Memo

Date:	Thursday, May 09, 2019
Project:	Whitney Road Corridor Planning Evaluation
To:	City of Concord, NH David Cedarholm, PE
From:	Roch Larochelle, PE Rick Plenge, PE, PTOE Jason Ayotte, PE Kevin Slattery, PWS / Nick Henke
Subject:	Phase 1 – Corridor Buildout Feasibility Evaluation

This memorandum documents the findings of an initial feasibility assessment that HDR has conducted to aid the City of Concord, NH (City) in determining the highest potential value and best use of a tract of land encompassing approximately 200 acres in the vicinity of I-93 Exit 17 inclusive of multiple privately-owned parcels bounded by I-93, the Merrimack River, Hoit Road, Whitney Road, and Sewalls Falls Road. HDR's evaluation efforts have included collecting available information; assessing the environmental resources potentially affected; projecting future traffic volumes based on current zoning and known developments; coordination with the City, Central New Hampshire Regional Planning Commission (CNHRPC), and the New Hampshire Department of Transportation (NHDOT) to understand corridor and network traffic concerns; and finally the development of a corridor concept in order to better define potential concerns, impacts, and costs of the conceptual improvements.

The following information details the results of the initial assessments of natural and cultural environmental resources, site generated traffic, as well as associated impacts with the anticipated parcel development and conceptual roadway and utility infrastructure program costs. It is understood that subsequent study phases and more detailed analysis and design may follow this study pending the City's review of these study results and definition of next steps..

Developable Land Environmental Constraints Evaluation (Task 1)

This task sought to perform an evaluation of environmental constraints associated with the potentially developable lands along a conceptual Whitney Road alignment area as described below. This assessment constitutes an initial, desktop level of review for planning purposes, utilizing Geographic Information System (GIS) data provided by the City of Concord, NH GRANIT GIS clearinghouse, and available plans from previously proposed developments.

Data Gathering and Review

Methods:

The Area of Interest (AOI) identified for this investigation is bounded by I-93, the Merrimack River, Hoit/Whitney Roads and Monitor Drive/Sewalls Falls Road. Within and adjacent to the AOI, GIS

information was used to create a desktop level inventory of environmental constraints to form the basis of the planning-level assessment. The environmental constraints reviewed included:

- National Register of Historic Places
- Local Potential Contamination Sources
- Remediation Sites
- Underground Storage Tanks
- Public Water Supply Wells
- Wellhead Protection Areas
- Outstand Resource Waters
- National Wetland Inventory
- Hydrography
- USDA Soils
- FEMA Flood Zones
- NHDES Shoreland Protection Zones
- Local Zoning Districts
- Topography

In addition, field delineated wetland resources at select locations were provided on previous development plans by the City of Concord. This information was then digitized from these plans and used in the constraints inventory for a higher level of wetland resource resolution where available. We then developed a conceptual level roadway alignment and footprint, including anticipated roadway right-of-way requirements, which was referenced to the constraints inventory as the basis for the evaluation of remaining areas for development and to identify expected permitting needs for the roadway.

Using the same environmental constraints data, potential development areas proximate to the conceptual roadway alignment were evaluated for suitability of future development and potential permitting needs. Suitability was evaluated by using avoidance of substantial physical, natural and protected resource constraints and recognition of complexity or challenges securing permits to develop the land. As depicted in **Figure 1**, undeveloped areas were selected that provided direct access to the conceptual roadway. A theoretical developable area boundary was then drawn allowing for a 25 foot offset from the proposed roadway right of way, neighboring parcel boundaries, and existing development, as well as to avoid major wetland and other natural resources, steep topography, and protected shoreland zoning districts.

Environmental and Zoning Constraints:

The conceptual roadway alignment that would connect Hoit/Whitney Roads with Monitor Drive/Sewalls Falls Road will require crossing two perennial watercourses, Burnham Brook and Hayward Brook. Both watercourses have associated wetlands and floodplains that would be affected by this roadway alignment. These watercourses are both tributaries to the Merrimack River which serves as the western boundary of the AOI. Areas located in the vicinity of the conceptual alignment, and that make up much of the AOI, are primarily wooded with some scattered wetlands. It is expected that based on the topography and mapped soil types, and from a review of site information conducted for a former development proposal which established field-delineated wetlands (Parcel: 06/P 8/), that the size and amount of actual wetlands within the AOI is likely to increase with a field delineation of these resources. Based upon that projection, it is possible that areas of currently un-mapped wetland would be encountered and further constrain the development.

The AOI is made up of parcels that fall into three base zoning districts defined by the City of Concord; Open Space Residential, Gateway Performance, and Industrial zoning districts.

Development of these parcels is guided by the approved uses defined in the Zoning Ordinance of the City of Concord for these zoning districts. Additionally, areas adjacent to the Merrimack River, Burnham Brook, and Hayward Brook fall within a Shoreland Protection zoning overlay district. This district further limits what can be constructed in the vicinity of these three watercourses.

City of Concord Infrastructure

Roadway Permitting:

Based on a review of the information available at this time, including the existing development conditions, onsite and adjacent natural resources and zoning resource constraints present, the Whitney Road development will require a series of local, state, and federal permits/approvals. With the understanding that subsequent property/land development will be segmented, permitting efforts will ultimately be dependent on when and where development takes place. The first element of development is expected to be the road connecting Hoit/Whitney Roads with Monitor Drive/Sewalls Falls Road. Clearances for this activity would include those issued by the US Army Corps of Engineers (USACE), US Environmental Protection Agency (EPA), US Fish and Wildlife Service (USFWS), New Hampshire Department of Environmental Services (NHDES), and the Concord Planning Board. Those permits/approvals are listed below (assuming the roadway is designed and constructed without the use of federal funds). Additionally, the proposed roadway will need to be designed for consistency with the New Hampshire Stormwater Manual, including post-construction BMPs, and Section 402 of the Clean Water Act (CWA) of 1972.

<u>Federal</u>

- USACE Section 404 Permit
- NPDES Construction General Permit (EPA)
- USFWS Section 7 Consultation for Northern Long-Eared Bat (*Myotis septentrionalis*) and Northeastern Bulrush (*Scirpus ancistrochaetus*).

