond)	$75,000
b. Borrow	$15,000
2. Drainage	$120,000
3. Pavement	
a. Surface	$85,000
b. Base	$15,000
c. Subbase	$80,000
4. Erosion/Sed. Cont.	$20,000
5. Miscellaneous	
a. Curb/Gutter	$45,000
b. Sidewalk	$30,000
c. Guardrail	
d. C.P.M. Schedule	
e. Clear/Grubb	$30,000
f. Field Office	
Other (specify)	
g.	
h.	
i.	
j.	
k.	
l.	
m.	

B. STRUCTURE CONSTRUCTION	$78,000
1. New Bridge	$78,000
a. Type	
b. Size	300
c. $/s.f.	$260
2. Old Structure Rem.	
a. Type	
b. Size	
c. $/c.y.	
3. Retaining Wall	
a. Type	
b. Size	
c. $/c.y.	
4. Box Culvert	
a. Type	
b. Size	
c. $/s.f.	
C. LANDSCAPING	$60,000
1. Beautification	$50,000
2. Noise Mitigation	
3. Visual Mitigation	
4. Tree Mitigation	$10,000
D. MAINTENANCE OF TRAFFIC	$300,000

(refer to Capital Improvement Project form, Part IV - Continued)

CAPITAL TRANSPORTATION PROJECT COST ESTIMATE

(Current Dollars)

Contract No. N/A

Project Title Churchmans Road Trail Study

PART IV -CONSTRUCTION (CONTINUED)

E. PROJECT TRAFFIC ITEMS	$5,000
1. Signing Structures	
a. Overhead Bridges	
b. Cantilever Supports	
2. Roadway Lighting	
3. Pavement Markings	$5,000
Other (specify)	
4.	
F. WETLAND MITIGATION	
G. UTILITY RELOC. IN CONTRACT	$145,000
1. Water	$5,000
2. Sanitary Sewer	
Other (specify)	
3. Utility Pole /Lighting	$140,000
H. SUBTOTAL (A thru G) ROUNDED	$1,103,000
I. MISC. ITEMS	$220,600
(15% of H for large projects and 20% for small)	
(At SF submission use 10% and 5%)	
20% (% used)	
J. CONTRACTOR'S CONST. ENG.	$55,150
(normally 5% of H) 5% (% used)	
K. INITIAL EXPENSE	$55,150
(normally 5% of H) 5% (% used)	
L. CONSTRUCTION CONTINGENCY	$110,300
(normally 10% of H) 10% (% used)	

P. REIMBURSABLE UTILITY RELOCATIONS BY OTHERS	$0
(Enter on PNR funding line 7)	
1. Water	
2. Sanitary Sewer	
3. Electric	
4. Telephone	
5. Gas	
6. CATV	
Other (specify)	
7.	
8.	
Utilities Estimator: Date:	

Q. TRAFFIC SECTION ITEMS	$75,000
(Enter on PNR funding line 6)	
1. Signing	$25,000
2. Signals	$50,000
3. Detour Signing	
4. DelTrac	
Other (specify)	
5.	
Traffic Estimator: Date:	

M. TOTAL CONSTRUCTION COSTS (H thru L) $1,544,200
(Enter on PNR funding line 5)

N. CONSTRUCTION ENGINEERING (normally 15% of construction costs) 20% (% used) $308,840
(Enter on PNR funding line 4)

O. TOTAL CONSTRUCTION COSTS (Construction Costs + Construction Engineering) $1,853,040
(use this total + Q + P for Construction Project Estimate from line 7d)

Estimator: WR&A

Date: 10/22/2013

CAPITAL TRANSPORTATION PROJECT COST ESTIMATE

(Current Dollars) Part V of V

Contract No. N/A Project Title: Churchmans Road Trail Study

SUMMARY

PART I - LOCATION AND ENVIRONMENTAL STUDIES (Part I to be included only for class "I" and "III" projects)	$11,000
PART II - PRELIMINARY ENGINEERING	$330,000
PART III - REAL ESTATE	$1,100,000
PART IV - CONSTRUCTION	$1,928,040
TOTAL ESTIMATED PROJECT COSTS (also total for Construction Project Estimate from line 7c)	$3,369,040

Date: _____

Project Manager

REVIEWED & CONCURRED IN:

Date: _____

Section Head

NOTE: Concurring section heads are to forward the original estimate copy to the Director of Transportation Solutions with one estimate copy each to the Assistant Director of Project Development, Assistant Director of Design Support, and the Cost Estimate Engineer.

Tab 7

MEMORANDUM

Date: April 23, 2013

To: Joy Ford, DelDOT Environmental Studies
From: Laura Callens, WR&A
Subject: Wetland Delineation
CC: Todd Oliver, WR&A
Amanda Baxter, WR&A

Work Order Number: 31896-003
Project: Churchmans Road Trail Study

On April 9, 2013, a field view of the Churchmans Road Trail Study project site was conducted to delineate the existing wetlands. Wetlands were delineated using methods as described in the 1987 Corps of Engineers Wetlands Delineation Manual and in the 2012 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region. Wetlands were identified and marked with pink wetland delineation flagging. Each flag was numbered consecutively and a sub-meter accuracy GPS unit was used to record flag locations. Wetland data was recorded on the Corps' "Wetland Determination Data Form – Atlantic and Gulf Coastal Plain Region" data forms. Two wetlands were identified within the boundaries of the proposed trail alternatives. Wetland Delineation Plans, data sheets, and a photo log of the two wetlands are attached. This information is intended to aid in the development of the Concept Design Report for the trail alternatives.

Wetland 1 is located along the north side of Churchmans Road approximately 500 feet east of Century Park and is characterized as palustrine emergent (PEM) wetland according to Cowardin et al classification (see ***Figure 1***). The dominant species in the herb stratum are *Scirpus cyperinus* (wool-grass), OBL; *Juncus effuses* (soft rush), OBL; and *Typha latifolia* (broad-leaf cattail), OBL. The dominant species in the sapling/shrub stratum is *Acer rubrum* (red maple), FAC. One hundred percent of the dominant vegetation ranks as facultative or wetter, satisfying the criteria for hydrophytic vegetation. At the time of field investigation, the wetland was inundated with approximately two inches of water. The primary indicators for wetland hydrology are Surface Water (A1), High Water Table (A2), Saturation (A3), and Water-Stained Leaves (B9). The soils in the wetland are mapped as Reybold silt loam, 2-5% slopes (ReB); and Urban Land (Up). Neither soil units are considered hydric. Soil at 0-8 inches is a silt loam that exhibits a Munsell matrix soil color of 10 YR 3/1, with mottles of 5 YR 5/6. Soil at 8-12+ inches is a silt loam with sand that exhibits a Munsell matrix soil color of 10 YR 4/1, with mottles of 10 YR 5/6. This soil meets the criteria of a hydric soil due to a qualification for Depleted Matrix (F3). Wetland 1 is approximately 0.1842 acres/8,024 square feet within the study area.

Wetland 1 collects flow from the adjacent upland field and forest, and then flows via culvert beneath Churchmans Road to eventually connect to the nearby Unnamed Tributary to Army Creek. Mapping indicates that NWI wetlands are located approximately 650 feet to the southwest at the location of the old borrow-mining site within the northeast quadrant of the intersection of Churchmans Road and SR 273. These welands which connect to the Unnamed Tributary to Army Creek through a very large culvert beneath SR 273 (see ***Figure 2***).

Wetland 2 is located along the unpaved portion of School Lane between US 13 and SR 273 adjacent to the William Penn High School recreational fields and characterized as palustrine emergent (PEM) wetland according to Cowardin

et al classification (see ***Figure 3***). The dominant species in the herb stratum is *Phragmites australis* (common reed), FACW. The dominant species in the sapling/shrub stratum are *Lonicera maackii* (bush honeysuckle), NI and *Prunus serotina* (black cherry), FACU. The dominant species in the woody vine stratum is *Toxicodendrun radicans* (poison ivy), FAC. Fifty percent of the dominant vegetation ranks as facultative or wetter, satisfying the criteria for hydrophytic vegetation. At the time of field investigation, the wetland was not inundated with water. The primary indicator for wetland hydrology is Saturation (A3), which was observed at the surface. The soils in the wetland are mapped as Reybold silt loam, 2-5% slopes (ReB) and Udorthents, 0-10% slopes. Soil at 0-3 inches is a loamy sand that exhibits a Munsell matrix soil color of 10 YR 4/1, with no mottles. Soil at 3-9 inches is a loamy sand that exhibits a Munsell matrix soil color of 10 YR 4/1, with mottles of 10 YR 5/6. Soil at 9-12 inches is a sandy clay loam that exhibits a Munsell matrix soil color of 10 YR 5/1, with mottles of 5 YR 5/8 and 5 YR 3/4. This soil meets the criteria of a hydric soil due to a qualification for Sandy Redox (S5). Wetland 2 is approximately 0.3442 acres/14,997 square feet within the study area.

