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Local Access Management Regulations

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Submitted by

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16. Abstract

The primary objective of this research is to identify and recommend strategies, tools, and guidelines to facilitate access management on local (i.e., county and municipal) roads intersecting and/or impacting state highways in New Jersey. State of New Jersey has an access management code that applies to state highways, but it does not apply to local roads. Local authorities in New Jersey do not have uniform access management codes, regulations, standards for local roads, as a result of which issues arise when developments take place on local roads near intersections with state routes. This research evaluated if/when similar issues are encountered in other states, how other state departments of transportation (DOTs) address access management on local roads, and how New Jersey local government and officials perceive access management on local roads near state highways. The study included a review of the literature and best practices, several stakeholder meetings, structured interviews with officials from other states DOTs, a survey of in-state officials, case studies involving intersections between local roads and state highways, and synthesis of results.

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This research was completed through a collaboration among Rutgers Center for Advanced Infrastructure and Transportation (CAIT) and the Alan M. Vorhees Transportation Center (VTC), AECOM, and Fitzgerald & Halliday, Inc. (FHI). A number of staff members from the Rutgers contributed to this research. Doctoral student Yizhou Wang compiled all the reviewed literature, assisted with the case studies, and wrote the literature review of this report. Omid Sarmad of CAIT contributed to case studies. Andrea Lubin of VTC helped to develop and administer the in-state official survey, assisted with the interviews with out-of-state officials, and edited the final report. Arnold J. Bloch, Ph.D. of FHI facilitated all stakeholder meetings and wrote the chapter of this report on stakeholder meetings. Dr. Bloch also provided insights to other tasks, including the survey of in-state officials and interview of out-of-state DOT officials.

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EXECUTIVE SUMMARY

Background

New Jersey has an access management code that is highly effective, but it applies only to state highways. As the state code does not apply to local roads, conflicts with property owners/developers arise when state highway improvements are undertaken, or new developments take place on local roads near intersections with state highways. In recent years, New Jersey Department of Transportation (NJDOT) had to deal with such issues in some instances in different parts of the state.

Research Objectives

The primary objective of this research is to comprehend and inform the NJDOT about the experiences and efforts of state departments of transportation (DOTs) in other parts of the country regarding the implementation of access management on local roads. A secondary objective of this research is to garner insights from local government officials and other relevant stakeholders in New Jersey regarding the implementation of access management on local roads. The purpose of this effort was to learn about ongoing efforts by counties and municipalities to develop and implement access management programs, learn about barriers to such efforts, and disseminate information about issues encountered by the NJDOT in implementing projects at or near intersections with local roads.

Research Tasks

Task 1: Review Literature, Regulations, and Practices. Review access management codes, regulations, and guidelines throughout the country, and gain insights from relevant publications by the Transportation Research Board (TRB), the Federal Highway Administration (FHWA), transportation research centers, state DOTs, local governments, and academics with an emphasis on access management practices.

Task 2: Organize and Facilitate Targeted Stakeholder Meetings. To establish and communicate with a stakeholder group consisting primarily of municipal, county, and metropolitan planning organization (MPO) engineers and planners from New Jersey with experience in access management to align the project team's efforts with meaningful, actionable outcomes to local practitioners.

Task 3: Conduct Structured Interviews with DOT Officials from Other States. To conduct structured telephone interviews with 10 to 12 officials from state DOTs nationwide who are responsible for promoting access management in their states with an emphasis on their approaches to implementing access management on local roads.

Task 4: Conduct Online Survey of Local Government Officials in New Jersey. To conduct an online survey of New Jersey local government officials to learn about current access management practices on local roads, about familiarity with access management issues on roads intersecting with state highways, and identification of case studies involving intersections of local roads and state highways.
Task 5: Local Access Management Case Studies. To conduct case study analysis involving actual locations near state highway and local road intersections where access management issues were encountered and seek guidance from in-state stakeholders and department of transportation officials in other states to resolve such issues in a timely and effective manner.

Key Findings

Review of practice and literature: The review of practices demonstrated that access management practices vary substantially from state to state. While a small number of states have access management codes, most other states have guidelines only. In almost all cases, the codes are pertinent to state highways only. Also, model ordinances have been developed in some states that can be used by local governments.

Stakeholder meetings: The meetings with the Stakeholder Committee revealed that there is considerable support among New Jersey professionals for access management on major local roads. They indicated that the state code standards are not always directly applicable to local roads, because of which there is a need to develop guidelines and standards that are suited to specific local governments.

Interviews: The interviews with the state DOT officials also demonstrated that their approaches to access management vary substantially. Like New Jersey, they are mostly concerned about state highways, although many acknowledged facing local-road issues similar to New Jersey. The interviews provided some insights and recommendations that may be pertinent to New Jersey. Perhaps the most pertinent practices in other states that are important to New Jersey are (a) corridor agreements between local governments and state DOTs, (b) training of local government professionals on access management, (c) establishing communication channels between local offices of state DOTs and local governments, and (d) funding local governments to develop their own access management guidelines and standards. On the whole, the interviews indicated that proactive measures are essential to address local access management issues.

Survey: Like the Stakeholder Committee meetings, the survey of local government officials revealed that there is considerable support for access management on local roads in New Jersey. However, the survey also showed that lack of funding and staff training on access management are two critical barriers faced by local governments interested in developing local access management guidelines and standards. The

survey further demonstrated that local governments are willing to have communication with NJDOT regarding such efforts, but they are not willing to delegate the power of local road access management to the state. The survey identified a gap in coordination between local governments and NJDOT regarding matters related to access management.

Second-Round of Survey: The second round of survey obtained more detailed responses related to addressing the access management regulations issues at intersections between state routes and local roads. The survey responses provide some of the latest spacing criteria used by NJ county and municipal governments. The survey also explored the factors affecting the collaboration between NJDOT and NJ local governments on access management issues in highway improvement projects involving both state routes and local roads. The survey also confirmed strategies such as training, develop a project-specific agreement, incentives in local-aid project competitions, and proactive measures such as corridor agreement to promote state-local coloration on local access management regulation issues.

Recommendations

1) Encourage local governments to develop their own access management guidelines and standards that are consistent with the state code but allow more flexibility for local roads. Based on the literature review and survey feedback, the criteria in Table 1 is provided for consideration by NJDOT and local governments to for intersections between state highways and local roads where no local access code or guidelines are available.

Table 1 - Recommended criteria of access spacing and corner clearance based on posted speed limit

Criteria	Agency	Posted Speed Limit (mph)						
		25	30	35	40	45	50	55
Minimum Access Spacing Peer State DOTs	Minimum Access Separation (feet)							
	NJDOT(C)	105	125	150	185	230	275	330
	Peer State DOTs	125-245	125-245	125-250	245-305	245-440	440-660	440-660
	AASHTO Sight Distance	280 (240*)	335 (290)	390 (335)	445 (385)	500 (430)	555 (480)	610 (530)
	TRB-Manual**	330	330	330	330	660	660	880
	NJ Local Agencies	150-300	200-350	250-425	300-475	350-525	400-600	400-600
Minimum Corner Clearance	Minimum Distance from Corner (feet)							
	NJDOT(C)	50	50	100	100	100	100	100
	Peer DOTs	Same as Access Spacing						
	NJ Survey	Same as Access Spacing						

Notes: (C) stands for Code/Regulations/Ordinance; (G) Stands for Guidelines/Manual/Standards; * for right-turn-only access points with median blockage; ** TRB Access Management Manual

2) Develop project-specific access management criteria including intersection spacing criteria at any state and local road intersections in highway improvement projects involving both NJDOT and local governments to help guide the project efforts related to access management and provide the basis for potential disputes.
3) Reach an early project-specific agreement between NJDOT and local governments on the standards, guidelines, and criteria of access management to apply in the project and communicate early on their potential implications to local agencies and property owners especially if they imply any potential loss of parking, road access, right-of-way, etc.
4) Encourage local governments, especially those having significant roads intersecting with state highways, to develop their own access management guidelines through funding, training, and expert assistance.
5) Provide incentives to local governments to establish and apply access management policies and guidelines (using a similar approach that has been applied to Complete Streets).
6) Adopt proactive measures such as corridor agreements with local governments at corridors with highway improvement projects in the next 5 or 10 years according to the state highway improvement plan of local MPOs and NJDOTs,

and specify the spacing criteria for state and local road intersections on selected corridors.