<u>State</u>

- Shoreland Permit – NHDES Water Division/Shoreland Program, Land Resources Management
- Wetlands Permit – NHDES Water Division/Wetlands Bureau, Land Resources Management
- Alteration of Terrain Permit – NHDES Water Division/Alteration of Terrain Bureau, Land Resources Management
- 401 WQC – NHDES Water Division, Water Quality Certification Program

<u>Local</u>

- Conditional Use Permit – Concord Planning Board

Potential Developer(s)/Subsequent Development

Potential Development Permitting:

Clearances for subsequent site development will depend primarily on location, zoning, existing conditions based upon field-delineated resources, and the extent of impacts if unavoidable. Based

on an initial review of the site and knowledge of existing permitting requirements, the following permit requirements may need to be considered as the project advances:

- Any dredging and/or fill within Waters of the US, which includes wetlands, will require a permit pursuant to Section 404 of the Clean Water Act (CWA) of 1972 issued by the USACE.
- A Section 106 review pursuant to the National Historic Preservation Act (NHPA) will also be necessary if a Section 404 permit is either a Pre-Construction Notification for a NH General Permit or an Individual Permit.
- For any discharges to receiving waters, a NPDES General or Individual Permit for facilities will be required by EPA pursuant to Section 402 of the CWA.
- Impacts to a state regulated wetland resources (wetlands, water bodies and watercourses, banks, vernal pools, etc.) will require a Wetlands Permit issued by NHDES.
- Any impacts within 250 feet of the reference line of protected water bodies, which in this location is the ordinary high water (OHW) line of the Merrimack River, will require a Shorelands Permit issued by NHDES.
- Any disturbance greater than 100,000 square feet (sf) (greater than 50,000 sf within a protected shoreline) of terrain or that disturbs an area with 25% or greater slope within 50 feet of any surface water will require an Alteration of Terrain Permit issued by NHDES.
- Any impacts to federal wetlands or indirectly to surface water quality will require a Water Quality Certification (WQC) pursuant to Section 401 of the CWA issued by NHDES.
- During construction due to exposure of ground, any discharges that could reach surface Waters of the US will require a NPDES Construction General Permit issued by the US EPA.
- This potential development area and roadway corridor is within the habitat range for the federally threatened Northern Long-Eared Bat (NLEB) and may require consultation with the US Fish and Wildlife Service (USFWS).
- Depending on the type of development proposed, approval may be required by the Concord Planning Board for uses outside of those allowable within the three defined zoning base districts.

The attached graphic (**Figure 1**) identifies the areas within the AOI that, based on topography, natural resources, and surrounding zoning and development, would likely be available for development, and are expected to require the least intensity of permits and/or approvals during the development process.

Potential Development Results:

Approximately 98 acres of total land area has been identified as potentially developable based on the methodology presented above and summarized within **Table 1**. The total area represents three distinct and separate locations (identified in **Figure 1** as Areas A-C and as further described below) abutting the conceptual roadway. These identified areas were not separated based upon existing parcels in order to identify the theoretical maximum developable land areas. Therefore, these three locations represent parcel combinations of contiguous land which ranges from completely within one parcel, to development area extending across separate contiguous parcels. The identified areas in large part avoid substantial physical, natural, and protected resource

constraints with the majority of the area being located within undeveloped areas zoned for Industrial use, however a portion in the northern-most area is zoned for Gateway Performance.

Area A – Constitutes an area located on the east side of the existing Whitney Road extent made up of select portions of two parcels located adjacent to, and partial between, the Mobil Gas Station/Dunkin Donuts and Wheelabrator Technologies Inc. This location is partially zoned for Industrial use and partially zoned for Gateway Performance use.

Area B – Constitutes an area encompassed within one parcel located immediately south of Burnham Brook, abutting the eastern side of the conceptual roadway alignment. This location is zoned for Industrial use.

Area C – Constitutes an area made up of select portions of four parcels, located south of Burnham Brook, abutting the western side of the conceptual roadway alignment, and extending south along this alignment to the confluence of Hayward Brook and the Merrimack River. This location is zoned for Industrial use.

Table 1 – Summary of Developable Areas

Developable Area	Parcels Involved	Approximate Area (acres)
Area A	2	31
Area B	1	18
Area C	4	49
Total	**6***	**98**

*Area B and Area C contain portions of the same parcel.

Other Concerns/Additional Evaluation Recommendations

- In order to provide a more definitive assessment of complexity and successfulness of the road and development, on-the-ground natural resource area delineations would need to be conducted to be certain of the extent of state and federal jurisdictional resources.
- Field investigations will need to take place to assess individual presence and/or suitable habitat for the Federally Threatened Northern Long-Eared Bat (*Myotis septentrionalis*) to assess the level of consultation that would be required with the USFWS. Additionally surveys would need to take place for presence of the Federally Endangered Northeastern Bulrush (*Scirpus ancistrochaetus*).
- Based on a high level assessment of the existing setting and landscape, this area likely has high potential for both prehistoric and historic archaeological sites based on its proximity to the Merrimack River with a potential for deeply buried prehistoric sites. Additionally, this area could be significant to local and/or regional Tribes. A discovery of any archaeological or historic resource will require Section 106 Consultation pursuant to the National Historic Preservation Act (NHPA) of 1966 with USACE, ACHP, SHPO, and/or THPO.

Traffic and Transportation Assessment (Task 2)

The analysis completed within this task sought to perform a high level traffic assessment of the Whitney Road corridor and adjacent intersections in order to understand the roadway

configuration and ultimately the cost associated with constructing the necessary improvements. This study did not include an operational evaluation of the Exit 17 interchange or the Harris Hill Road roundabout which were both outside of the scope of this analysis. This analysis builds off of the environmental analysis completed within Task 1 and estimates of future traffic based on proposed land use along the Whitney Road corridor which includes a new connection to Sewalls Falls Road.

Background Traffic Conditions

This task was initiated by first developing both an existing conditions and the base opening year (assumed 2030) traffic condition model using available traffic data from the New Hampshire Department of Transportation (NHDOT), Central NH Regional Planning Commission (CNHRPC) and private developers working along the corridor. Recent May 2018 peak hour turning movement counts were provided by the Rauseo mixed-use commercial development located in the northeast quadrant of Hoit Road and Whitney Road. Average daily traffic (ADT) data provided by the NHDOT and CNHRPC were used to determine background traffic growth rates over the last 10 years. Based on review of this data and subsequent discussions with NHDOT and CNHRPC it was determined that a 1.25% annual growth rate along Hoit Road (US Route 4) and the adjacent regional roadways was appropriate. Based on the less regional nature of Whitney Road, a 1% annual growth rate was applied to Whitney Road background traffic to arrive at 2019 and 2030 traffic conditions.

In order to understand the potential regional impacts of extending Whitney Road to Sewalls Falls Road, HDR collaborated with CNHRPC. The CNHRPC travel demand modeling staff performed a high level review of the existing and future Traffic Analysis Zones (TAZ) and noted that the regional model would likely be challenged in providing usable insights into the potential trip diversion with the Whitney Road connection in place. This is based on the travel demand models reduced sensitivity to changes in the lower volume local road network. In order to provide a conservative estimate of additional background traffic, it was assumed that up to 500 vehicles a day would divert from either Village Street/Hoit Road or Sewalls Falls Road and use a new Whitney Road connection. This was based on a review of the TAZ's and number of land parcels that would be drawn to use this new connection. It should be noted that based on the lower current ADT of Sewalls Fall Road of around 4,000 vehicles a day, that even if a large proportion of that traffic is drawn to use a new Whitney Road connection, it will likely not be significant enough to influence the number of lanes required along the proposed roadway.