Wetland 2 has formed in the linear depressional ditch located along the northeastern edge of School Lane. This wetland receives surface flow from the adjacent agricultural and recreational fields and drains easterly into a large drainage field. NWI wetlands are located approximately 650 feet southeast of Wetland 2 (see ***Figure 4***); however, Wetland 2 appears to be isolated as no connections to upstream or downstream waterways were observed during the field investigation. Wetland 2 does not appear to have a hydrologic surface connection to wetlands south of SR 273.

By Federal mandate, the U.S. Army Corps of Engineers does not take jurisdiction over hydrologically isolated wetlands. It is recommended that a Jurisdictional Determination request be submitted to the Corps to obtain assurance of the jurisdictional status of Wetland 2, as well as Wetland 1, prior to proceeding with design of the trail adjacent to School Lane.

If more detail and documentation of the findings is required, or if there are any questions about the contents of this technical memorandum, please contact me at 443-224-1633, email lcallens@wrallp.com

Laura Callens

Laura C. Callens, CFM
Environmental Scientist

Figure 1- Wetland 1 over Aerial Photography (Source: Bing Maps, 2012)

Figure 2- Wetland 1 with DNREC and NWI Wetlands
(Source- DE State-wide Monitoring Program and USFWS National Wetlands Inventory over USGS Quadrangle topographic base map, 2012)

Figure 3 - Wetland 2 over Aerial Photography (Source: Bing Maps, 2012)

Figure 4- Wetland 2 with DNREC and NWI Wetlands
(Source- DNREC Delaware State-wide Monitoring Program and USFWS National Wetlands Inventory over USGS Quadrangle topographic base map, 2012)

PHOTO 1: Wetland 1 near data point, facing southwest.

PHOTO 2: Wetland 1 from Flag W1-16, facing northeast.

PHOTO 3: Upland data point, facing northwest.

PHOTO 4: Wetland 2 from flag W2-01, facing northwest.

WETLAND DETERMINATION DATA FORM - Atlantic and Gulf Coastal Plan Region

Project/Site: Churchmans Road Trail City/County: New Castle Sampling Date: 4/9/2013

Applicant/Owner: Delaware Department of Transportation State: DE Sampling Point: Wetland 1

Investigator(s): Laura Callens, Tim Hess Section, Township, Range: _____

Landform (hilltop, terrace, etc.): Roadside slope Local Relief (concave, convex, none): concave Slope (%): 4-10%

Subregion (LLR or MLRA): MLRA Lat: 39º40'11"N Long: 75º36'49"W Datum: NAD83

Soil Map Unit Name: Reybold silt loam, 2-5% slopes (ReB) and Urban Land (Up) NWI Classification: PEM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (if no explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland?** **Yes X No ____**
Hydric Soil Present?	Yes X	No ____	
Wetland Hydrology Present?	Yes X	No ____	

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15) (LRR U)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surfaces (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Sphagnum moss (D8) (**LRR T, U**)

Field Observations:

Surface Water Present?	Yes X	No ____	Depth (Inches):	2
Water Table Present?	Yes X	No ____	Depth (Inches):	4
Saturation Present (includes capillary fringe)	Yes X	No ____	Depth (Inches):	surface

Wetland Hydrology Present? **Yes X No ____**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Vegetation (Four Strata) - Use scientific names of plants

Sampling Point : Wetland 1

Tree Stratum (Plot Size: 30' x 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0	= Total Cover	
50% of total Cover =	0%	20% of total cover =	0%
Sapling/Shrub Stratum (Plot Size: 15' x 15')			
1. *Acer rubrum* (red maple)	5	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	5	= Total Cover	
50% of total Cover =	3%	20% of total cover =	1%
Herb Stratum (Plot Size: 5' x 5')			
1. *Scirpus cyperinus (wool-grass)*	15	Y	OBL
2. *Juncus effusus (soft rush)*	20	Y	OBL
3. *Typha latifolia (broad-leaf cattail)*	60	Y	OBL
4. *Polygonum pensylvanicum (smartweed)*	10	N	FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	105	= Total Cover	
50% of total Cover =	53%	20% of total cover =	21%
Woody Vine Stratum (Plot Size:5' x 5')			
1.			
2.			
3.			
4.			
5.			
	0	= Total Cover	
50% of total Cover =	0%	20% of total cover =	0%

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC	4	(A)
Total Number of Dominant Species Across All Stratum	4	(B)
Number of Dominant Species That Are OBL, FACW, or FAC.	100%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species		x1=	0
FACW specie:		x2=	0
FAC species		x3=	0
FACU species		x4=	0
UPL species		x5=	0
Column Totals	0 (A)		0 (B)

Prevalence Index = B/A= #DIV/0!

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is > 50%
- ___ 3 - Prevalence Index is < 3.0 [1]
- Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree - Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height. **30' Radius**

Sapling/Shrub - Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 (1m) tall. **15" Radius**

Herb - All herbaceous (non-woody) plants, regardless of size, & woody plants < 3.28 ft tall. **5' Radius**

Woody Vine - All woody vines greater than 3.28 ft in height. **5' Radius**

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (If observed, list morphological adaptations below).

Soil

Sampling Point: Wetland 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-4	10 YR 3/1	90%	5 YR 5/6	10%	C	M	Silt loam	
4 to 8	10 YR 3/1	75%	5 YR 5/6	25%	C	M	Silt loam	
8-12+	10 YR 4/1	60%	10 YR 5/6	40%	C	M	Silt loam w/sand	possible fill material

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2] Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Organic Bodies (A6) (**LRR P, T, U**)
- ___ 5 cm Mucky Mineral (A7) (**LRR P, T, U**)
- ___ Muck Present (A8) (**LRR U**)
- ___ 1 cm Muck (A9) (**LRR P,T**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Coast Prairie Redox (A16) (**MLRA 150A**)
- ___ Sandy Mucky Mineral (S1) (**LRR, 0, S**)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR P, S, T, U**)
- ___ Polyvalue Below Surface (S8) (**LRR S, T, U**)
- ___ Thin Dark Surface (S9) (**LRR S, T, U**)
- ___ Loamy Mucky Mineral (F1) (**LRR O**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR U**)
- ___ Depleted Ochric (F11) (**MLRA 151**)
- ___ Iron-Manganese Masses (F12) (**LRR O, P, T**)
- ___ Umbric Surface (F13) (**LRR P, T, U**)
- ___ Delta Ochric (F17) (**MLRA 151**)
- ___ Reduced Vertic (F18) (**MLRA 150 A, 150B**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149A**)
- ___ Anomalous Bright Loamy Soils (F20) (**MLRA 149A, 153C, 153D**)

Indicators for Problematic Hydric Soils[3]

- ___ 1 cm Muck (A9) (**LRR O**)
- ___ 2 cm Muck (A10)(**LRR S**)
- ___ Reduced Vertic (F18) (**outside MLRA 150A,B**)
- ___ Piedmont Floodplain Soils (F19) (**LRR P, S, T**)
- ___ Anomalous Bright Loamy Soils (F20) (**MLRA 153B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soils Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM - Atlantic and Gulf Coastal Plan Region

Project/Site: Churchmans Road Trail City/County: New Castle Sampling Date: 4/9/2013

Applicant/Owner: Delaware Department of Transportation State: DE Sampling Point: Wetland 2

Investigator(s): Laura Callens, Tim Hess Section, Township, Range: _____

Landform (hilltop, terrace, etc.): flat field Local Relief (concave, convex, none): none Slope (%): 2%

Subregion (LLR or MLRA): MLRA Lat: 39º39'57"N Long: -75º35'8"W Datum: NAD 83

Soil Map Unit Name: Reybold silt loam, 2-5% slopes (ReB) and Udorthents, 0-10% slopes (UzC) NWI Classification: PEM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (if no explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland?** **Yes X No ____**
Hydric Soil Present?	Yes X	No ____	
Wetland Hydrology Present?	Yes X	No ____	