7) Develop communication channels between divisional offices of NJDOT and local governments so that all concerned parties are aware of planned projects and developments long before the projects and developments materialize.
8) Use the Stakeholder Committee established through this research to develop and augment a dialogue between NJDOT and local governments regarding access management on local roads.

INTRODUCTION

The Access Management Manual of the Transportation Research Board (2014) defines access management as "*the coordinated planning, regulation, and design of access between roadways and land development*." The Institute of Transportation Engineers (2004) maintains that access management processes or programs ensure that major roads operate safely and efficiently while also meeting access needs of abutting land uses along the roads. Therefore, the challenge for any access management program is to maintain a balance between mobility and safety of roadway users and respecting rights of property owners. Although improved mobility through access management may be beneficial for a highway corridor, some businesses and residents at specific locations of the corridor may be adversely affected due to the reduced number of access/egress points or some route circuity. Being dependent on property taxes, local governments have an interest in keeping current property owners satisfied and attracting new businesses, but they are also responsible for maintaining safety and mobility on their roadways.

Access management issues are often encountered when significant developments take place near major roads or when major roadway improvements take place. As a result, local governments may not be highly motivated to maintain a sustained access management program or process. For state transportation agencies, on the other hand, access management is of paramount importance because of their emphasis on mobility and safety of motorists. Therefore, conflicts may arise in and around areas where state highways intersect local roads. Such conflicts are most pressing for parcels that abut both state highways and local roads.

In New Jersey, the State Highway Access Management Code (N.J.A.C. 16:47) gives authority to the New Jersey Department of Transportation (NJDOT) to implement access management on the state highway system. However, New Jersey is a home-rule state, and the authority for access management on local roads is vested in local governments. Although local government officials widely recognize that access management is essential for motorists' safety, the approaches to implementing access management on local roads lack uniformity. A potential reason for the lack of consistency is that some parts of the state are highly urban, whereas other parts are suburban, and yet other parts are rural.

The primary objective of this research is to comprehend and inform NJDOT about the experiences of state departments of transportation (DOTs) in other parts of the country regarding access management on local roads. To comprehend how the agencies address access management issues, it is important to learn how the authority is vested, whether the state DOTs have similar authority as the NJDOT, whether their authority over state highways is statutory, whether they have authority over local roads, how they resolve issues related to developments on local roads near state highways, what

standards they use for implementing access management of state highways and local roads, and how they communicate with local authorities in matters related to access management.

A secondary objective of this research is to garner insights from local government officials and other relevant stakeholders in New Jersey regarding the implementation of access management on local roads. The purpose of this effort is to learn about ongoing efforts by counties and municipalities to develop and implement access management programs, learn about barriers to such efforts, and disseminate information about issues encountered by the NJDOT in implementing projects at or near intersections with local roads.

The specific objectives of this research are to:

(a) Learn about the access management policies, programs, and practices of state departments of transportation in other parts of the country regarding the implementation of access management on local roads.

(b) Identify policies, programs, guidelines, and standards in other states that may be useful to promote access management on local roads in New Jersey.

(c) Establish a stakeholder group of transportation and planning professionals in New Jersey to assist promoting access management on local roads near state highways.

(d) Learn about the barriers encountered by local governments in developing access management policies, programs, standards, and guidelines for implementation on local roads.

(e) Inform New Jersey local governments about the access management issues arising from highway improvement projects.

(f) Establish a forum for the stakeholders to continue the promotion of access management on local roads through sustained communication with NJDOT and the development and use of appropriate guidelines, standards, and training.

The various tasks for this research are the following:

Task 1: Review Literature, Regulations, and Practices. Review relevant publications by the Transportation Research Board (TRB), the Federal Highway Administration (FHWA), transportation research centers, state DOTs, local governments, and academics with an emphasis on access management practices.

Task 2: Organize and Facilitate Targeted Stakeholder Meetings. To establish and communicate with a stakeholder group consisting primarily of municipal, county, and metropolitan planning organization (MPO) engineers and planners from New Jersey with experience in access management to align the project team's efforts with meaningful, actionable outcomes to local practitioners.

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Task 5: Local Access Management Case Studies. To conduct case study analysis involving actual locations near state highway and local road intersections where access management issues were encountered and seek guidance from in-state stakeholders and department of transportation officials in other states to resolve such issues in a timely and effective manner.

Task 6. Synthesize and Communicate Research Outcome. To synthesize and disseminate the research findings among transportation professionals within and outside New Jersey with the production of a final report and publication of research findings in the form of conference papers.

The remainder of this report is divided into six broad sections, the first five corresponding to tasks 1 through 5 of the research and the final section synthesizing the findings and recommendations from the entire study. The first section presents a synthesis of the literature review and practice scan. The second section describes the functioning of the stakeholder group and synthesizes the minutes from the meetings with particular attention to the recommendations of the group for the development of standards and guidance for local authorities for better implementation of access management on local roads. The third section describes the structured interviews with the department of transportation officials from other states and synthesizes the findings. The fourth section describes the online survey of in-state officials and summarizes the survey findings. The fifth section describes the case studies and summarises the key findings. The concluding section synthesizes the findings from the previous sections and presents the recommendations.

LITERATURE REVIEW AND PRACTICE SCAN

A review of existing literature on access management policies and standards was conducted as a part of Task 1. The review has been described below in this order. TRB and American Association of State Highway and Transportation Officials (AASHTO) guidelines, state access code and guidelines developed by state DOTs, reports and papers, and Model Ordinance and existing access spacing criteria. The access pacing criteria for Model Ordinance are provided because they may be more appropriate for local roads, considering state access codes are usually more stringent than the criteria.

TRB published the second edition of *Access Management Application Guidelines* [1] and the second edition of Access *Management Manual* [2] in 2014, addressing access management concepts and effects, offering planning and design guidance for associated contextual applications, describing the administration of access management, and supplying supporting information, including techniques and a glossary.

The *Access Management Manual* suggested a permitted-by-variance approach when minimum spacing is not achievable. As shown in Table 2, a spacing value less than the minimum but equal to or larger than the spacing values that are permitted by variances is considered a minor deviation. A spacing value less than that permitted by variance is considered a major deviation and may be approved only if justified.

Table 2 - Common and suggested practice for unsignalized spacing standards

Speed (MPH)	**Common Practice**		**Suggested Practice**	
	Desirable Spacing (ft)	**Minimum Spacing (ft)**	**Minimum Spacing (ft)**	**May Be Permitted by Variance (ft)**
<=40	330	200	330	200
45-50	660	400	660	400
55-60	880	600	880	600
>60	1320	900	1320	900

Corner Clearance is determined according to clearance types as shown in Figure 1 and Table 3.