The 2019 existing and 2030 background volumes are summarized within **Figures 2** and **3**. Both figures highlight both projected ADT volumes in the surrounding study area roadway network along with the peak hour volumes at the Hoit Road and Whitney Road intersection.

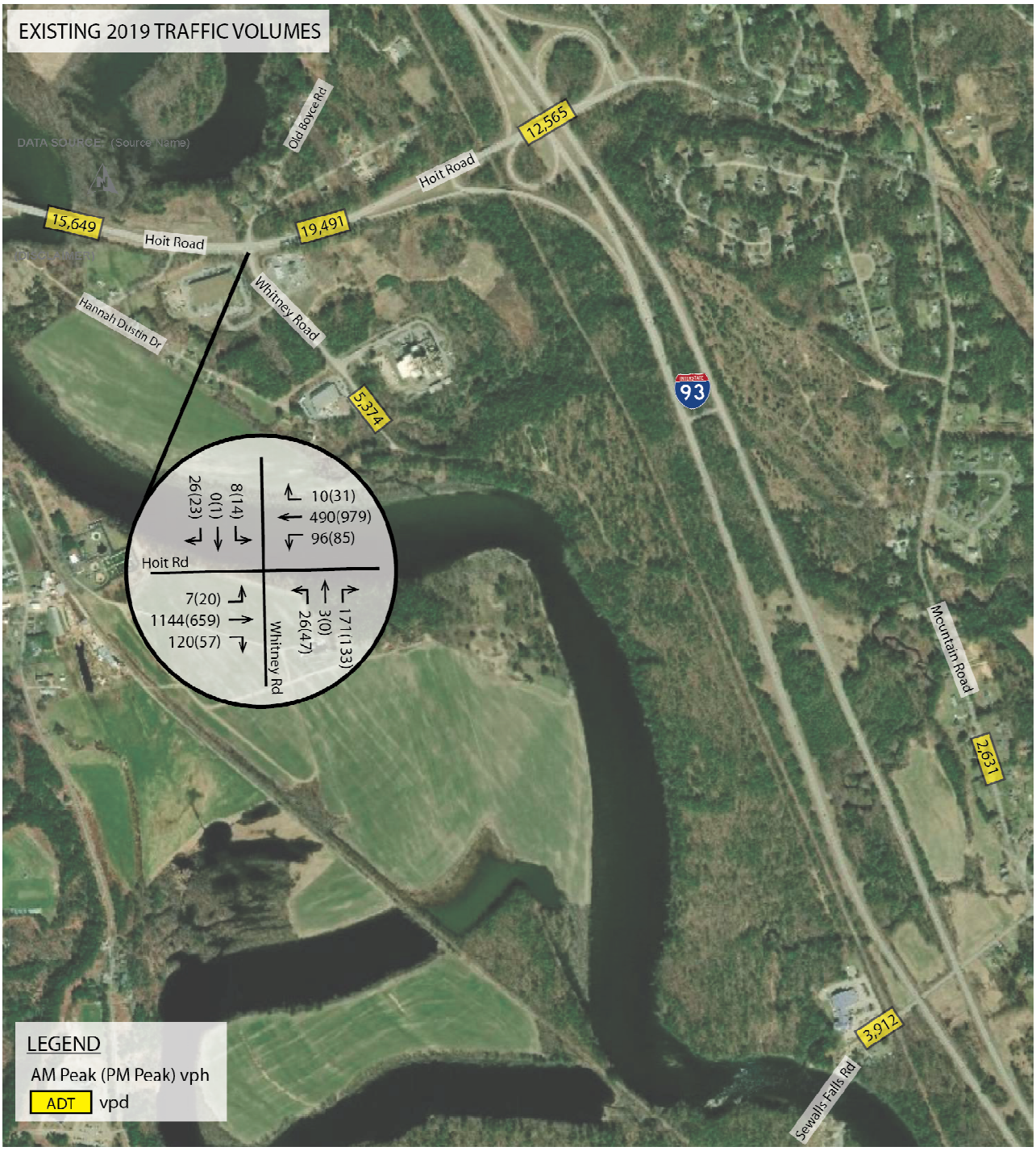

Figure 2: Existing 2019 Traffic Volumes

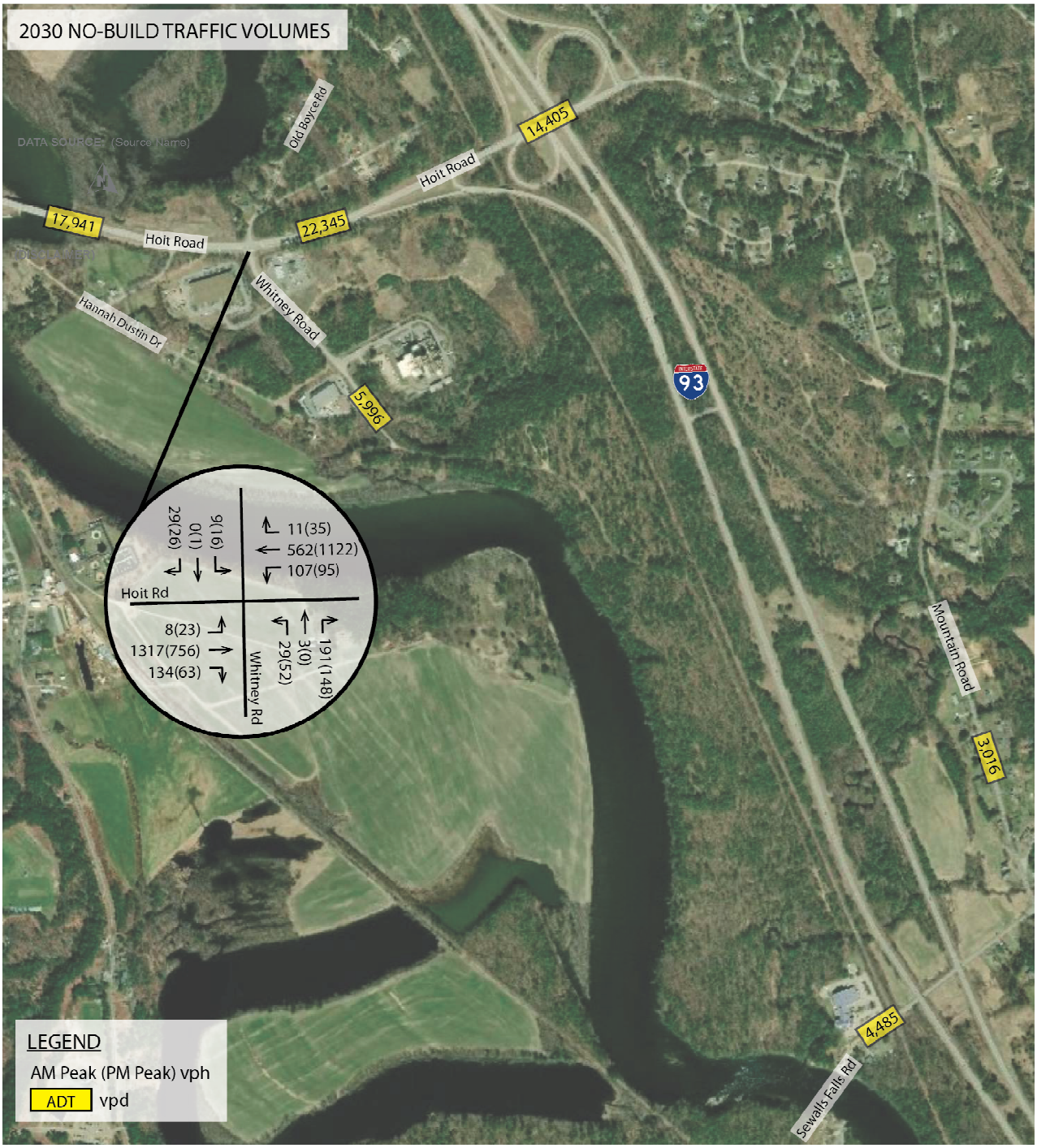

Figure 3: 2030 No-Build Traffic Volumes

Trip Generation and Distribution

In order to develop an understanding of future build traffic conditions within the study area, a trip generation analysis was performed using current zoning for developable land along Whitney

Road. As noted within Task 1, it was determined that there is approximately 98 acres of developable land along Whitney Road between Hoit Road and Sewalls Falls Road. Subtracting out the known Rauseo mixed use commercial development that comprises approximately 32 acres, leaves approximately 66 acres of industrial land use south the current terminus of the existing Whitney Road alignment.

The Institute of Transportation Engineers Trip Generation Handbook, 9th Edition, was used to develop trip generation for known parcels within the Rauseo development and for the industrial land use area. **Table 2** below summarizes the projected trip generation for the AM and PM peak hours along with daily totals.

WHITNEY ROAD PROJECT: TRIP GENERATION SUMMARY								
Parcel	Area	Unit	Land Use Code	Trip Generation (Veh)				
				Daily	AM		PM	
				In+Out	In	Out	In	Out
SIT DOWN RESTAURANT	6,028	SF	932	768	36	29	36	23
FAST FOOD	2,400	SF	934	1,192	56	53	41	37
RETAIL 1	14,698	SF						
RETAIL 2	14,000	SF						
RETAIL 3	20,000	SF						
RETAIL 4	11,850	SF						
Total Retail	60,548	SF	826	2,684	79	85	72	92
SUPERMARKET	78,920	SF	850	8,070	166	102	382	366
BANK	2,240	SF	912	332	15	12	27	27
DENTAL OFFICE/ EYE CARE CENTER	6,392	SF	720	232	12	3	6	17
MEDICAL OFFICE	7,600	SF	720	276	14	4	8	19
New Industrial Land use	66	Acre	110	3,420	411	85	105	374
			Total	16,974	789	373	677	955
Distribution Facility*				412	35	110	50	40
* TRIPS PROVIDED BY CITY								