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ____ Surface Water (A1)
- ____ High Water Table (A2)
- X Saturation (A3)
- ____ Water Marks (B1)
- ____ Sediment Deposits (B2)
- ____ Drift Deposits (B3)
- ____ Algal Mat or Crust (B4)
- ____ Iron Deposits (B5)
- ____ Inundation Visible on Aerial Imagery (B7)
- ____ Water-Stained Leaves (B9)
- ____ Aquatic Fauna (B13)
- ____ Marl Deposits (B15) (LRR U)
- ____ Hydrogen Sulfide Odor (C1)
- ____ Oxidized Rhizospheres on Living Roots (C3)
- ____ Presence of Reduced Iron (C4)
- ____ Recent Iron Reduction in Tiled Soils (C6)
- ____ Thin Muck Surface (C7)
- ____ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ____ Surface Soil Cracks (B6)
- ____ Sparsely Vegetated Concave Surfaces (B8)
- ____ Drainage Patterns (B10)
- ____ Moss Trim Lines (B16)
- ____ Dry-Season Water Table (C2)
- ____ Crayfish Burrows (C8)
- ____ Saturation Visible on Aerial Imagery (C9)
- ____ Geomorphic Position (D2)
- ____ Shallow Aquitard (D3)
- ____ FAC-Neutral Test (D5)
- ____ Sphagnum moss (D8) (**LRR T, U**)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (Inches): ____	**Wetland Hydrology Present?**	**Yes X No ____**
Water Table Present?	Yes X	No ____	Depth (Inches): 10		
Saturation Present (includes capillary fringe)	Yes X	No ____	Depth (Inches): surface		

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Vegetation (Four Strata) - Use scientific names of plants

Sampling Point : Wetland 2

Tree Stratum (Plot Size: 30' x 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0	= Total Cover	
50% of total Cover =	0%	20% of total cover =	0%

Sapling/Shrub Stratum (Plot Size: 15' x 15')			
1. *Lonicera maackii* (bush honeysuckle)	10	Y	NI
2. *Prunus serotina* (black cherry)	10	Y	FACU
3.			
4.			
5.			
6.			
7.			
8.			
	20	= Total Cover	
50% of total Cover =	10%	20% of total cover =	4%

Herb Stratum (Plot Size: 5' x 5')			
1. *Phragmites australis* (common reed)	90	Y	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	90	= Total Cover	
50% of total Cover =	45%	20% of total cover =	18%

Woody Vine Stratum (Plot Size:5' x 5')			
1. *Toxicodendrun radicans (poison ivy)*	20	Y	FAC
2.			
3.			
4.			
5.			
	20	= Total Cover	
50% of total Cover =	10%	20% of total cover =	4%

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC	2	(A)
Total Number of Dominant Species Across All Stratum	4	(B)
Number of Dominant Species That Are OBL, FACW, or FAC.	50%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		**Multiply by:**	
OBL species		**x1=**	0
FACW specie:		**x2=**	0
FAC species		**x3=**	0
FACU species		**x4=**	0
UPL species		**x5=**	0
Column Totals	0 (A)		0 (B)

Prevalence Index = B/A= #DIV/0!

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is > 50%
- ___ 3 - Prevalence Index is < 3.0 [1]
- Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree - Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height. **30' Radius**

Sapling/Shrub - Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 (1m) tall. **15" Radius**

Herb - All herbaceous (non-woody) plants, regardless of size, & woody plants < 3.28 ft tall. **5' Radius**

Woody Vine - All woody vines greater than 3.28 ft in height. **5' Radius**

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (If observed, list morphological adaptations below).

The northern portion of Wetland 2 is dominated by *Solidago adora* (anisescented golden rod), NI; Cichorium intybus (chicory), NI; Polygonum pennsylvanicum (smartweed), NI; and *Sassafras albidum* (sassafras), FACU

Soil

Sampling Point: Wetland 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-3	10 YR 4/1	100%	none				loamy sand	
3 to 9	10 YR 4/1	80%	10 YR 5/6	20%	C	M	loamy sand	
9 to 12	10 YR 5/1	65%	5 YR 5/8	25%	C	M	sandy clay loam	
			5 YR 3/4	10%	C	M	clay loam	

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2] Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Organic Bodies (A6) (**LRR P, T, U**)
- ___ 5 cm Mucky Mineral (A7) (**LRR P, T, U**)
- ___ Muck Present (A8) (**LRR U**)
- ___ 1 cm Muck (A9) (**LRR P,T**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Coast Prairie Redox (A16) (**MLRA 150A**)
- ___ Sandy Mucky Mineral (S1) (**LRR, 0, S**)
- ___ Sandy Gleyed Matrix (S4)
- X Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR P, S, T, U**)
- ___ Polyvalue Below Surface (S8) (**LRR S, T, U**)
- ___ Thin Dark Surface (S9) (**LRR S, T, U**)
- ___ Loamy Mucky Mineral (F1) (**LRR O**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR U**)
- ___ Depleted Ochric (F11) (**MLRA 151**)
- ___ Iron-Manganese Masses (F12) (**LRR O, P, T**)
- ___ Umbric Surface (F13) (**LRR P, T, U**)
- ___ Delta Ochric (F17) (**MLRA 151**)
- ___ Reduced Vertic (F18) (**MLRA 150 A, 150B**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149A**)
- ___ Anomalous Bright Loamy Soils (F20) (**MLRA 149A, 153C, 153D**)

Indicators for Problematic Hydric Soils[3]

- ___ 1 cm Muck (A9) (**LRR O**)
- ___ 2 cm Muck (A10)(**LRR S**)
- ___ Reduced Vertic (F18) (**outside MLRA 150A,B**)
- ___ Piedmont Floodplain Soils (F19) (**LRR P, S, T**)
- ___ Anomalous Bright Loamy Soils (F20) (**MLRA 153B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soils Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM - Atlantic and Gulf Coastal Plan Region

Project/Site: Churchmans Road Trail City/County: New Castle Sampling Date: 4/9/2013

Applicant/Owner: Delaware Department of Transportation State: DE Sampling Point: Upland W-1

Investigator(s): Laura Callens, Tim Hess Section, Township, Range: _____

Landform (hilltop, terrace, etc.): forest Local Relief (concave, convex, none): concave Slope (%): 2%

Subregion (LLR or MLRA): MLRA Lat: 39º40'11"N Long: 75º36'49"W Datum: NAD 83

Soil Map Unit Name: Reybold silt loam, 2-5% slopes (ReB) NWI Classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (if no explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland?** **Yes X No ____**
Hydric Soil Present?	Yes ____	No X	
Wetland Hydrology Present?	Yes X	No ____	

Remarks:

Upland plot taken within concave area of adjacent forest

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ____ Surface Water (A1)
- ____ High Water Table (A2)
- ____ Saturation (A3)
- ____ Water Marks (B1)
- ____ Sediment Deposits (B2)
- ____ Drift Deposits (B3)
- ____ Algal Mat or Crust (B4)
- ____ Iron Deposits (B5)
- ____ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ____ Aquatic Fauna (B13)
- ____ Marl Deposits (B15) (LRR U)
- ____ Hydrogen Sulfide Odor (C1)
- ____ Oxidized Rhizospheres on Living Roots (C3)
- ____ Presence of Reduced Iron (C4)
- ____ Recent Iron Reduction in Tiled Soils (C6)
- ____ Thin Muck Surface (C7)
- ____ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ____ Surface Soil Cracks (B6)
- ____ Sparsely Vegetated Concave Surfaces (B8)
- ____ Drainage Patterns (B10)
- ____ Moss Trim Lines (B16)
- ____ Dry-Season Water Table (C2)
- ____ Crayfish Burrows (C8)
- ____ Saturation Visible on Aerial Imagery (C9)
- ____ Geomorphic Position (D2)
- ____ Shallow Aquitard (D3)
- ____ FAC-Neutral Test (D5)
- ____ Sphagnum moss (D8) (**LRR T, U**)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (Inches): ____
Water Table Present?	Yes ____	No X	Depth (Inches): ____
Saturation Present (includes capillary fringe)	Yes ____	No X	Depth (Inches): ____

Wetland Hydrology Present? **Yes X No ____**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

dry in pit

Vegetation (Four Strata) - Use scientific names of plants

Sampling Point : Upland W-1

Tree Stratum (Plot Size: 30' x 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum* (red maple)	40	Y	FAC
2. *Diospyros virginiana* (persimmon)	30	Y	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	70	= Total Cover	
50% of total Cover =	35%	20% of total cover =	14%
Sapling/Shrub Stratum (Plot Size: 15' x 15')			
1. *Viburnum dentatum* (arrow-wood)	20	Y	FAC
2. *Acer negundo (box-elder)*	10	Y	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	30	= Total Cover	
50% of total Cover =	15%	20% of total cover =	6%
Herb Stratum (Plot Size: 5' x 5')			
1. none			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	0	= Total Cover	
50% of total Cover =	0%	20% of total cover =	0%
Woody Vine Stratum (Plot Size:5' x 5')			
1. none			
2.			
3.			
4.			
5.			
	0	= Total Cover	
50% of total Cover =	0%	20% of total cover =	0%

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC	4	(A)
Total Number of Dominant Species Across All Stratum	4	(B)
Number of Dominant Species That Are OBL, FACW, or FAC.	100%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply by:	
OBL species		x1=	0	
FACW specie:		x2=	0	
FAC species		x3=	0	
FACU species		x4=	0	
UPL species		x5=	0	
Column Totals	0	(A)	0	(B)

Prevalence Index = B/A= #DIV/0!