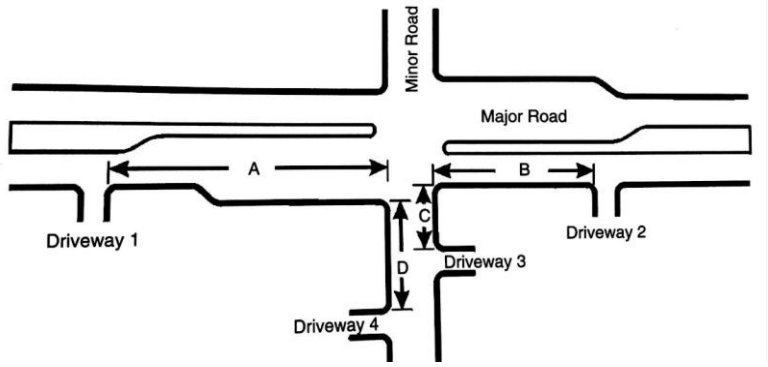

Figure 1. Intersection corner clearance types

Table 3 - Intersection corner clearances

Clearance Type	**Description**	**Sample Clearance Criteria**
A	Upstream on the major roadway	Minimum corner clearance should equal or exceed the sum of perception-reaction time distance, deceleration and lane change distance, queue storage length
B	Downstream on the major roadway	Separation should equal or exceed (*a*) the upstream functional dimensions of the driveway or (*b*) the influence distance. Minimum separation is no less than the stopping distance
C	Approach side on the minor roadway	Maximum queue
D	Departure side on the minor roadway	Separation of the intersection from entering and exiting maneuvers at the driveway

The *Access Management Manual* also stated that the desirable Corner Clearance should be equal to or larger than Access Spacing, which is different with NJDOT's criteria. Thus, the team chooses to use the criteria in accordance with NJDOT's.
The *Access Management Application Guidelines* summarized access spacing distances based on various criteria compiled from multiple sources, as shown in Table 4.

Table 4 - Access management manual corner clearance criteria

Operating Speed (MPH)	Spacing (ft)					
	Right-Turn Entry Overlap	Stopping Sight Distance	Intersection Sight Distance	Right-Turn Exit Influence Distance	Functional Area	Egress Capaci-ty
30	100-185	200	335	380	325	315
35	150-245	250	390	405	425	450
40	185-300	305	445	460	525	625
45	230-350	360	500	530	630	870
50	--	425	555	620	750	1140
55	--	495	610	725	875	1470

Note: -- = no value given

AASHTO recommended access spacing according to the safe sight triangles [3]. Each quadrant of an intersection should contain a triangular area (sight triangles) free of obstructions that might block an approaching driver's view of potentially conflicting vehicles, as shown in Figure 2.

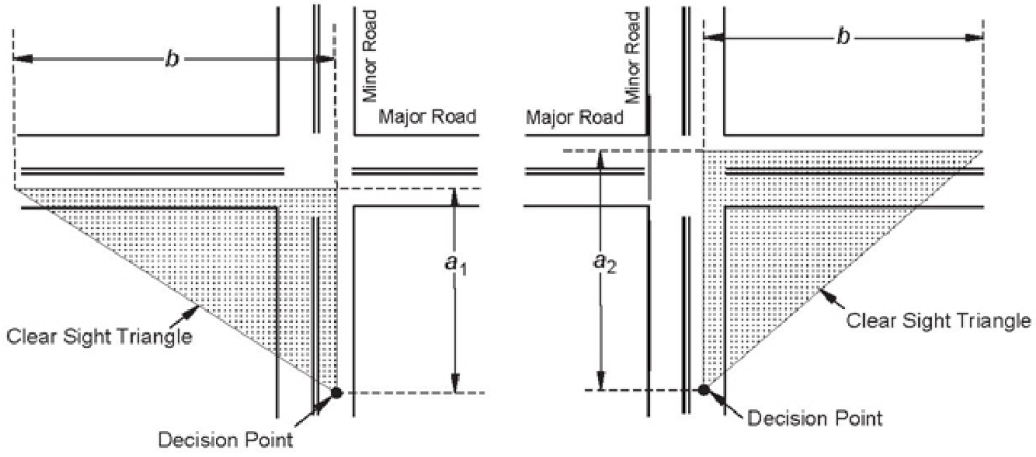

Figure 2. Sight triangles

The sight triangles vary with the type of traffic control used at an intersection because different types of control impose different legal constraints on drivers, resulting in different driver behavior. Table 5 summarized the sight distance values designed by AASHTO.

Table 5 - Design intersection sight distance

Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars	
		Calculated (ft)	Design (ft)
15	80	165.4 (143.3*)	170 (145)
20	115	220.5 (191.1)	225 (195)
25	155	275.6 (238.9)	280 (240)
30	200	330.8 (286.7)	335 (290)
35	250	385.9 (334.4)	390 (335)
40	305	441.0 (382.2)	445 (385)
45	360	496.1 (430.0)	500 (430)
50	425	551.3 (477.8)	555 (480)
55	495	606.4 (525.5)	610 (530)
60	570	661.5 (573.3)	665 (575)
70	730	771.8 (668.9)	775 (670)
75	820	826.9 (716.6)	830 (720)
80	910	882.0 (764.4)	885 (765)

Note: * for access without median

State Access Codes

- **New Jersey DOT**: *The Access Code Regulations (N.J.A.C. 16:47)*

This access code regulation is the latest version (2014) of the state highway access management code. The code covers all aspects of access management on state highways in New Jersey. Its primary objective is to provide specifications for allowable infrastructure elements. It provides geometric designs of the infrastructure elements as well the processes involved. It also describes the major and minor permit processes for different types of land uses, etc. Although the geometric design elements were most relevant for the study, an understanding of the procedures was also beneficial to the research team.

- **Pennsylvania DOT**: *Chapter 441. Access and Occupancy of Highways by Driveways and Local Roads*

This regulation controls the location, design, construction, maintenance and drainage of access driveways, local roads, and other property within State highway right-of-way for security, the economy of maintenance, preservation of proper drainage and safe and reasonable access.

- **Florida DOT**: *Access Management: Rules and Forms (Rules 14-96, 14-97 and Florida Statute 335.18)*

This rule chapter sets forth an access control classification system and access management standards to implement the State Highway System Access Management Act of 1988. The implementation of the access control classification system and

access management standards protect public health, safety and welfare, provide for the mobility of people and goods, and preserve the functional integrity of the State Highway System.

State Guidelines and Standards

- **Mississippi DOT**: *Access Management Manual*

The manual [4], developed by Mississippi DOT, introduces a roadway classification system and relative level of access. The geometric design criteria, traffic engineering analysis and administrative procedures are also discussed. Nevertheless, local roads are not considered in these standards. The manual only regulates the coordination between local jurisdiction and Mississippi DOT, as follows: all applications for driveways to sites that will generate more than 100 peak hour trips shall be submitted by the applicant to the appropriate local jurisdiction for review and comment before submission to the Mississippi DOT.

- **New York State DOT**: *Policy and Standards for the Design of Entrances to State Highways.*

New York State provides clear procedures and criteria for access-related works, including the permit application, Traffic Impact Study, intersection sight distance, etc. *Policy and Standards for the Design of Entrances to State Highways* [5] addresses the importance of the coordination between local and state governments and recommends access applicants to use the State Environmental Quality Review Act (SEQR) coordinated review process.