			TOTAL TRIPS	**17,386**	**824**	**483**	**727**	**995**

Table 2: Trip Generation Summary

Based on the mixed use nature of the Rauseo development and consistent with common practice, a 20% internal capture rate was applied to the ITE trip generation for the commercial land uses. This is based on the finding that typically a portion of customers visiting commercial developments have a tendency to visit multiple sites during their visit. **Table 3** below reflects the reduced trip generation values. It should be noted that the trips generated by the proposed 66 acres of industrial land use and Distribution warehouse were not adjusted.

WHITNEY ROAD PROJECT: TRIP GENERATION SUMMARY INCLUDING 20% INTERNAL CAPTURE							
Parcel	Area (SF)	Land Use Code	Trip Generation (Veh)				
			Daily	AM		PM	
			In+Out	In	Out	In	Out
SIT DOWN RESTAURANT	6,028	932	614	29	23	29	18
FAST FOOD	2,400	934	954	45	42	33	30
RETAIL 1	14,698						
RETAIL 2	14,000						
RETAIL 3	20,000						
RETAIL 4	11,850						
Total Retail	60,548	826	2,147	63	68	58	74
SUPERMARKET	78,920	850	6,456	133	82	306	293
BANK	2,240	912	266	12	10	22	22
DENTAL OFFICE/ EYE CARE CENTER	6,392	720	186	10	2	5	14
MEDICAL OFFICE	7,600	720	221	11	3	6	15
NEW Industrial Land use	66 Acres	110	3,420	411	85	105	374
		Total	14,263	713	315	563	839
Distribution Facility*			412	35	110	50	40
*TRIPS PROVIDED BY CITY							
		TOTAL TRIPS	**14,675**	**748**	**425**	**613**	**879**

Table 3: Trip Generation Summary with Internal Capture Reduction

It should also be noted that all traffic was distributed to the Hoit Road and Whitney Road intersection based on current turning movement distribution percentages at that intersection.

Future Traffic Conditions

In order to develop an assessment of future 2030 traffic conditions, the prior background and trip generation analyses were combined to develop representative 2030 build volumes. **Figure 4** below summarizes the future 2030 AM and PM peak hour traffic volumes at the intersection of Hoit Road and Whitney Road along with the daily segment traffic volumes along the surrounding roadway network.