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is > 50%
- ___ 3 - Prevalence Index is < 3.0 [1]
- Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree - Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height. **30' Radius**

Sapling/Shrub - Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 (1m) tall. **15" Radius**

Herb - All herbaceous (non-woody) plants, regardless of size, & woody plants < 3.28 ft tall. **5' Radius**

Woody Vine - All woody vines greater than 3.28 ft in height. **5' Radius**

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (If observed, list morphological adaptations below).

Soil

Sampling Point: Upland W-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-6	10 YR 3/4	100%	none				loam	
6 to 12	10 YR 4/6	100%	none				loam	

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2] Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Organic Bodies (A6) (**LRR P, T, U**)
- ___ 5 cm Mucky Mineral (A7) (**LRR P, T, U**)
- ___ Muck Present (A8) (**LRR U**)
- ___ 1 cm Muck (A9) (**LRR P,T**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Coast Prairie Redox (A16) (**MLRA 150A**)
- ___ Sandy Mucky Mineral (S1) (**LRR, 0, S**)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR P, S, T, U**)
- ___ Polyvalue Below Surface (S8) (**LRR S, T, U**)
- ___ Thin Dark Surface (S9) (**LRR S, T, U**)
- ___ Loamy Mucky Mineral (F1) (**LRR O**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR U**)
- ___ Depleted Ochric (F11) (**MLRA 151**)
- ___ Iron-Manganese Masses (F12) (**LRR O, P, T**)
- ___ Umbric Surface (F13) (**LRR P, T, U**)
- ___ Delta Ochric (F17) (**MLRA 151**)
- ___ Reduced Vertic (F18) (**MLRA 150 A, 150B**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149A**)
- ___ Anomalous Bright Loamy Soils (F20) (**MLRA 149A, 153C, 153D**)

Indicators for Problematic Hydric Soils[3]

- ___ 1 cm Muck (A9) (**LRR O**)
- ___ 2 cm Muck (A10)(**LRR S**)
- ___ Reduced Vertic (F18) (**outside MLRA 150A,B**)
- ___ Piedmont Floodplain Soils (F19) (**LRR P, S, T**)
- ___ Anomalous Bright Loamy Soils (F20) (**MLRA 153B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soils Present? **Yes** ___ **No** X

Remarks:

THIS WETLAND DELINEATION WAS PERFORMED BY WHITMAN, REQUARDT & ASSOCIATES ON APRIL 9, 2013.

WP-01

DELAWARE DEPARTMENT OF TRANSPORTATION	ADDENDUMS / REVISIONS	SCALE 0 30 60 90 FEET	CHURCHMANS ROAD TRAIL STUDY	CONTRACT N/A	BRIDGE NO. N/A	WETLAND DELINEATION PLAN	SHEET NO. 1
				COUNTY NEW CASTLE	DESIGNED BY:		TOTAL SHTS. 2
					CHECKED BY:		

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THIS WETLAND DELINEATION WAS PERFORMED BY WHITMAN, REQUARDT & ASSOC. ON APRIL 9, 2013

WP-02

DELAWARE
DEPARTMENT OF TRANSPORTATION

ADDENDUMS / REVISIONS	

SCALE
0 60 120 180
FEET

CHURCHMANS ROAD
TRAIL STUDY

CONTRACT	BRIDGE NO.	N/A
N/A	DESIGNED BY:	
COUNTY		
NEW CASTLE	CHECKED BY:	

WETLAND DELINEATION
PLAN

SHEET NO.
2
TOTAL SHTS.
2

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Tab 8

1: New Churchmans Rd/SR 58 (Churchmans Rd) & SR 273
HCM Signalized Intersection Capacity Analysis

6/5/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	113	861	19	70	354	524	11	27	27	188	36	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	7.0	7.0	5.0	7.0	7.0		6.0	6.0	7.0	7.0	7.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00		1.00	1.00	0.95	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.99	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1752	3505	1455	1805	3471	1599		1746	1509	1665	1721	1524
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.99	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1752	3505	1455	1805	3471	1599		1746	1509	1665	1721	1524
Peak-hour factor, PHF	0.76	0.88	0.48	0.76	0.84	0.77	0.69	0.56	0.84	0.84	0.64	0.71
Adj. Flow (vph)	149	978	40	92	421	681	16	48	32	224	56	24
RTOR Reduction (vph)	0	0	23	0	0	426	0	0	29	0	0	21
Lane Group Flow (vph)	149	978	17	92	421	255	0	64	3	139	141	3
Heavy Vehicles (%)	3%	3%	11%	0%	4%	1%	9%	7%	7%	3%	0%	6%
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2			6			3			4
Actuated Green, G (s)	13.7	40.0	40.0	8.4	34.7	34.7		7.9	7.9	12.8	12.8	12.8
Effective Green, g (s)	13.7	40.0	40.0	8.4	34.7	34.7		7.9	7.9	12.8	12.8	12.8
Actuated g/C Ratio	0.15	0.43	0.43	0.09	0.37	0.37		0.08	0.08	0.14	0.14	0.14
Clearance Time (s)	5.0	7.0	7.0	5.0	7.0	7.0		6.0	6.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	5.0	5.0	3.0	5.0	5.0		4.0	4.0	4.0	4.0	4.0
Lane Grp Cap (vph)	255	1489	618	161	1279	589		146	126	226	234	207
v/s Ratio Prot	c0.09	c0.28		0.05	0.12			c0.04		c0.08	0.08	
v/s Ratio Perm			0.01			0.16			0.00			0.00
v/c Ratio	0.58	0.66	0.03	0.57	0.33	0.43		0.44	0.02	0.62	0.60	0.02
Uniform Delay, d1	37.5	21.6	15.7	41.1	21.3	22.3		41.0	39.6	38.3	38.3	35.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.4	1.4	0.0	4.8	0.3	1.1		2.9	0.1	5.6	5.0	0.0
Delay (s)	40.9	23.0	15.8	46.0	21.7	23.4		43.8	39.6	43.9	43.2	35.2
Level of Service	D	C	B	D	C	C		D	D	D	D	D
Approach Delay (s)		25.0			24.5			42.4			42.9	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	27.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	94.1	Sum of lost time (s)	25.0
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

1: New Churchmans Rd/SR 58 (Churchmans Rd) & SR 273
Queues

6/5/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	113	861	19	70	354	524	11	27	27	188	36	17
Peak Hour Factor	0.76	0.88	0.48	0.76	0.84	0.77	0.69	0.56	0.84	0.84	0.64	0.71
Heavy Vehicles (%)	3%	3%	11%	0%	4%	1%	9%	7%	7%	3%	0%	6%
Shared Lane Traffic (%)										38%		
Lane Group Flow (vph)	149	978	40	92	421	681	0	64	32	139	141	24
v/c Ratio	0.57	0.64	0.06	0.44	0.34	0.68		0.33	0.11	0.60	0.59	0.07
Control Delay	50.0	25.5	0.2	50.6	23.5	6.0		48.5	0.7	55.6	54.6	0.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	50.0	25.5	0.2	50.6	23.5	6.0		48.5	0.7	55.6	54.6	0.4
Queue Length 50th (ft)	89	260	0	56	97	2		38	0	88	89	0
Queue Length 95th (ft)	138	366	0	97	145	16		53	0	#183	124	0
Internal Link Dist (ft)		1905			1830			595			1408	
Turn Bay Length (ft)	500		225	175		325				160		325
Base Capacity (vph)	410	1793	810	422	1747	1140		388	448	253	262	347
Starvation Cap Reductn	0	0	0	0	0	0		0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0		0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0		0	0	0	0	0
Reduced v/c Ratio	0.36	0.55	0.05	0.22	0.24	0.60		0.16	0.07	0.55	0.54	0.07