- **Virginia DOT**: *Access Management Regulations*

The Virginia General Assembly required the Virginia DOT to implement regulations for access management, so they produced the *Access Management Regulations* (24VAC30-73) [6] and added Appendix F, *Access Management Design Standards for Entrances and Intersections*, to the *Road Design Manual* [7].

The Virginia DOT *Frequently Asked Questions* document [8] clarifies when the standards in Appendix F are applied. These standards apply to all roads maintained by Virginia DOT, including arterial, collector, and local roads. They do not apply to roads maintained by cities, towns with a population higher than 3,500, and local roads in Henrico County and Arlington County. The standards may apply on a local road when there is a Virginia DOT project in a locality that maintains its own roads and the agreement with the locality states that *Road Design Manual* will be used for construction standards.

- **Utah DOT**: *Access Management*

Authorized by several sections of the Utah Code, the Utah DOT prepared the *Access Management Rule* within the *Transportation, Preconstruction Rules* [9]. The standards only apply to state highways, but there is a section of the rules on local authority highway projects. Local authorities must maintain their roads at connection points to the state highway system in conformance with the state access management rules. Through working with local authorities, the Utah DOT may develop corridor

agreements of the subtypes, signal control plan or access corridor plan. These agreements must be considered by local authorities when making development orders and may supersede the classification of the corridor.

- **California DOT (Caltrans)**: *Access Management Plan*

Caltrans created an *Access Management Plan* [10] for a 7.1 mile stretch of Highway 17 between the City of Scotts Valley in the south to Summit Road in the north. The plan is intended to guide the Santa Cruz County Regional Transportation Commission (SCCRTC) Regional Transportation Plan, in which projects and funding to enact the plan will be specified. The section of the plan that summarizes access management techniques includes the following statement, clarifying that the scope of the report is limited "*This summary is provided for a theoretical background on access management, and is not intended to represent specific Caltrans guidance or standards*." The plan also states that the authority for access management that is requiring permits for access to conform to their standards is provided in sections of the California Streets and Highways Code.

The *Caltrans Highway Design Manual* [11] does not deal with access management by name. However, there are sections on Access Control, and Road Connections and Driveways. This manual guides design functions of Caltrans.

- **Tennessee DOT**: *Roadway Design Guidelines*

The Tennessee DOT *Roadway Design Guidelines* (Revised 10/27/15) [12], contains a section on Access Management and Private Driveways at Roundabouts.

In 2015, the Tennessee DOT issued a Research Need Statement [13] for access management guidance to inform future state DOT roadways projects. The statement listed a timeline of one year and described the task as examining and modifying the TRB Access Management Manual to meet Tennessee DOT's needs.

Guidelines and Model Ordinance for Local Governments

Due to that fact that local agencies usually do not have their access codes and they also do not have sufficient resources to develop guidelines, the model ordinance would be a perfect option and improve the overall access management. The followings are a summary of Guidelines and Model Ordinance prepared by peer state DOTs.

- **Pennsylvania DOT** (Model Ordinance)*: Access Management Model Ordinances for Pennsylvania Municipalities Handbook.*

The development of the handbook from Pennsylvania DOT was sponsored by the Pennsylvania Department of Transportation (PennDOT), and completed in 2005 [14]. The focus of the document is to help municipalities develop a program that best suits their local conditions. More specifically, this handbook provides the flexibility required to make access management meaningful and fruitful for municipalities. There are three basic elements of an access management program including, defining and assigning a classification system, establishing requirements for a traffic impact or access study, and a preparing a list of best practices. The first element is an excellent reference for

the local agencies to develop their own access classification system. The second element identifies the requirements that determine when a new development must complete a traffic impact or access study. The last item includes descriptions, advantages, obstacles, and general design guidelines for access management, which can assist the development of access criteria for municipalities in Pennsylvania.

- **Indiana DOT** (Guidelines and Model Ordinance): *Access Management Guide*

This Guide [15] presents how and when to use access management techniques to improve the performance of traffic and solve access-related problems. In the Appendix of this Guide, two documents can be used by local governments in developing their own Access Management Codes tailored to their unique situations. The two model ordinances have sections highlighted where communities or counties can adapt the concepts to their own areas. The sample ordinances are:

  - A Model of the Access Management Ordinance used by Kentucky [16].
  - A Model of the Access Management Ordinance from the Michigan Access Management Guidebook [17].

Overall, the Indiana Access Management Guide is intended to be the document that governs all access management decisions for Indiana DOT. The concepts herein can also be used by community or county entities to manage access decisions at the local level as well.

- **Iowa DOT** (Guidelines): *Access Management Handbook*

Iowa DOT established the access management code called "*Iowa Primary Highway Access Management Policy"* to control the access to primary highways [18]. Furthermore, Iowa DOT funded the preparation of the *Access Management Handbook* [19] by the Center for Transportation Research and Education (CTRE) at Iowa State University. The handbook addresses the importance of access management in a community's comprehensive development plan and also contains model ordinances, in the Appendix, that can be implemented at the city and county levels. It should be noted that municipalities are urged to tailor the code to meet local needs and develop additional code language as necessary.

- **Kentucky Transpiration Cabinet (KYTC)** (Guidelines and Model Ordinance)

The report, *Access Management for Kentucky*, addresses the significant differences between the access management at the state level and local level [20] and guides coordination issues related to access management between KYTC and local governments. Moreover, a model access management ordinance is provided to assist Kentucky cities and counties in developing access management ordinances [16]. KYTC also describes the benefits of the proposed access management plan for Kentucky [21].

- **Minnesota DOT** (Guidelines and Model Ordinance): *Access Management Manual*

This manual provides the guidelines for public street and driveway connections, Access Classification System (ACS), and the process of reviewing access and impact studies [22]. A model ordinance is also developed by Minnesota DOT for local governments to regulate accesses [23]. Some standards in this model ordinance are blank, for local governments to input their own standards.

Existing Access Spacing and Corner Clearance Criteria

Access spacing is an important aspect of access management. The access spacing is the distance between two consecutive driveways on the same side of the road. In many states, spacing standards vary by roadway category, with the higher (lower numerically) category of roadways being more restrictive. These minimum spacing standards should take into consideration the safety of the traveling public, as well as access to the street and highway system by private landowners.
On the other hand, corner clearance is also essential to ensure the safety of the intersection. Corner clearance is the distance along the edge of the traveled way from the closest edge of pavement of the intersecting roadway to the closest edge of pavement of the nearest access connection. It should be noted that corner clearance spacing must meet or exceed the minimum access point spacing requirements of the applicable managed access highway class. Below are the access spacing and corner clearance criteria from different states or local agencies:

- **Pennsylvania DOT** (Guidelines)*: Access Management Model Ordinances for Pennsylvania Municipalities Handbook*

Driveway spacing: The following driveway spacing standards are desirable for arterial highways and major collector roads: (1) Principal Arterial: 600 feet; (2) Minor Arterial: 400 feet; and (3) Major Collector: 200 feet.

- **Ohio DOT (Guidelines):** State Highway Access Management Manual

Access has been classified into five different categories based on the functionalities of roadways. Category V applies to roads and streets that are designed to provide local land access. Accordingly, Access Category Charts represent the standards and specifications applied to various design features for each of the access categories. Moreover, for all access categories, where two roads of different access levels intersect, the restrictions of the higher level roadway will apply along the other roadway for a specified distance from the intersection as follows:

- Intersecting a Category I or II roadway-
  - At ramp intersections: 1000 feet
  - At terminal intersections: 1000 feet
- Intersecting a Category III roadway: 500 feet
- Intersecting a Category IV roadway: 250 feet

- **Washington State DOT (Guidelines):** *Access Guide to the State Highway System.* The Washington State DOT classified the road system into five classes (Table 6). Each class has its own minimal access spacing and limitations.