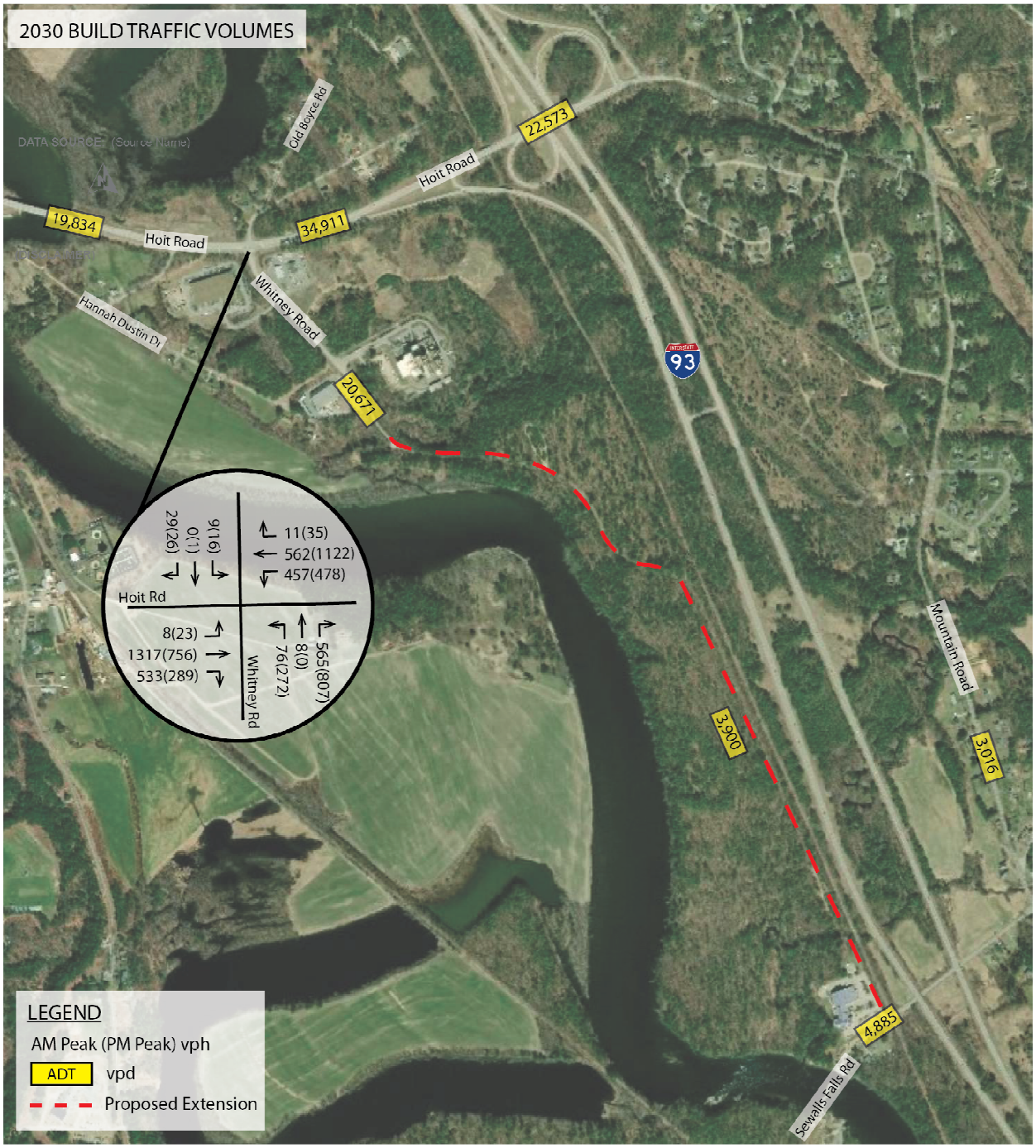

Figure 4: 2030 Build Traffic Volumes

Traffic Analysis

Based on the high level nature of the traffic analysis, an initial assessment of intersection operations was performed using the FHWA CAP-X program to assess conditions at the Hoit Road and Whitney Road intersection and identify recommended lane configurations on all approaches. The CAP-X results showed that some intersection movements at Hoit Road and Whitney Road were beginning to fail under future 2030 conditions with both a multi-lane roundabout and traffic signal in place. Thus a subsequent analysis was performed using both the Synchro (signalized) and SIDRA (roundabouts) software platforms to better understand the proposed intersection capacity under both traffic signal and roundabout control and necessary lane configurations in order to optimize the intersection operations. **Tables 4** and **5** summarize the Synchro and SIDRA analysis for 2030 build conditions, respectively. Under the traffic signal control the overall intersection operates at a LOS D or better assuming two travel lanes are provided on both the east and west approaches of Hoit Road. It is shown that based on the projected westbound left turn demand that movement experiences significant delay during both AM and PM peak hours. It should be noted that based on the higher right turn volume, the northbound approach is proposed to have an exclusive left turn lane along with a shared through/right and exclusive right turn lane.

The SIDRA output shows that a multi-lane roundabout would likely fail due to the very high westbound left turn volume from Hoit Road into Whitney Road which limits the ability for eastbound through movements to be processed.

	AM PEAK HOUR (7:00 AM-8:00 AM)				PM PEAK HOUR (4:00 PM-5:00 PM)			
WHITNEY RD AT HOIT RD/ OLD BOYCE RD	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)
Hoit Rd. EB - L	A	9.9	2	7	B	13.4	6	16
Hoit Rd. EB - T T	D	53.5	608	773	D	51.5	241	355
Hoit Rd. EB - R	A	9.4	53	183	A	7	0	65
Hoit Rd. WB - L	F	94.2	413	633	E	75.8	279	476
Hoit Rd. WB - T TR	A	7.5	84	140	B	18.6	231	383
Whitney Rd. NB - L	D	48.1	59	108	D	46	138	281
Whitney Rd. NB - TR	B	11.6	6	109	A	3.6	0	16
Whitney Rd. NB - R	B	17.6	118	230	A	8.7	63	177
Old Boyce Rd. SB - L	D	42.3	7	23	C	22.2	6	21
Old Boyce Rd. SB - TR	A	0.2	0	0	B	12.5	0	23
All Movements	**D**	37.8			**C**	30.6		

Table 4: 2030 Build – Hoit Road and Whitney Road Intersection Traffic Signal Analysis

WHITNEY RD AT HOIT RD/ OLD BOYCE RD	AM PEAK HOUR (7:00 AM-8:00 AM)				PM PEAK HOUR (4:00 PM-5:00 PM)			
	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)
Hoit Rd. EB - LT	F	223	1171	2910	D	32.3	104	258
Hoit Rd. EB - TR	F	224.3	1156	2873	D	33.6	99	246
Hoit Rd. WB - LT	A	9.5	33	82	E	43.4	242	601
Hoit Rd. WB - TR	A	8.9	36	89	E	41.8	262	652
Whitney Rd. NB - LTR	E	46.8	71	176	F	147.3	494	1229
Whitney Rd. NB - R	E	46.9	71	176	F	147.3	494	1229
Old Boyce Rd. SB - LTR	B	12.1	4	10	D	34.6	10	24
All Movements	F	127.3			F	69.4		

Table 5: 2030 Build – Hoit Road and Whitney Road Intersection Roundabout Analysis

Alternative Analysis

Based on the projected delay for the westbound left turn movement at Hoit Road, additional lane configuration scenarios were analyzed for the signalized intersection option. Alternative 1 provided double westbound left turns and double westbound through lanes. Alternative 2 provided a single westbound through lane along with double westbound left turn lanes. A primary consideration for these Alternatives as discussed later within Task 3 is the westbound lane transition that needs to occur immediately downstream of the Whitney Road intersection where the roadway needs to transition back to two travel lanes (one in each direction) across the Merrimack River bridge.

Tables 6 and **7** below summarize the capacity analysis for both Alternatives 1 and 2. Based on the reduction in queuing, improvement in intersection operations and ability to accommodate future traffic growth on Whitney Road, Alternative 1 was recommended to be moved forward into the Infrastructure Assessment within Task 3.