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

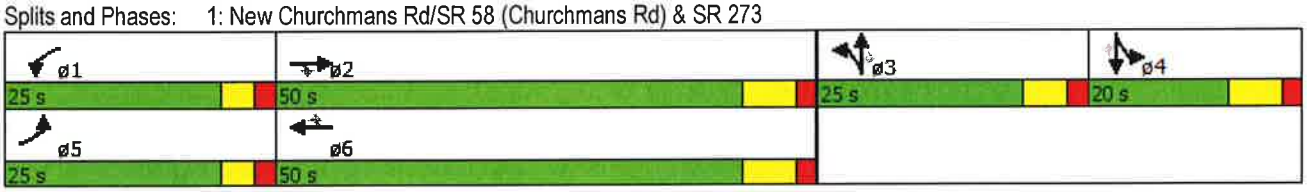
1: New Churchmans Rd/SR 58 (Churchmans Rd) & SR 273
Timing Report, Sorted By Phase

6/5/2013

Phase Number	1	2	3	4	5	6
Movement	WBL	EBT	NBTL	SBTL	EBL	WBT
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Min	None	None	None	Min
Maximum Split (s)	25	50	25	20	25	50
Maximum Split (%)	20.8%	41.7%	20.8%	16.7%	20.8%	41.7%
Minimum Split (s)	11	23	12	13	11	23
Yellow Time (s)	3	5	4	5	3	5
All-Red Time (s)	2	2	2	2	2	2
Minimum Initial (s)	5	15	5	5	5	15
Vehicle Extension (s)	3	5	4	4	3	5
Minimum Gap (s)	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0
Walk Time (s)						
Flash Dont Walk (s)						
Dual Entry	No	Yes	No	No	No	Yes
Inhibit Max	No	No	No	No	No	No
Start Time (s)	0	25	75	100	0	25
End Time (s)	25	75	100	0	25	75
Yield/Force Off (s)	20	68	94	113	20	68
Yield/Force Off 170(s)	20	68	94	113	20	68
Local Start Time (s)	95	0	50	75	95	0
Local Yield (s)	115	43	69	88	115	43
Local Yield 170(s)	115	43	69	88	115	43

Intersection Summary	
Cycle Length	120
Control Type	Actuated-Uncoordinated
Natural Cycle	60

Splits and Phases: 1: New Churchmans Rd/SR 58 (Churchmans Rd) & SR 273



1: New Churchmans Rd/SR 58 (Churchmans Rd) & SR 273
HCM Signalized Intersection Capacity Analysis

6/5/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	34	628	28	43	728	285	38	30	74	482	21	86
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	7.0	7.0	5.0	7.0	7.0		6.0	6.0	7.0	7.0	7.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00		1.00	1.00	0.95	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.98	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1752	3471	1455	1805	3574	1599		1787	1553	1681	1698	1615
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.98	1.00	0.95	0.96	1.00
Satd. Flow (perm)	1752	3471	1455	1805	3574	1599		1787	1553	1681	1698	1615
Peak-hour factor, PHF	0.94	0.92	0.70	0.60	0.92	0.81	0.86	0.63	0.71	0.86	0.66	0.90
Adj. Flow (vph)	36	683	40	72	791	352	44	48	104	560	32	96
RTOR Reduction (vph)	0	0	26	0	0	213	0	0	91	0	0	82
Lane Group Flow (vph)	36	683	14	72	791	139	0	92	13	297	295	14
Heavy Vehicles (%)	3%	4%	11%	0%	1%	1%	8%	0%	4%	2%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2			6			3			4
Actuated Green, G (s)	4.6	32.6	32.6	7.6	35.6	35.6		11.3	11.3	13.5	13.5	13.5
Effective Green, g (s)	4.6	32.6	32.6	7.6	35.6	35.6		11.3	11.3	13.5	13.5	13.5
Actuated g/C Ratio	0.05	0.36	0.36	0.08	0.40	0.40		0.13	0.13	0.15	0.15	0.15
Clearance Time (s)	5.0	7.0	7.0	5.0	7.0	7.0		6.0	6.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	5.0	5.0	3.0	5.0	5.0		4.0	4.0	4.0	4.0	4.0
Lane Grp Cap (vph)	89	1257	527	152	1413	632		224	194	252	254	242
v/s Ratio Prot	0.02	0.20		c0.04	c0.22			c0.05		c0.18	0.17	
v/s Ratio Perm			0.01			0.09			0.01			0.01
v/c Ratio	0.40	0.54	0.03	0.47	0.56	0.22		0.41	0.07	1.18	1.16	0.06
Uniform Delay, d1	41.4	22.8	18.5	39.3	21.1	18.0		36.3	34.7	38.2	38.2	32.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.0	0.8	0.0	2.3	0.8	0.4		1.7	0.2	113.7	107.2	0.1
Delay (s)	44.4	23.6	18.5	41.6	21.9	18.4		37.9	34.9	151.9	145.4	32.9
Level of Service	D	C	B	D	C	B		D	C	F	F	C
Approach Delay (s)		24.4			22.1			36.3			132.5	
Approach LOS		C			C			D			F	

Intersection Summary			
HCM 2000 Control Delay	50.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	25.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

1: New Churchmans Rd/SR 58 (Churchmans Rd) & SR 273
Queues

6/5/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	34	628	28	43	728	285	38	30	74	482	21	86
Peak Hour Factor	0.94	0.92	0.70	0.60	0.92	0.81	0.86	0.63	0.71	0.86	0.66	0.90
Heavy Vehicles (%)	3%	4%	11%	0%	1%	1%	8%	0%	4%	2%	0%	0%
Shared Lane Traffic (%)										47%		
Lane Group Flow (vph)	36	683	40	72	791	352	0	92	104	297	295	96
v/c Ratio	0.24	0.55	0.07	0.38	0.55	0.41		0.41	0.32	1.16	1.13	0.27
Control Delay	47.2	25.4	0.2	47.4	22.7	3.9		45.2	5.4	143.3	136.7	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	47.2	25.4	0.2	47.4	22.7	3.9		45.2	5.4	143.3	136.7	4.9
Queue Length 50th (ft)	20	163	0	41	188	0		51	0	~234	~230	0
Queue Length 95th (ft)	56	246	0	59	275	33		73	0	#443	#301	21
Internal Link Dist (ft)		1905			1830			595			1408	
Turn Bay Length (ft)	500		225	175		325				160		325
Base Capacity (vph)	412	1758	804	425	1810	983		400	460	257	260	362
Starvation Cap Reductn	0	0	0	0	0	0		0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0		0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0		0	0	0	0	0
Reduced v/c Ratio	0.09	0.39	0.05	0.17	0.44	0.36		0.23	0.23	1.16	1.13	0.27

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

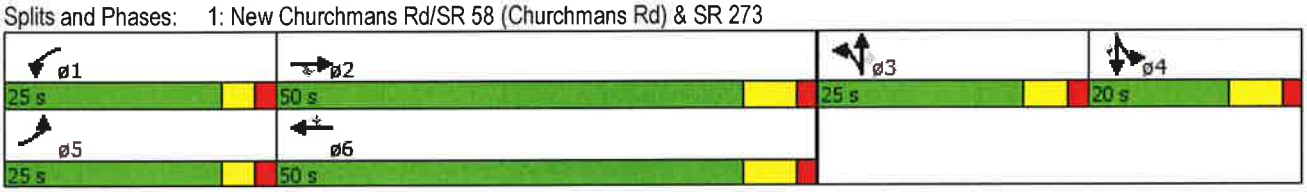
1: New Churchmans Rd/SR 58 (Churchmans Rd) & SR 273
Timing Report, Sorted By Phase

6/5/2013

Phase Number	1	2	3	4	5	6
Movement	WBL	EBT	NBTL	SBTL	EBL	WBT
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Min	None	None	None	Min
Maximum Split (s)	25	50	25	20	25	50
Maximum Split (%)	20.8%	41.7%	20.8%	16.7%	20.8%	41.7%
Minimum Split (s)	11	23	12	13	11	23
Yellow Time (s)	3	5	4	5	3	5
All-Red Time (s)	2	2	2	2	2	2
Minimum Initial (s)	5	15	5	5	5	15
Vehicle Extension (s)	3	5	4	4	3	5
Minimum Gap (s)	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0
Walk Time (s)						
Flash Dont Walk (s)						
Dual Entry	No	Yes	No	No	No	Yes
Inhibit Max	No	No	No	No	No	No
Start Time (s)	0	25	75	100	0	25
End Time (s)	25	75	100	0	25	75
Yield/Force Off (s)	20	68	94	113	20	68
Yield/Force Off 170(s)	20	68	94	113	20	68
Local Start Time (s)	95	0	50	75	95	0
Local Yield (s)	115	43	69	88	115	43
Local Yield 170(s)	115	43	69	88	115	43

Intersection Summary	
Cycle Length	120
Control Type	Actuated-Uncoordinated
Natural Cycle	65