Table 6 - Minimal access spacing and limitations for different classes

Class	**Access Spacing**
Class 1 Mobility is the primary function	1,320 ft
Class 2 Mobility is favored over access	660 ft
Class 3 Balance between mobility and access in areas with less than maximum buildout	330 ft
Class 4 Balance between mobility and access in areas with less than maximum buildout	250 ft
Class 5 Access needs may have priority over mobility	125 ft

In addition to the five access control classes, there are also corner clearance criteria that must be used for access connections near intersections. Corner clearance spacing must meet or exceed the minimum access point spacing requirements of the applicable managed access highway class. The Washington DOT defines the minimal corner clearance as shown in Table 7.

Table 7 - Washington DOT corner clearance criteria

With Restrictive Median		
Position	**Access Allowed**	**Minimum (ft)**
Approaching Intersection	Right In/Right Out	115
Approaching Intersection	Right In Only	75
Departing Intersection	Right In/Right Out	230
Departing Intersection	Right Out Only	100
Without Restrictive Median Position Access Allowed Minimum		
Position	**Access Allowed**	**Minimum (ft)**
Approaching Intersection	Full Access**	230
Approaching Intersection	Right In Only	100
Departing Intersection	Full Access**	230
Departing Intersection	Right Out Only	100
*125 ft may be used for Class 5 facilities with a posted speed of 35 mph or less. **Full Access = All four movements (Right in/Right out; Left in/Left out)		

- **Corpus Christi MPO**: *Access Management Study*

The standards from the Corpus Christi MPO Access Management Study are shown in Table 8.

Table 8 - Minimum connection spacing and corner clearance criteria

Criteria	Posted Speed (mph)	Texas DOT (1)	Corpus Christi (Arterial) (2)	Corpus Christi (Collector) (2)	Corpus Christi (Local) (2)
Minimum Connection Spacing	Minimum Driveway Separation (feet)				
	⩽30	200	450	325	125
	35	250	450	325	125
	40	305	450	325	125
	45	360	450	325	125
	⩾50	425	450	325	125
Minimum Corner Clearance	Minimum Distance from Corner (feet)				
	⩽30	200	125	75	50
	35	250	125	75	50
	40	305	125	75	50
	45	360	125	75	50
	⩾50	425	125	75	50

[1]Texas Department of Transportation “Access Management Manual, 2004”

[2]City of Corpus Christi “Draft Unified Development Code, May 2006”

Source: Access Management Study, Corpus Christi MPO, Mar. 2007, p. 29.

Research Reports & Papers

NCHRP Report 348 [24] was prepared to serve state DOTs, city and county traffic engineering, transportation planning agencies, and private developers concerned with preserving and improving the capacity and safety of the overall highway systems near activity centers through better management of access control. The purpose of this research was to present methods to coordinate transportation and land development through developing access management guidelines and procedures, outlining design and operational techniques, and recommending legislative options and enforcement techniques. The report is based on an extensive literature search and a survey of state and local traffic engineers and major private developers to obtain information on effective access management practices, policies, and enforcement techniques. Many of the methods in the report, especially the survey, are highly relevant to this study.

NCHRP Report 420 [25] reviewed various types of access management techniques. It began with a literature review and subsequently screened more than 100 techniques. The screening process resulted in 12 methods that were illustrated in detail for practitioners. The report does not necessarily cover issues related to resistance from local governments to access management. However, the analytical techniques could be valuable for the research at hand.

NCHRP Report 548 [26] is meant for transportation agency managers, engineers, and planners to assist with establishing a planning process to implement a systematic and

consistent access management approach. It recognizes that access management is most effective when it is consistently applied by different functional organizations within a transportation agency. Although it does not address the issue of inter-agency coordination, several components of the study are pertinent to the proposed research. For example, the study specifies the roles of various types of agencies, state DOTs, MPOs, and local governments in matters related to access management.

NCHRP Synthesis 404 [27] is the most relevant document to this research, among all reviewed studies. It reports the way in which various agencies act on the components of an access management program, barriers to action, and how newer efforts might improve implementation of access management strategies. Although the report's primary focus is on state DOTs, it also includes access management for counties, municipalities, and MPOs. The report considers legal and legislative issues related to access management and provides some results from a survey of transportation agencies that implement access management.
Institute of Transportation Engineers (ITE) provides some essential but highly useful information about access management [28] and explicitly describes access management and its various benefits. The report appears to be more useful to policymakers than technical professionals.

A study sponsored by North Carolina DOT focuses on the effect of access management on businesses [29]. Through a survey and statistical analysis, it was determined that the perceived negative impacts of access management are not consistent with reality. A recent study [30] on access management sponsored by the Virginia DOT focuses on the importance of coordinated land use and transportation planning so that access management is addressed at the outset. The report describes a process that could be used for successful implementation of access management.

The Maricopa Association of Governments (MAG) surveyed MPOs to assess the implementation of access management at the regional level [31]. The results show that most MPOs had not adopted guidelines/regulations/standards (78% of 41 respondents), programming guidelines that included access management (75.6%), or a regional access management plan (97.6%). However, the majority had adopted a regional functional classification system (75.6%) or goals/objectives in the MPOs' Long-Range (Regional) Transportation Plan (73.2%).

Williams et al. [32] summarized elements of the local comprehensive plan and addressed the importance of local and collector streets in access development. Williams also explored strategies for land use planning and interagency coordination to engage local governments and land use planners in access management [33].
Gluck et al. [34] discussed access issues encountered in a retrofit project for a roadway in a densely developed, commercialized area on NY-27. This paper reviewed operational and safety problems associated with access configuration along the NY-

27 corridor. It also examined the alternative that was approved and being constructed in the project. The results demonstrated that real-world considerations have to be addressed in retrofit projects and a theoretical alternative needs to be modified to be acceptable to stakeholders.

The Texas DOT sponsored a research project with the aim of providing recommendations for implementation of a comprehensive access management program in the state [35]. It addressed the importance of including all stakeholders as early as possible. Moreover, it concluded that an access classification system, a consistent theme, and ongoing training are also needed for successful development and implementation of an access management program.

INTERVIEW WITH DOT OFFICIALS FROM OTHER STATES

Introduction

Structured telephone interviews were conducted between May 2nd and 30th of 2017 with state Department of Transportation officials from 13 states include: California, Colorado, Florida, Indiana, Iowa, Massachusetts, Minnesota, Mississippi, North Carolina, Ohio, Pennsylvania, Tennessee, and Virginia. The interview script was approved by the Institutional Review Board (IRB) of Rutgers University prior to the interviews. The script contained questions on credentials and access management experiences of the interviewees, general access management practices of the agencies, jurisdiction of the agencies over local roads, local government access management practices, issues encountered with local governments when implementing access management, experiences with conflicts regarding access to properties at or near intersections of state highways with local roads, communication channels with local governments regarding access management, and recommendations for developing and implementing access management on local roads.

The interviewees were selected on the basis of (a) the research team's acquaintance with their prior work in the area of access management, and (b) availability of relevant access management material in the agency's website. Some agencies were chosen for geographic diversity. Priority was given to agencies in home-rule states.