WHITNEY RD AT HOIT RD/ OLD BOYCE RD	AM PEAK HOUR (7:00 AM-8:00 AM)				PM PEAK HOUR (4:00 PM-5:00 PM)			
	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)
Hoit Rd. EB - L	A	8.2	2	8	B	13.3	6	18
Hoit Rd. EB - T T	D	38.8	406	565	C	31.5	217	286
Hoit Rd. EB - R	A	4.8	0	63	A	5.4	0	57
Hoit Rd. WB - L L	D	47.9	103	200	C	24.5	85	141
Hoit Rd. WB - T TR	B	10.5	83	149	C	22.5	256	415
Whitney Rd. NB - L	C	25.7	34	70	C	30.6	129	207
Whitney Rd. NB - TR	B	10.7	21	113	A	9.4	21	130
Whitney Rd. NB - R	B	12.9	65	167	B	11.9	83	213
Old Boyce Rd. SB - L	C	22.6	4	16	B	19.8	6	20
Old Boyce Rd. SB - TR	A	0.2	0	0	B	12.4	0	23
All Movements	C	25.3			C	21.2		

Table 6: Alternative 1 – Hoit Road and Whitney Road Intersection (Double WB Left's/Double WB Thru's)

WHITNEY RD AT HOIT RD/ OLD BOYCE RD	AM PEAK HOUR (7:00 AM-8:00 AM)				PM PEAK HOUR (4:00 PM-5:00 PM)			
	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)
Hoit Rd. EB - L	A	8.2	2	8	B	16.7	7	17
Hoit Rd. EB - T T	D	38.8	406	565	C	24.5	241	369
Hoit Rd. EB - R	A	4.8	0	63	A	3.5	0	56
Hoit Rd. WB - L L	D	47.9	103	200	B	12.5	91	117
Hoit Rd. WB - TR	B	15.3	198	386	E	71	1384	1656
Whitney Rd. NB - L	C	25.7	34	70	F	81.6	267	472
Whitney Rd. NB - TR	B	10.7	21	113	B	11.1	7	135
Whitney Rd. NB - R	B	12.9	65	167	C	32.2	275	389
Old Boyce Rd. SB - L	C	22.6	4	16	D	46.3	13	34
Old Boyce Rd. SB - TR	A	0.2	0	0	C	21.3	1	33
All Movements	**C**	26.1			**D**	39		

Table 7: Alternative 2 – Hoit Road and Whitney Road Intersection (Double WB Left's/Single WB Thru)

Sensitivity Analysis

Through discussions with City officials it was identified that further sensitivity analysis of the 2030 Build traffic operations at the Whitney Road and Hoit Road intersection should be performed to account for latent demand associated with drivers who are currently discouraged from turning left into and out of Whitney Road due to the extensive delays experienced at the intersection. The sensitivity analysis of the Whitney Road and Hoit Road intersection was performed by redistributing both the inbound and outbound left and right turn movements to reflect a 50/50 split in approach volumes. The analysis was applied to both signalized and roundabout intersection configurations. Based on these conditions (50/50 split distribution) the following observations were made:

- Roundabout Control - A multi-lane roundabout still performs poorly. As summarized in **Table 8** below, the roundabout analysis using the SIDRA software shows that the overall intersection would operate at a LOS F during both the 2030 Build AM and PM peak hours and experiences little improvements with the addition of auxiliary bypass lanes for heavy right-turn movements into and out of Whitney Road.

WHITNEY RD AT HOIT RD/ OLD BOYCE RD	AM PEAK HOUR (7:00 AM-8:00 AM)				PM PEAK HOUR (4:00 PM-5:00 PM)			
	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)
Hoit Rd. EB - LT	F	239.5	1195	2971.2	C	21.2	86	214.9
Hoit Rd. EB - TR	F	240.6	1181	2935.5	C	22.4	81	201
Hoit Rd. WB - LT	C	19.1	63	157.3	F	118	581	1443.8
Hoit Rd. WB - TR	C	17.7	69	171.6	F	116.6	588	1462
Whitney Rd. NB - LTR	E	44.1	68	169.2	F	147.3	494	1228.1
Whitney Rd. NB - R	E	41.7	63	157.4	F	146.5	491	1219.8
Old Boyce Rd. SB - LTR	C	18.2	6	13.7	D	29.6	9	21.5
All Movements	F	135.5			F	95.6		

Table 8: Sensitivity Analysis –Hoit Road and Whitney Road Roundabout Analysis

- Signal Control - As is summarized within **Table 9**, the signalized intersection scenario with a single westbound left turn lane on Hoit Road operates overall at a Level of Service D or better. However, the individual WB left turn movements operates very poorly at a Level of Service F in the AM and E in the PM with a queue in excess of 700 feet in the AM condition. This scenario included double northbound left-turn lanes based on the higher northbound left-turn volume which does not impact the width of Whitney Road as this movement is shared with the through movement.

In summary, the current analysis assumes all industrial development on the southern end of the Whitney Road corridor and as such there is limited flexibility in the conceptual geometric layout for additional growth in traffic volumes beyond what was assumed for this study. If the southern land use along the extended Whitney Road corridor where to change to include additional commercial and/or residential development, there will likely be a significant increase in site generated traffic beyond the current project volumes. Considering these conditions and assumptions, a dual WB-left is still recommended based on the reduced overall intersection delay, reduction in queue length and ability to accommodate changes in future land use.

WHITNEY RD AT HOIT RD/ OLD BOYCE RD	AM PEAK HOUR (7:00 AM-8:00 AM)				PM PEAK HOUR (4:00 PM-5:00 PM)			
	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)	LEVEL OF SERVICE (LOS)	DELAY (Sec)	AVERAGE QUEUE (FT)	95TH %ile QUEUE (FT)
Hoit Rd. EB - L	B	11.4	2	8	B	13.2	6	17
Hoit Rd. EB - T T	E	65.6	678	849	D	39.4	231	324
Hoit Rd. EB - R	B	12.4	92	226	A	6.8	0	73
Hoit Rd. WB - L	F	97.3	494	724	E	63.3	190	378
Hoit Rd. WB - T TR	A	7.7	89	145	C	20.1	242	397
Whitney Rd. NB - L	E	73.3	152	287	D	40.6	141	268
Whitney Rd. NB - LT	E	76.4	155	300	D	40.6	141	268
Whitney Rd. NB - R	B	17.9	137	251	B	13.6	122	303
Old Boyce Rd. SB - L	D	44.7	7	24	C	20.4	6	21
Old Boyce Rd. SB - TR	A	0.2	0	0	B	12.4	0	23
All Movements	D	49.2			C	28.8		

Table 9: Sensitivity Analysis –Hoit Road and Whitney Road Signal Control Intersection (Single WB Left Turn Lane)

General Roadway Configuration

The general proposed roadway lane configuration for the preferred Hoit Road and Whitney Road concept (Alternative 1) is shown in the attached **Figures 5** through **8**. Throughout the Whitney Road corridor, 11-foot travel lanes along with 6-foot bike lanes are recommended along with a detached 6-foot sidewalk on the eastern edge of the street. For Whitney Road, a three (3) lane cross-section with one travel lane in each direction and a center turn lane is proposed between the Hoit Road and Hannah Dustin Drive. Between Hoit Road and the primary Rauseo development driveway, one auxiliary northbound and southbound travel lane will be provided to meet the necessary intersection capacity needs on the approach and departures of Whitney Road at Hoit Road. Extending southerly from the Hannah Dustin Drive intersection, a two-lane roadway (one lane in the northbound and southbound directions) is proposed.