Splits and Phases: 1: New Churchmans Rd/SR 58 (Churchmans Rd) & SR 273



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	498	345	148	275	251	69	352	3425	289	185	881	207
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.0	8.0	8.0	7.0	7.0	7.0	6.0	8.0	8.0	6.0	8.0	8.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.86	1.00	0.97	0.86	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1538	3367	3505	1524	3467	6471	1568	3273	6108	1568
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1538	3367	3505	1524	3467	6471	1568	3273	6108	1568
Peak-hour factor, PHF	0.84	0.83	0.70	0.91	0.86	0.51	0.89	0.89	0.84	0.68	0.86	0.67
Adj. Flow (vph)	593	416	211	302	292	135	396	3848	344	272	1024	309
RTOR Reduction (vph)	0	0	165	0	0	120	0	0	98	0	0	189
Lane Group Flow (vph)	593	416	46	302	292	15	396	3848	246	272	1024	120
Heavy Vehicles (%)	2%	2%	5%	4%	3%	6%	1%	1%	3%	7%	7%	3%
Turn Type	Split	NA	Perm	Split	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	3	3		4	4		5	2		1	6	
Permitted Phases			3			4			2			6
Actuated Green, G (s)	36.8	36.8	36.8	20.6	20.6	20.6	23.7	77.6	77.6	16.0	69.9	69.9
Effective Green, g (s)	36.8	36.8	36.8	20.6	20.6	20.6	23.7	77.6	77.6	16.0	69.9	69.9
Actuated g/C Ratio	0.20	0.20	0.20	0.11	0.11	0.11	0.13	0.43	0.43	0.09	0.39	0.39
Clearance Time (s)	8.0	8.0	8.0	7.0	7.0	7.0	6.0	8.0	8.0	6.0	8.0	8.0
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	5.0	4.0	4.0
Lane Grp Cap (vph)	701	723	314	385	401	174	456	2789	675	290	2371	608
v/s Ratio Prot	c0.17	0.12		c0.09	0.08		c0.11	c0.59		0.08	0.17	
v/s Ratio Perm			0.03			0.01			0.16			0.08
v/c Ratio	0.85	0.58	0.15	0.78	0.73	0.09	0.87	1.38	0.36	0.94	0.43	0.20
Uniform Delay, d1	68.9	64.6	58.7	77.5	77.0	71.3	76.6	51.2	34.6	81.5	40.5	36.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.47	6.65
Incremental Delay, d2	10.2	1.8	0.5	11.6	7.9	0.5	17.2	173.2	1.5	35.4	0.5	0.7
Delay (s)	79.1	66.3	59.2	89.1	84.9	71.8	93.8	224.4	36.1	103.6	60.0	243.1
Level of Service	E	E	E	F	F	E	F	F	D	F	E	F
Approach Delay (s)		71.3			84.2			199.0			102.6	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	150.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	29.0
Intersection Capacity Utilization	100.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

3: US 13 & SR 273
Queues

6/5/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	498	345	148	275	251	69	352	3425	289	185	881	207
Peak Hour Factor	0.84	0.83	0.70	0.91	0.86	0.51	0.89	0.89	0.84	0.68	0.86	0.67
Heavy Vehicles (%)	2%	2%	5%	4%	3%	6%	1%	1%	3%	7%	7%	3%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	593	416	211	302	292	135	396	3848	344	272	1024	309
v/c Ratio	0.84	0.58	0.44	0.78	0.73	0.44	0.87	1.38	0.45	0.94	0.43	0.39
Control Delay	80.9	68.1	10.3	92.4	88.4	10.9	95.9	212.1	19.1	104.4	60.4	23.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.9	68.1	10.3	92.4	88.4	10.9	95.9	212.1	19.1	104.4	60.4	23.7
Queue Length 50th (ft)	351	236	4	181	178	0	240	~1751	139	167	272	37
Queue Length 95th (ft)	391	271	15	239	223	0	#315	#1739	200	164	386	149
Internal Link Dist (ft)		1830			1598			2459			3334	
Turn Bay Length (ft)	350		375	425		475	425		375	275		525
Base Capacity (vph)	705	727	480	392	408	312	462	2789	773	290	2372	797
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.57	0.44	0.77	0.72	0.43	0.86	1.38	0.45	0.94	0.43	0.39

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

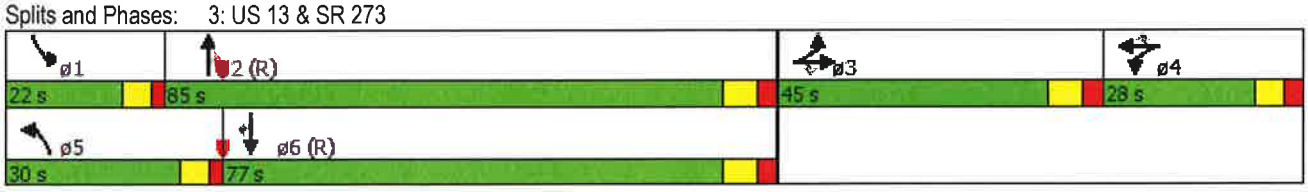
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Phase Number	1	2	3	4	5	6
Movement	SBL	NBT	EBTL	WBTL	NBL	SBT
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	None	None	None	C-Max
Maximum Split (s)	22	85	45	28	30	77
Maximum Split (%)	12.2%	47.2%	25.0%	15.6%	16.7%	42.8%
Minimum Split (s)	12	19	14	13	12	19
Yellow Time (s)	4	5	5	4	4	5
All-Red Time (s)	2	3	3	3	2	3
Minimum Initial (s)	5	10	5	5	5	10
Vehicle Extension (s)	5	4	5	5	5	4
Minimum Gap (s)	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0
Walk Time (s)						
Flash Dont Walk (s)						
Dual Entry	No	Yes	No	No	No	Yes
Inhibit Max	No	No	No	No	No	No
Start Time (s)	150	172	77	122	150	0
End Time (s)	172	77	122	150	0	77
Yield/Force Off (s)	166	69	114	143	174	69
Yield/Force Off 170(s)	166	69	114	143	174	69
Local Start Time (s)	150	172	77	122	150	0
Local Yield (s)	166	69	114	143	174	69
Local Yield 170(s)	166	69	114	143	174	69

Intersection Summary	
Cycle Length	180
Control Type	Actuated-Coordinated
Natural Cycle	150

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green, Master Intersection

Splits and Phases: 3: US 13 & SR 273



3: US 13 & SR 273
HCM Signalized Intersection Capacity Analysis

6/5/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	652	292	286	563	417	67	273	1598	174	77	3337	355
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.0	8.0	8.0	7.0	7.0	7.0	6.0	8.0	8.0	6.0	8.0	8.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.86	1.00	0.97	0.86	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3502	3574	1599	3502	3539	1524	3467	6408	1583	3400	6408	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3502	3574	1599	3502	3539	1524	3467	6408	1583	3400	6408	1599
Peak-hour factor, PHF	0.87	0.83	0.83	0.95	0.80	0.76	0.84	0.96	0.71	0.84	0.99	0.89
Adj. Flow (vph)	749	352	345	593	521	88	325	1665	245	92	3371	399
RTOR Reduction (vph)	0	0	121	0	0	72	0	0	135	0	0	179
Lane Group Flow (vph)	749	352	224	593	521	16	325	1665	110	92	3371	220
Heavy Vehicles (%)	0%	1%	1%	0%	2%	6%	1%	2%	2%	3%	2%	1%
Turn Type	Split	NA	Perm	Split	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	3	3		4	4		5	2		1	6	
Permitted Phases			3			4			2			6
Actuated Green, G (s)	26.0	26.0	26.0	32.0	32.0	32.0	16.0	80.8	80.8	12.2	77.0	77.0
Effective Green, g (s)	26.0	26.0	26.0	32.0	32.0	32.0	16.0	80.8	80.8	12.2	77.0	77.0
Actuated g/C Ratio	0.14	0.14	0.14	0.18	0.18	0.18	0.09	0.45	0.45	0.07	0.43	0.43
Clearance Time (s)	8.0	8.0	8.0	7.0	7.0	7.0	6.0	8.0	8.0	6.0	8.0	8.0
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	5.0	4.0	4.0
Lane Grp Cap (vph)	505	516	230	622	629	270	308	2876	710	230	2741	684
v/s Ratio Prot	c0.21	0.10		c0.17	0.15		c0.09	c0.26		0.03	c0.53	
v/s Ratio Perm			0.14			0.01			0.07			0.14
v/c Ratio	1.48	0.68	0.97	0.95	0.83	0.06	1.06	0.58	0.15	0.40	1.23	0.32
Uniform Delay, d1	77.0	73.1	76.6	73.3	71.4	61.5	82.0	36.9	29.4	80.4	51.5	34.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.73	1.19	2.88
Incremental Delay, d2	227.9	4.8	51.6	25.4	9.8	0.2	66.5	0.9	0.5	1.5	105.6	0.8
Delay (s)	304.9	77.8	128.3	98.7	81.2	61.7	148.5	37.8	29.8	60.3	167.0	99.1
Level of Service	F	E	F	F	F	E	F	D	C	E	F	F
Approach Delay (s)		207.5			88.4			53.0			157.5	
Approach LOS		F			F			D			F	