Each interview took between 45 and 90 minutes. Two senior research team members participated in each interview. Despite using a questionnaire, interviewees were encouraged to discuss what they felt were important. Notes were taken during all interviews, and they were then synthesized in a task report.

The interviews focused on current access management laws/regulations, resolving issues related to the development of corner lots, proactive steps taken to avoid access management issues, and recommendations for developing and implementing access management. The lessons learned from the interviews are presented below.

Current Access Management Laws/Regulations

All states have some access management law or regulation, whether that is statutory or not. In most states, a law gives power to the state DOT Commissioner or Director to implement access management, and the DOT develops standards based on that power. In those states, the standards are not written into law, but their effect is the same because the standards are developed pertinent to the power given to the Commissioner/Director. The laws given to the DOT Commissioner/Director often mention the authority is granted to ensure the safety of road users. In all states except

Virginia, the state access management laws and standards do not apply to county and municipal roads. Thus, these states necessarily face the same access management related issues as New Jersey. In Virginia, the state has had authority over local roads since historical times (This authority applies to all areas except two counties). As a result, the state DOT has an easier time dealing with access management issues on local roads.

The interviews indicated that state DOT's level of concern about access management on local roads does not depend on whether it has statutory or regulatory authority. For example, despite using only AASHTO-based Project Development and Design Guidelines, the interviewee from Massachusetts did not show a high level of concern over access management on local roads because many municipalities agreed to use the guidelines. Agreeing with local governments seems to be essential for access management on local roads.

The interviews also revealed that the demand for land development has a lot to do with access management issues on local roads. For instance, the interviews revealed that in states like Mississippi and Tennessee, access management on local roads is not as significant an issue for the state DOT as in other states. Even in states where access management on local roads is an issue, the issue is encountered only in certain parts of the state.

Resolving Issues Related to Development on Corner Lots

All states could potentially encounter problems like New Jersey regarding corner lot development except Virginia, where the state has authority over local roads. However, the interviews stated that cases involving land development on corner lots abutting local roads that affect state highways are only sporadically encountered. In some states, like Iowa and Minnesota, buying development or access rights by state DOTs for such problematic lots is common. However, DOTs in some other states like Massachusetts are not allowed to purchase development or access rights of such properties. In some states, like Minnesota, North Carolina, Ohio, and Washington, the state DOT has authority over development on local roads up to a particular distance from the intersection of local roads and state routes. The distances vary, the lowest specified distance was 150 ft, whereas the highest was 1,000 ft. In some cases, the distance is based on law, but in some other cases, it is simply an understanding between the state DOT and the local governments.

While most interviewees mentioned that litigation by landowners/developers is rare, state DOTs do sometimes experience such situations. In some states, state DOTs have established arbitration committees involving stakeholders from local governments, state governments, and consultants so that litigation can be avoided. When setting up, such committees seem to have been highly effective.

Although not binding, some states have an understanding with local governments about developments in lots abutting local roads near state highways. State DOTs are informed of such developments ahead of time so that solutions can be sought before development takes place.

Many state DOTs handle access management issues through traffic impact studies. When large developments (decided by potential traffic volume) are proposed on local roads near state highways, usually the local government informs the state DOT so that a process can be set up to negotiate access issues ahead of time.

Proactive Steps by State DOTs to Avoid Access Management Issues

Several states take recourse to corridor agreements to avoid access management issues. These agreements come to fruition as a result of collaboration between the state DOT and local governments. Some states have only one or two such agreements, but other states have established a number of such agreements with local governments. In some of these agreements, local roads are also included so that all stakeholders are aware what will be permitted along which segment of road.

Some state DOTs organize regular access management training for local government officials. The training sessions provide an opportunity to discuss access management needs and issues by all stakeholders.

Some state DOTs provide funding for local road improvements such as the installation of signals near state routes, which generates a collaborative atmosphere between the state DOT and the local governments.

Several state DOTs mentioned that decentralization of access management functions to district offices helps since the district officials have a much better understanding of local issues than do officials at DOT headquarter.

Summary of Major Findings

The interviews convened for this study ultimately presented invaluable insights as well as recommendations for beneficial access management practices that should be explored and considered for implementation in New Jersey. The list of strategies presented below was either directly recommended by interviewees or have been generated by the study team based on the input received during the interview process. They are presented in no specific order.

- ***State DOTs should develop proactive and positive relationships with local governments and other local stakeholders***. Interviewees almost universally cited this recommendation. They explained that developing

transparent, proactive and open communication between the state DOT and local government stakeholders regarding projects, funding, etc., is key to avoiding and/or helping to address access management conflicts and concerns.

- ***State DOTs should develop access management plans, corridor agreements and/or arterial management plans – especially for growth corridors – as a means to eliminate or minimize access conflicts.*** This recommendation was developed as a long-term strategy to assist state DOTs and local public and private stakeholders in resolving land use, access management, and other related concerns.

- ***State DOTs should foster local stakeholder education efforts that inform on access management issues and impart its diverse benefits.*** Widespread education about the benefits of access management and training of professionals with local governments were recommended by most interviewees, with the reasoning that the more informed local stakeholders are about the benefits of access management, the more likely they are to work collaboratively with state DOTs in proactively addressing access issues.

- ***State DOTs should consider acquiring access and development rights as needed.*** While this strategy is not permissible in some states, when permitted, it should be considered as a last resort.

- ***State DOTs should consider developing and utilizing a statewide access management manual, handbook and/or guidelines.*** This recommendation is related to the previously cited strategy of educating stakeholders and training professionals on access management. Developing practical manuals/handbooks for local agencies on access management can both inform the audience and make local authorities adhere to the standards.

- ***State DOTs should explore possibilities for funding and/or supporting the local government as a means to build a relation between the Department and local communities.*** Interviewees indicated that DOT support for local roadway maintenance costs and local roadway initiatives help to grow positive relations between the Department and communities.

- ***State DOTs should consider pursuing Superstreets.*** This newer and more innovative recommendation builds on the premise that access management theory is a vital component of Superstreets. Superstreets are roadway intersections designed to reduce conflict points using restricted crossing U-turn (RCUT) and other features.

SURVEY OF NEW JERSEY OFFICIALS

Introduction

Between November 2016 and March 2017, an online survey of New Jersey officials was conducted to comprehend the perspectives of a diverse group of county, city, and MPO officials about access management on local roads. The survey helped to examine the propensity of local governments to develop access management tools (e.g., guidelines, standards) applicable to local roads helped to identify the barriers to developing such tools. The survey also helped to disseminate the concerns about not having uniform standards and guidelines for local road access management in the state to a broad audience.

The survey instrument, containing 42 questions, was approved by the IRB of Rutgers University. About 600 agency officials were invited by email to take the survey. A total of 189 respondents took the survey. Municipal officials constituted 60% of the respondents, county officials represented 16%, private consultants working for local governments constituted 16%, and MPO officials, real estate professionals and other constituted the remaining 8%. The respondents belonged to 20 of the state's 21 counties. Managers, administrators, traffic engineers, municipal engineers, and transportation planners, and urban planners constituted 88% of the respondents, whereas elected officials, law enforcement officers, and emergency responders and others represented the remaining 12%. All respondents had at least some knowledge of the issues involving access management and most had in-depth expertise because they were primarily engaged in planning, engineering, design, permitting, right of way, and roadway operations. Of the respondents, 35% reported having used the state access management code at least once, 12% reported reviewing but not using it, 31% reported being aware but not reviewing or using it, and 22% stated not hearing about it. The following sections summarize the key findings from the survey.