Hannah Dustin Drive

As part of the Whitney Road improvements, it is recommended that Hannah Dustin Drive be extended to connect with Whitney Road to provide another connection. As part of this recommendation and in order to enhance the safety and operations along Hoit Road, it is also recommended that the Hannah Dustin Drive intersection with Hoit Road be restricted to right-in/right-out or potentially closed entirely.

Infrastructure Assessment (Task 3)

The infrastructure assessment task assembled GIS base mapping, integrated lane use requirements conducted in the Traffic and Transportation Assessment, and combined a brief field review and historical knowledge from City of Concord, NHDOT, and CNHRPC to develop the conceptual layout and program costs as outlined in the Environmental Constraints Evaluation. This assessment and corridor is based in-part on the conceptual layouts for the new Whitney Road Extension and intersection concepts of Hoit Road and Whitney Road by the City, as well as previous studies conducted by the City.

The intent is to apply planning and engineering principles based on the data gathering, regulatory stipulations, design criteria assumptions, and needs of the City of Concord to develop an understanding and basis of the program cost. Based on the traffic data collected from potential developers, full development of adjacent parcels, and anticipated background growth of Hoit Road in the City of Concord and Towns of Boscawen and Canterbury; the team conducted the preliminary study to assist the City in determining potential off-site improvements that may be required within the State of NH limited/controlled access right of way.

Existing Conditions

The project study area includes Hoit Road beginning at the bridge over the Merrimack River and extends through the existing intersections of Hannah Dustin Drive, Whitney Road, and terminating at the intersection of Interstate 93 Southbound Ramps and Hoit Road over the State of New

Hampshire Railroad. The Whitney Road Corridor begins at the intersection of Hoit Road on the existing roadway, extends southerly approximately 750 linear feet to its current terminus along the paved roadway, then continues following the City of Concord water line easement to the limit of the study at the intersection with Sewalls Falls Road for an approximate total length of 8,200 linear feet (1.50 miles). The properties between the end of the paved section of Whitney Road and Sewalls Falls are forested, undeveloped, and segmented by Burnham and Hayward Brooks between I-93 and the Merrimack River. Past studies have been based on the existing waterline easement and access roadway, which also follows the abandoned Hannah Dustin roadway discontinued after construction of I-93. The existing roadway is evident for nearly 3,000 linear feet before the Whitney Road alignment proceeds southerly and parallel to the State of New Hampshire Railroad.

Proposed Design Considerations

Whitney Road's curvilinear geometry, proposed lane and shoulder widths, and sidewalk that promotes pedestrian connections to Sewalls Falls Road fall within recommendations for lower speed classification. Counter to Whitney Road, the proposed improvements to Hoit Road (US Route 4) consider a different roadway functionally that promotes higher travel speed and capacity improvements to meet the NHDOT and City's requirements for arterial roadways. Horizontally, the conceptual design and layout for both roadways, lane and shoulder widths, turning lanes, deceleration and taper lengths, as well as sidewalk width have been assessed utilizing AASHTO *A Policy on Geometric Design of Highways and Streets*, as well as NHDOT *Highway Design Manual*, and the City's standards.

Additionally, the concept of the studied roadways has been based on the following:

Roadway	Classification	Posted Speed	Design Speed
Whitney Road	Minor Collector	---	30 mph
Hoit Road (US Route 4)	Minor Arterial (Rural)	45 mph	45 mph
Hannah Dustin Drive	Local Roadway	30 mph	30 mph
I-93 SB On Ramp	Freeway Ramp	---	30 mph

The site's topography is rolling and consists of grades less than 5.0%, and steep embankments in the vicinity of the stream crossings. Roadway improvements will need to consider the existing roadways and developed properties, Merrimack River bank and existing buffers, stream crossings, soil conditions, and depth of the existing 20-inch waterline. The existing stream crossings may present challenges in considering cross section and vertical requirements of the roadway over the existing waterline. Vertical geometric design is beyond the limits of the study, however stopping and intersection sight distance need to be considered carefully for each of the roadways. Hoit Road, Whitney Road, and the I-93 Southbound On Ramp should be able to maintain posted speed and design speed considerations, however there would be challenges for Hannah Dustin Drive at the existing intersection approach to Hoit Road, as well as a new intersection with Whitney Road to limit property and environmental impacts.

Furthermore, the intersections of Hoit Road with Hannah Dustin Drive and Whitney Road are located approximately 500 linear feet apart. It is recommended to extend Hannah Dustin Drive to intersect with Whitney Road, and extend a proposed raised median on Hoit Road to restrict left

turns at Hannah Dustin Drive. This is based on site observations that have revealed that during the AM and PM peak hours there are limited concurrent gaps in east and westbound traffic along Hoit Road. Extending Hannah Dustin Drive along the original alignment, connecting at the unsignalized intersection with Whitney Road, and facilitating all lefts through the protected signalized intersection of Whitney Road and Hoit Road will all serve to enhance the safety and operations of the Hoit Road/US Route 4 corridor.

Typical Section Considerations

Each roadway typical section reflects the traffic demands and analysis conducted in Traffic and Transportation Assessment. Lane and shoulder widths depicted meet considerations for higher volumes of traffic, larger truck percentages, bicyclist's needs, and recommended standards. There is adequate length within the corridors to accommodate the 95% queue determined by the traffic analysis, deceleration length for the design speed, and typical taper lengths. Typical sections for each roadway are illustrated in the attachments, and in general consider 11'-0" travel lanes, 6'-0" shoulders, and a 6'-0" sidewalk. Roadway specific considerations include:

<u>Whitney Road</u>

- 11'-0" lane widths are acceptable for the traffic volumes and turning movements required. A two lane roadway is sufficient for northbound and southbound volumes for the Whitney Road extension south of the Hannah Dustin Drive intersection.
- A Two-Way Left Turn Lane (TWLTL) is proposed between Hoit Road and the proposed Hannah Dustin Drive Connection. Geometrically, a left turn lane needs to be developed for Whitney and Old Boyce Road, and TWLTL will assist in managing volumes between the businesses without adding auxiliary lanes. Geometrically, the lanes align well with the Old Boyce Road intersection leg.
- Auxiliary lanes required by the analysis include:
    - Two (2) southbound receiving lanes are required on Whitney Road due to the two (2) westbound left turns on Hoit Road. In addition, the left turns require the large median illustrated along Hoit Road.
    - Dual right turn lanes are proposed on Whitney Road create a need to extend the eastbound auxiliary lane and facilitate movements to I-93 SB.
    - Bike lanes that are consistent with the City's complete street approach and the opportunity to promote connectivity to corridors within the City's Bike & Pedestrian Master Plan.