Intersection Summary			
HCM 2000 Control Delay	129.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.20		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	29.0
Intersection Capacity Utilization	110.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

3: US 13 & SR 273
Queues

6/5/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	652	292	286	563	417	67	273	1598	174	77	3337	355
Peak Hour Factor	0.87	0.83	0.83	0.95	0.80	0.76	0.84	0.96	0.71	0.84	0.99	0.89
Heavy Vehicles (%)	0%	1%	1%	0%	2%	6%	1%	2%	2%	3%	2%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	749	352	345	593	521	88	325	1665	245	92	3371	399
v/c Ratio	1.48	0.68	0.98	0.95	0.83	0.24	1.06	0.58	0.29	0.40	1.23	0.46
Control Delay	276.0	80.6	86.5	98.4	83.4	5.4	141.3	38.1	4.0	61.7	155.3	23.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	276.0	80.6	86.5	98.4	83.4	5.4	141.3	38.1	4.0	61.7	155.3	23.2
Queue Length 50th (ft)	~625	211	259	362	317	0	~215	423	0	54	~1408	163
Queue Length 95th (ft)	#723	248	#397	#483	338	4	#291	473	7	m65	#1445	310
Internal Link Dist (ft)		1830			1598			2459			3334	
Turn Bay Length (ft)	350		375	425		475	425		375	275		525
Base Capacity (vph)	505	516	352	622	629	365	308	2876	845	302	2741	863
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.48	0.68	0.98	0.95	0.83	0.24	1.06	0.58	0.29	0.30	1.23	0.46

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

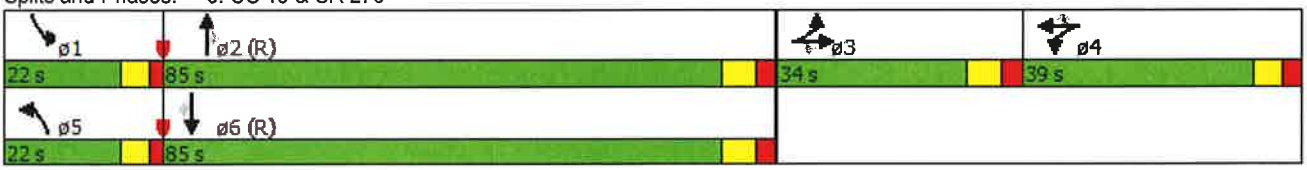
m Volume for 95th percentile queue is metered by upstream signal.

Phase Number	1	2	3	4	5	6
Movement	SBL	NBT	EBTL	WBTL	NBL	SBT
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	None	None	None	C-Max
Maximum Split (s)	22	85	34	39	22	85
Maximum Split (%)	12.2%	47.2%	18.9%	21.7%	12.2%	47.2%
Minimum Split (s)	12	19	14	13	12	19
Yellow Time (s)	4	5	5	4	4	5
All-Red Time (s)	2	3	3	3	2	3
Minimum Initial (s)	5	10	5	5	5	10
Vehicle Extension (s)	5	4	5	5	5	4
Minimum Gap (s)	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0
Walk Time (s)						
Flash Dont Walk (s)						
Dual Entry	No	Yes	No	No	No	Yes
Inhibit Max	No	No	No	No	No	No
Start Time (s)	158	0	85	119	158	0
End Time (s)	0	85	119	158	0	85
Yield/Force Off (s)	174	77	111	151	174	77
Yield/Force Off 170(s)	174	77	111	151	174	77
Local Start Time (s)	158	0	85	119	158	0
Local Yield (s)	174	77	111	151	174	77
Local Yield 170(s)	174	77	111	151	174	77

Intersection Summary	
Cycle Length	180
Control Type	Actuated-Coordinated
Natural Cycle	150

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green, Master Intersection

Splits and Phases: 3: US 13 & SR 273



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	8	13	13	3	70	36	3617	21	77	1545	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0	6.0	6.0	7.0	7.0	6.0	7.0	7.0
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.86	1.00	0.97	0.86	1.00
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.97	1.00	0.95	0.97	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1432	1495	1309	1448	1524	1805	6285	1417	3273	5996	1615
Flt Permitted		0.97	1.00	0.95	0.97	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1432	1495	1309	1448	1524	1805	6285	1417	3273	5996	1615
Peak-hour factor, PHF	0.45	0.50	0.65	0.65	0.75	0.70	0.53	0.97	0.53	0.66	0.86	0.50
Adj. Flow (vph)	20	16	20	20	4	100	68	3729	40	117	1797	12
RTOR Reduction (vph)	0	0	19	0	0	95	0	0	12	0	0	4
Lane Group Flow (vph)	0	36	1	12	12	5	68	3729	28	117	1797	8
Heavy Vehicles (%)	22%	38%	8%	31%	0%	6%	0%	4%	14%	7%	9%	0%
Turn Type	Split	NA	Perm	Split	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	3	3		4	4		5	2		1	6	
Permitted Phases			3			4			2			6
Actuated Green, G (s)		9.6	9.6	8.9	8.9	8.9	12.9	123.8	123.8	12.7	123.6	123.6
Effective Green, g (s)		9.6	9.6	8.9	8.9	8.9	12.9	123.8	123.8	12.7	123.6	123.6
Actuated g/C Ratio		0.05	0.05	0.05	0.05	0.05	0.07	0.69	0.69	0.07	0.69	0.69
Clearance Time (s)		6.0	6.0	6.0	6.0	6.0	6.0	7.0	7.0	6.0	7.0	7.0
Vehicle Extension (s)		4.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Grp Cap (vph)		76	79	64	71	75	129	4322	974	230	4117	1108
v/s Ratio Prot		c0.03		c0.01	0.01		c0.04	c0.59		0.04	0.30	
v/s Ratio Perm			0.00			0.00			0.02			0.01
v/c Ratio		0.47	0.01	0.19	0.17	0.07	0.53	0.86	0.03	0.51	0.44	0.01
Uniform Delay, d1		82.7	80.7	82.1	82.0	81.6	80.6	21.6	8.9	80.6	12.6	8.9
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.13	0.57	1.00	1.00	1.00	1.00
Incremental Delay, d2		6.2	0.1	1.9	1.5	0.5	0.5	0.2	0.0	2.4	0.3	0.0
Delay (s)		89.0	80.8	84.0	83.5	82.1	91.4	12.4	9.0	83.0	13.0	8.9
Level of Service		F	F	F	F	F	F	B	A	F	B	A
Approach Delay (s)		86.1			82.4			13.8			17.2	
Approach LOS		F			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	25.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

6: US 13 & NCC Airport/School Ln
Queues

6/5/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	9	8	13	13	3	70	36	3617	21	77	1545	6
Peak Hour Factor	0.45	0.50	0.65	0.65	0.75	0.70	0.53	0.97	0.53	0.66	0.86	0.50
Heavy Vehicles (%)	22%	38%	8%	31%	0%	6%	0%	4%	14%	7%	9%	0%
Shared Lane Traffic (%)				40%								
Lane Group Flow (vph)	0	36	20	12	12	100	68	3729	40	117	1797	12
v/c Ratio		0.42	0.11	0.19	0.17	0.59	0.53	0.85	0.04	0.51	0.43	0.01
Control Delay		94.6	1.2	87.2	85.8	27.0	91.5	13.4	0.0	87.9	13.7	0.0
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		94.6	1.2	87.2	85.8	27.0	91.5	13.4	0.0	87.9	13.7	0.0
Queue Length 50th (ft)		42	0	14	14	0	85	186	0	70	265	0
Queue Length 95th (ft)		45	0	28	33	25	m65	m125	m0	76	339	0
Internal Link Dist (ft)		583			942			3334			1396	
Turn Bay Length (ft)			50	215		300	400		300	300		100
Base Capacity (vph)		127	221	159	176	274	170	4365	1011	309	4157	1147
Starvation Cap Reductn		0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio		0.28	0.09	0.08	0.07	0.36	0.40	0.85	0.04	0.38	0.43	0.01

Intersection Summary

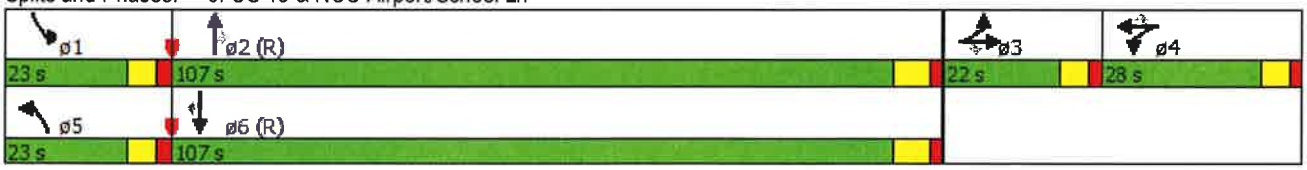
m Volume for 95th percentile queue is metered by upstream signal.