Local Access Management Guidelines

A question was included in the survey inquiring whether the agencies served by the respondents had any formal or informal access management guidelines. Only 27% of the respondents mentioned their agencies having such guidelines, whereas 45% stated that their agencies did not have such guidelines, and 28% respondents stated that they did not know whether their agencies had such guidelines.

The survey revealed that it is far less common for municipalities to have their own access management guidelines than counties. Only 19 of 86 (22%) municipal agency officials stated that their agencies had access management guidelines, whereas 18 of 25 (72%) of the county officials mentioned their agencies having such guidelines.

Officials from 11 counties (out of 20 represented by the respondents) reported their agencies having formal or informal access management guidelines.

The 40 respondents who mentioned that their agencies had access management guidelines also identified the elements included in their guidelines by selecting from a list provided in the survey questionnaire. Their responses are summarized in Table 9. Among the 14 elements provided in the list, the most common appears to be driveway width, driveways per lot, and driveway spacing distance. In contrast, elements related to roundabouts and jug-handles as well as spacing distance between signals are least common. For this study, the location of driveways about acceleration and/or deceleration lanes and jug-handles are highly important due to the study's focus on areas near state highways. However, the survey shows that guidelines relating to those elements are not very common for counties and municipalities.

Table 9 - Elements Included in local access management guidelines

Elements Included	Responses	Percent (of 40)
Widths of driveways	35	87.5
Number of driveways per lot	32	80.0
Spacing distance between driveways	30	75.0
Grades for driveways	27	67.5
Differences for commercial versus residential lots	22	55.0
Distance of driveways to traffic signals	18	45.0
Location of driveways in relation to traffic signals	17	42.5
Waivers	17	42.5
Location of driveways in relation to exclusive turn lanes	10	25.0
Bifurcation of driveways	10	25.0
Location of driveways in relation to acceleration and/or deceleration lanes	9	22.5
Location of driveways in relation to jug-handles	5	12.5
Location of driveways in relation to roundabouts	5	12.5
Spacing distance of traffic signals	5	12.5

Local Driveway Permit Application Process

Of the 140 respondents who answered a question inquiring about local driveway application process, 67% reported their agencies having such an application process, 24% reported not having one, and 9% reported not knowing. All county officials reported having a driveway permit application process, whereas only 75% of the municipal officials reported having a procedure. 40% reported that their driveway permit application process was also applicable to changes in existing developments that will result in a significant increase in driveway volumes, whereas 34% indicated that their process did not apply to such cases (the remaining 26% did not know the answer). 43% of the respondents stated that their driveway permit application process

required a traffic impact study while 38% reported not requiring one (the remaining 19% did not know). When asked about the circumstances where a traffic impact study was required, most mentioned the generated traffic volume is being a consideration, whereas others mentioned the size of development (or redevelopment), subdivision, and commercial development.

The respondents were also asked if driveway reduction or consolidation was considered by the agencies when undertaking roadway construction projects. 48% of the respondents mentioned that being the case, while 30% indicated that not being the case (the remaining 22% did not know). When asked whether their agencies had undertaken any access management projects to reduce or consolidate driveways and/or median openings, only 20% reported having done so and 59% reported not having done so (the remaining 22% did not know). The responses seem to indicate that access management projects specifically for driveway consolidation/reduction and median opening are not very common.

Resource Documents Used to Address Access-Related Issues

Respondents were asked about the resource documents their agencies used to address roadway access-related issues. From a list of potential resources, they were asked to identify all types of resources they used. The responses to the question, summarized in
Table 10, shows that the most common resource for the agencies is the state access code (24%), followed by the agencies' own resources documents (21%). Among the respondents who mentioned using the agencies' own resource documents, almost all mentioned using land use or zoning ordinances. The responses show that it is common for agencies to address roadway access issues through land use regulations or zoning instead of access management guidelines of standards.

Table 10 - Resources used for addressing access-related issues by agencies

Resources used for Addressing Access Issues	Responses	Percent
Agency's own reference document	37	21.4
New Jersey Access Code	42	24.3
Access Management Manual	23	13.3
ITE Reports or journal articles	18	10.4
Highway Capacity Manual	35	20.2
Other publications	18	10.4
Total	173	100.0

Coordination of Transportation and Land Use

Due to overlapping land use and transportation issues related to roadway access management, the respondents were asked about the types of the agencies' actions

that involved coordination between transportation and land use staff. The responses, summarized in Table 11, show that it is common for transportation and land use staff to coordinate. Site plan review, subdivision review, and zoning/rezoning involve the most coordination between land use and transportation staff.

Table 11 - Actions Involving coordination of land use and transport staff

Actions	Responses	Percent
Zoning/rezoning	75	23.4
Site plan review	100	31.3
Subdivision review	85	26.6
Building permit approvals	39	12.2
Corridor overlay zones	17	5.3
Other	4	1.3
Total	320	100.0

The respondents were also asked how land use and transportation decisions related to access management were typically coordinated by their agencies. The responses, summarized in Table 12, show that it is far more common for roadway jurisdiction to prevail over land use jurisdiction, although coordination meetings between roadway and land use jurisdictions are also fairly common. Only a small proportion of the respondents reported separate decisions by the two jurisdictions.

Table 12 - Types of coordination of transportation and land use decisions related to access management

Typical Practice	Responses	Percent
Agency with jurisdiction over the subject roadway typically governs	87	54.7
Agency with jurisdiction over the land use typically governs	17	10.7
Coordination meeting occurs among the involved agencies	37	23.3
An access management plan is prepared	4	2.5
Transportation and land use decisions are made separately and not coordinated	9	5.7
Other	5	3.1
Total	159	100.0

Support for Local Access Management and Assess Management Code

When asked whether they agreed or disagreed that county/municipal governments should incorporate access management concepts and strategies into their planning process, 81% respondents agreed or strongly agreed, 17% had no opinion, and only

2% disagreed or strongly disagreed. The responses show that there is a general agreement that roadway access management is highly important for municipalities and counties. In response to another question, 84% of the respondents strongly agreed or agreed that counties and municipalities should incorporate access management considerations into their zoning and/or other development regulations.

When asked whether local governments should have access management standards similar to the state highway code, 60% stated that such standards would be beneficial, 17% stated that they would not be beneficial, and 23% stated they would be neither beneficial nor not beneficial (i.e., neutral). These responses show that the respondents are mostly supportive of local governments having access management standards.

The respondents perceived access management being important for higher level roads only. As shown in Table 13, only 30% believed access management was important for all roads, whereas 44% believed it was important for important county and municipal roads. Response to another question revealed that, in view of the respondents, traffic volume (26%) should be the most important consideration when deciding where access management is needed, although the need for coordinating transport and land use (16%) and driveway spacing (14%) should also be important considerations.

Table 13 - Types of roads for which local access management standards are beneficial

Type of Roads	Respondents	Percent
Important county roads	6	11.1
All county roads	8	14.8
Important county and municipal roads	24	44.4
All county and municipal roads	16	29.6
Total	54	100.0

Barriers to Access Management Standards for Local Roads

The respondents were asked about the most serious barriers for New Jersey counties and municipalities to develop and adopt access management standards. As shown in Table 14, lack of funding is considered to be the most serious barrier, followed by lack of technical expertise of staff and opposition from landowners. Lack of political will is also considered to be a significant barrier by many.