<u>Hoit Road/US Route 4</u>

- Currently, Hoit Road has 12'-0" lanes with 12'-0" auxiliary lanes and unsignalized intersections of the I-93 Southbound Ramps, Whitney Road/Old Boyce Road, and Hannah Dustin Drive. The roadway crosses the Merrimack River Bridge with one lane in the eastbound and westbound directions, and crosses I-93 with two eastbound and westbound lanes, respectively.
- Due to the number of turning and auxiliary lanes required by the analysis, 11'-0" lanes are proposed in order to reduce the amount of roadway widening required. The existing Hoit Road shoulders are 10'-12' in width. Similarly, narrower 5'-0" shoulders are recommended to help reduce the amount of roadway widening required.

Hannah Dustin Drive

- The existing pavement width is approximately 20', and due to the limited parcels and traffic expected, restricted widths should be considered. For this study, 10'-0" lanes with 5'-0" shoulders are proposed.

I-93 SB On Ramp

- The proposed modifications to this ramp are consistent with the recent 2021-2030 TYP proposal and conceptual layout by the CNHRPC in association with desired safety improvements at that location to mitigate the high-speed eastbound movement to the southbound ramp.
- Pavement width and geometry as proposed herein is consistent with the NHDOT Highway Design Manual Volume II, and will promote compatible speeds at the existing ramp merge.

Bicyclists & Pedestrians

- The 6'-0" shoulder width along Whitney Road is will help improve cyclists comfort and safety while also providing adequate separation between vehicular traffic and drainage structures.
- One (1) sidewalk is proposed along the east side of Whitney Road within the conceptual roadway layout. The sidewalk is proposed to be separated from vehicular travel lanes by a 5'-0" buffer that extends south from the proposed Whitney Road and Hannah Dustin Drive intersection.
- In the future the proposed sidewalk along Whitney Road might justify widening to a multi-use path facility in order to promote connectivity between the Hannah Dustin historical area and Heritage Trails along Sewalls Falls Road.

Program Costs

Program-level cost estimating can be a challenge based on the limited information of the design, unknowns and risks associated with permits, utilities, construction, construction sector and economic trends. Estimates for this level of design and planning are conceptual only and have been prepared based on experience with past projects of similar work scope utilizing roadway per linear foot and bridge square-foot cost averages. Roadway linear foot costs include pavement, roadway and sidewalk materials, curb and drainage as applicable, erosion control and landscaping materials. The NHDOT's Weighted Average Unit Prices can be used to estimate current costs for roadway materials in order to develop linear foot costs. Furthermore, percentages for roadway and bridge incidental construction that may include temporary erosion control and traffic control signals and conduit can be found through the NHDOT and City's bid prices of recent similar project types. Additional costs and contingencies have been estimated for water quality basins, maintenance of traffic for Hoit Road and existing Whitney Road, wetland mitigation, construction project costs, and engineering. Lastly, due to the nature of a program-level cost estimate with limited information to assess the cost, contingencies are added to help mitigate the many unknowns. For program estimates, higher contingencies are included to account for these risks.

Major items and assumptions of work that are envisioned for the project include:

Whitney Road

- New roadway including pavement, sidewalk, materials, curb, drainage, and other incidentals.
- New gravity sewer along the Whitney Road extension.
- The existing 20-inch water line will not be impacted.
- Retaining walls or support structures, outside the bridge structures adjacent to Burnham and Hayward Brooks, are not required.
- Water quality best management practices will be required to meet Alteration of Terrain regulations.
- Lighting is required at the intersections, and minor standard AASHTO lighting for the new roadway extension.
- Maintenance of traffic is required for the existing Whitney Road section. The Whitney Road and Hannah Dustin Drive extensions are considered negligible within the scope of the project.
- The existing abandoned roadway bed and waterline easement will be utilized and major changes in elevation between the existing and proposed ground are not anticipated.
- A large three (3) sided arch culvert structure has been estimated for the Burnham Brook crossing.
- A simple span (150' x 50') bridge structure has been estimated for the Hayward Brook crossing.
- Fee acquisition or dedication of right of way by private abutters will be required for the new roadway and change of use.
- There are no accommodations for any improvements to the existing railroad infrastructure contemplated as part of this concept.

Hoit Road/US Route 4

- The existing horizontal and vertical alignment will be maintained and the roadway will be widened in-kind for the required additional lanes. It is assumed the existing roadway will receive new pavement for the lanes and the existing shoulders will be rehabilitated.
- The widened roadways include pavement, select materials, and typical roadway incidentals such as permanent erosion control.
- No utilities are included, however a drainage and water quality basin is expected to accommodate the additional impervious area.
- Major items include traffic signals, conduit, and maintenance of traffic.
- The traffic analysis eliminated the opportunity for multi-lane roundabouts, and other alternative intersection types have not been evaluated for this estimate.

Hannah Dustin Drive

- New roadway including pavement, select materials, and other incidentals.
- The intersection approach will be reconstructed and includes new pavement and materials to match Hoit Road.
- Drainage may not be collected, and runoff will be required to be treated in water quality best management practices that may be located along Hoit and Whitney Roads.

I-93 Southbound On Ramp

- NHDOT Curbed Ramp Typical is estimated and includes new ramp pavement, concrete medians, select materials, curb, drainage, and other incidentals.
- Maintenance of traffic will be managed and associated with Hoit Road.

Description	Estimated Program Costs
CIP# 502 Whitney Road Extension	
Roadway	$4,358,678
Traffic (Signals)	$0
Structure 1 - (Burnham Brook-30' Rigid Frame)	$375,000
Structure 2 – (Hayward Brook-150' Bridge)	$1,500,000
Utilities (Gravity Sewer)	$1,003,500
Construction (Mobilization & Misc. Incidentals)	$561,031
Project Costs (Engineering, Permitting, R/W & Contingency):	$2,261,480
PROGRAM ESTIMATE TOTAL	**$10,059,689**
SAY	**$10,100,000**
CIP #30 - Hoit Road / Whitney Road Intersection Signalization	
Roadway	$2,988,298
I-93 SB On-Ramp modifications	$250,000
Traffic (Signals)	$180,000
Structures	$0
Utilities	$0
Construction (Mobilization & Misc. Incidentals)	$307,647
Project Costs (Engineering, Permitting, R/W & Contingency):	$1,080,524
PROGRAM ESTIMATE TOTAL	**$4,806,468**
SAY	**$4,900,000**
Total Project Cost	**$15,000,000**

Table 10: Program Cost Summary