Phase Number	1	2	3	4	5	6
Movement	SBL	NBT	EBTL	WBTL	NBL	SBT
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	None	None	None	C-Max
Maximum Split (s)	23	107	22	28	23	107
Maximum Split (%)	12.8%	59.4%	12.2%	15.6%	12.8%	59.4%
Minimum Split (s)	12	18	12	12	12	18
Yellow Time (s)	4	5	4	4	4	5
All-Red Time (s)	2	2	2	2	2	2
Minimum Initial (s)	5	10	5	5	5	10
Vehicle Extension (s)	4	5	4	4	4	5
Minimum Gap (s)	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0
Walk Time (s)						
Flash Dont Walk (s)						
Dual Entry	No	Yes	No	No	No	Yes
Inhibit Max	No	No	No	No	No	No
Start Time (s)	8	31	138	160	8	31
End Time (s)	31	138	160	8	31	138
Yield/Force Off (s)	25	131	154	2	25	131
Yield/Force Off 170(s)	25	131	154	2	25	131
Local Start Time (s)	157	0	107	129	157	0
Local Yield (s)	174	100	123	151	174	100
Local Yield 170(s)	174	100	123	151	174	100

Intersection Summary	
Cycle Length	180
Control Type	Actuated-Coordinated
Natural Cycle	100

Offset: 31 (17%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Splits and Phases: 6: US 13 & NCC Airport/School Ln



6: US 13 & NCC Airport/School Ln
HCM Signalized Intersection Capacity Analysis

6/5/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	66	12	68	92	3	178	19	2330	5	247	3402	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0	6.0	6.0	7.0	7.0	6.0	7.0	7.0
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.86	1.00	0.97	0.86	1.00
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1798	1615	1698	1716	1568	1805	6536	1615	3502	6536	1615
Flt Permitted		0.96	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1798	1615	1698	1716	1568	1805	6536	1615	3502	6536	1615
Peak-hour factor, PHF	0.69	0.50	0.74	0.85	0.38	0.86	0.79	0.90	0.63	0.86	0.95	0.56
Adj. Flow (vph)	96	24	92	108	8	207	24	2589	8	287	3581	16
RTOR Reduction (vph)	0	0	84	0	0	178	0	0	3	0	0	5
Lane Group Flow (vph)	0	120	8	58	58	29	24	2589	5	287	3581	11
Heavy Vehicles (%)	0%	8%	0%	1%	0%	3%	0%	0%	0%	0%	0%	0%
Turn Type	Split	NA	Perm	Split	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	3	3		4	4		5	2		1	6	
Permitted Phases			3			4			2			6
Actuated Green, G (s)		15.9	15.9	13.2	13.2	13.2	6.1	106.3	106.3	19.6	119.8	119.8
Effective Green, g (s)		15.9	15.9	13.2	13.2	13.2	6.1	106.3	106.3	19.6	119.8	119.8
Actuated g/C Ratio		0.09	0.09	0.07	0.07	0.07	0.03	0.59	0.59	0.11	0.67	0.67
Clearance Time (s)		6.0	6.0	6.0	6.0	6.0	6.0	7.0	7.0	6.0	7.0	7.0
Vehicle Extension (s)		4.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Grp Cap (vph)		158	142	124	125	114	61	3859	953	381	4350	1074
v/s Ratio Prot		c0.07		c0.03	0.03		0.01	0.40		c0.08	c0.55	
v/s Ratio Perm			0.01			0.02			0.00			0.01
v/c Ratio		0.76	0.06	0.47	0.46	0.26	0.39	0.67	0.00	0.75	0.82	0.01
Uniform Delay, d1		80.2	75.2	80.0	80.0	78.8	85.1	25.0	15.1	77.9	22.3	10.1
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.02	0.83	1.00	1.00	1.00	1.00
Incremental Delay, d2		19.8	0.2	3.8	3.7	1.6	3.3	0.5	0.0	8.7	1.9	0.0
Delay (s)		100.0	75.4	83.8	83.7	80.4	90.0	21.3	15.1	86.5	24.1	10.2
Level of Service		F	E	F	F	F	F	C	B	F	C	B
Approach Delay (s)		89.3			81.6			21.9			28.7	
Approach LOS		F			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	30.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	25.0
Intersection Capacity Utilization	80.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

6: US 13 & NCC Airport/School Ln
Queues

6/5/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	66	12	68	92	3	178	19	2330	5	247	3402	9
Peak Hour Factor	0.69	0.50	0.74	0.85	0.38	0.86	0.79	0.90	0.63	0.86	0.95	0.56
Heavy Vehicles (%)	0%	8%	0%	1%	0%	3%	0%	0%	0%	0%	0%	0%
Shared Lane Traffic (%)				46%								
Lane Group Flow (vph)	0	120	92	58	58	207	24	2589	8	287	3581	16
v/c Ratio		0.76	0.40	0.47	0.46	0.71	0.27	0.67	0.01	0.76	0.81	0.01
Control Delay		108.3	16.3	90.9	90.4	25.5	87.6	22.1	0.0	90.9	24.6	0.0
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		108.3	16.3	90.9	90.4	25.5	87.6	22.1	0.0	90.9	24.6	0.0
Queue Length 50th (ft)		140	0	70	70	17	30	307	0	171	917	0
Queue Length 95th (ft)		117	27	115	49	90	m44	m290	m0	215	1102	0
Internal Link Dist (ft)		583			942			3334			1396	
Turn Bay Length (ft)			50	215		300	400		300	300		100
Base Capacity (vph)		169	240	226	228	375	180	3861	991	408	4438	1126
Starvation Cap Reductn		0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio		0.71	0.38	0.26	0.25	0.55	0.13	0.67	0.01	0.70	0.81	0.01

Intersection Summary

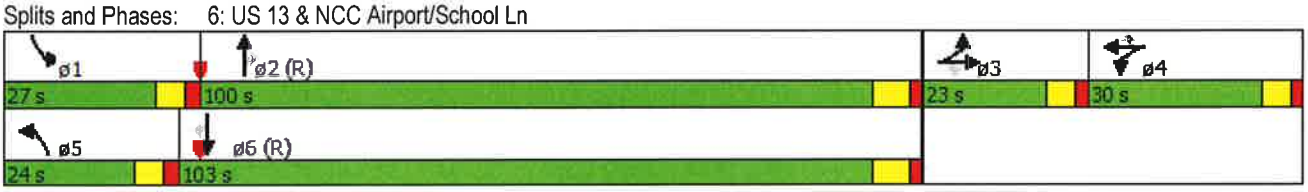
m Volume for 95th percentile queue is metered by upstream signal.

Phase Number	1	2	3	4	5	6
Movement	SBL	NBT	EBTL	WBTL	NBL	SBT
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	None	None	None	C-Max
Maximum Split (s)	27	100	23	30	24	103
Maximum Split (%)	15.0%	55.6%	12.8%	16.7%	13.3%	57.2%
Minimum Split (s)	12	18	12	12	12	18
Yellow Time (s)	4	5	4	4	4	5
All-Red Time (s)	2	2	2	2	2	2
Minimum Initial (s)	5	10	5	5	5	10
Vehicle Extension (s)	4	5	4	4	4	5
Minimum Gap (s)	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0
Walk Time (s)						
Flash Dont Walk (s)						
Dual Entry	No	Yes	No	No	No	Yes
Inhibit Max	No	No	No	No	No	No
Start Time (s)	4	31	131	154	4	28
End Time (s)	31	131	154	4	28	131
Yield/Force Off (s)	25	124	148	178	22	124
Yield/Force Off 170(s)	25	124	148	178	22	124
Local Start Time (s)	153	0	100	123	153	177
Local Yield (s)	174	93	117	147	171	93
Local Yield 170(s)	174	93	117	147	171	93

Intersection Summary	
Cycle Length	180
Control Type	Actuated-Coordinated
Natural Cycle	90

Offset: 31 (17%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Splits and Phases: 6: US 13 & NCC Airport/School Ln



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