Highly useful responses were obtained from a question inquiring about the practical strategies to implement access management on county and local roads. As shown in Table 15, expanding coordination and dialogue between NJDOT and local governments received the most support, followed by technical assistance to counties and municipalities from the NJDOT. Dedicated funding to counties and municipalities

to develop their own standards also received support from a large number of respondents. On the whole, the top two strategies identified by the respondents require NJDOT involvement, one regarding coordination and the other regarding technical assistance. Even the third most recognized strategy that calls for dedicated funding may also require NJDOT involvement.

Table 14 - Barriers to developing access management standards by counties and municipalities

Barriers	**Responses**	**Percent**
Lack of funding	53	26.2
Lack of staff with technical expertise	35	17.3
Lack of political will	31	15.3
Potential opposition from businesses	13	6.4
Potential opposition from land owners in general	35	17.3
Lack of public understanding about access management and its benefits	35	17.3
Total	202	100.0

Table 15 - Effective strategies to implement access management on county and municipal roads

Effective Strategies	**Responses**	**Percent**
Creating and distributing educational material about the benefits of access management	31	11.4
Expanding coordination and dialogue between NJDOT and local governments	60	22.0
Establishing legislation to give more power to NJDOT for access management on county and municipal roads that intersect and/or impact State routes	11	4.0
Improving engagement of businesses and residents in access management projects	23	8.4
Dedicating funding to county and municipal governments to develop their own access management standards that would be consistent with the Access Code	47	17.2
Providing technical assistance by NJDOT to counties and municipalities to develop access management standards	51	18.7
Establishing standards to help make access decisions	43	15.8
Other	7	2.6
Total	273	100.0

Perceived Role of NJDOT

All respondents were asked if there are situations where the NJDOT should have extended authority beyond the State Highway system, including county and municipal roads. The responses indicated only lukewarm support for such an extension. Only 18% of the respondents supported such an extension, while 47% opposed, and the remaining respondents did not take sides. Among the respondents supporting an extension of NJDOT authority to local roads, the most support was for the extension of oversight to roads with high traffic volume, followed by roads intersecting with state highways, roads with high crash volumes, and roads with specific types of land uses in abutting properties.

Overall, however, the survey showed only modest support for the extension of NJDOT's authority over county and municipal roads. However, the survey revealed that the respondents have a high degree of support for coordination and dialogue with NJDOT and for technical assistance from NJDOT on matters related to access management on local roads.

Second-round Survey Summary

The team also conducted a second round survey sent to stakeholders and other peer states. The second round of survey covers specifically several key local access scenarios to be investigated according to NJDOT needs. The Second-round survey has two versions designed for local agencies in New Jersey and other state DOTs, respectively. 97 local agency officials and 19 state DOT officials were invited by email to take the survey. 55 officials from local and 11 officials from states took the survey. 19 of 55 from local and 2 of 11 completed the survey. There were multiple agencies used AASHTO design recommendations as their access spacing criteria, as described in the previous Literature Review section.

Spacing Criteria and Factors Considered

A question is asked if the spacing criteria vary depending upon whether the project is a "retrofit" in a built-up area to their agencies. Only 1 of 14 respondents varies their criteria upon retrofit area, while 8 of 14 respondents do not change their criteria and 5 of 14 respondents vary their criteria depending on other factors.

When asked if the local agencies work with State DOT to develop special access spacing criteria for the local roads in a State and local road intersection project, 8 of 15 respondents said they would work with NJDOT. Three respondents would apply their own spacing criteria, and four respondents stated that they have to follow NJDOT's decisions for each project. The respondents were asked about factors they considered in developing spacing criteria. The results are shown in Table 16.

Table 16 - Factors considered in developing spacing criteria

Factors Considered	Responses	Percent
Traffic Volumes	5	17.9
Crash History	4	14.3
Roadway Functional Class	2	7.1
Land Use	4	14.3
Area Type	3	10.7
Intersection Type	3	10.7
Speed Limit	5	17.9
Other	2	7.1
Total	28	100.0

Regarding traffic volume considered in developing spacing criteria, Table 17 shows types of volumes that respondents considered.

Table 17 - Factors considered in developing spacing criteria

Type of Volumes	Responses	Percent
State route traffic volume	4	18.2
Local road volume	5	22.7
Left-turn/Right-turn volume	5	22.7
Entering and exiting volume to and from targeted properties	4	11.2
Truck volume	4	11.2
Total	22	100.0

Land use is another factor widely considered: commercial and business will be allowed wider access points; On-site vehicle circulation is a consideration especially for a gas station needing space for a fuel truck to access the site; Single family and two shared single-family homes are excluded from driveway spacing standards. Regarding speed limits, several respondents follow the guidelines set by AASHTO for the calculation of sight triangle. Road with lower speed limits is less restrictive on minimum access spacing than road with higher speed.

State and Local Agency Collaboration

In the absence of local access code or standards,
Table 18 shows actions respondents would take for highway improvement projects involves both state highways and local roads.

Table 18 - Actions taken in the absence of local access code

Actions	Responses	Percent
Apply State Code or similar standards	7	41.2
Provide model ordinance overlay/guidelines	1	5.9
Develop and recommend project-specific guidelines	5	29.4
Others	4	23.5
Total	17	100.0

The survey also asked the local respondents' opinions on DOT's and their local agencies' typical willingness level to participate in the coordination effort for State DOT initiated highway improvement project. As shown Table 19, the willingness level is on a scale from 0 to 5, where 0 means no interest at all and 5 means a great deal of interest.

Table 19 - Willingness level of coordination

Local Agency's Willingness Level	**0**	**1**	**2**	**3**	**4**	**5**	**Total**
Responses	0	0	0	0	3	6	9
Percent (%)	0	0	0	0	33.3	66.7	100
State DOT's Willingness Level	**0**	**1**	**2**	**3**	**4**	**5**	**Total**
Responses	0	0	1	1	4	3	17
Percent (%)	0	0	11.1	11.1	44.4	33.4	100

The survey asked the major difficulties in promoting local-state coordination for access management. Table 20 summarized the feedbacks of respondents.

Table 20 - Actions taken in the absence of local access code

Type of Difficulty	**Responses**	**Percent**
Lack of inter-agency relationships	7	21.9
Insufficient knowledge base or training	0	0.0
Limitation in the efficiency and complexity of related institutional procedures	2	6.3
Limitation of budget and resources	4	12.5
Limitation of personnel and workforce	4	12.5
Lack of early communication at the planning stage of projects	5	15.6
Others	10	31.3
Total	32	100.0

The survey provided potential strategies for the agency to choose to assist their coordination with State DOT. Table 21 shows the choices of respondents. Several

respondents also addressed the importance of the state-local communication during project planning phase.

Table 21 - Actions taken in the absence of local access code

Training Strategies	Responses	Percent
Regular training and education	8	26.7
Distribution and education of state guidelines	8	26.7
Incentives in local aid project evaluation	6	20.0
Assistance with development of local spacing guidelines	5	16.7
Others	3	10.0
Total	30	100.0

Summary of Major Findings

The survey provided key insights about roadway access management in general and for access management for local roads. It revealed that New Jersey local officials and professionals recognize the importance of access management for mobility and safety of roadway users, but they also realize that it involves a balance between the needs of property owners and users and mobility and safety of roadway users.

The survey also revealed that the NJ professionals recognize the importance of access management for the county and local roads. However, it is not common for municipalities to have access management standards. Most respondents are in favor of municipal and county access management standards, but lack of funding and technical know-how at the local level appear to be two critical barriers to developing such standards. In the absence of particular access management standards, a significant proportion of local governments utilize the State Access Code and their own land use regulations for access management purposes, but many also recognize that the state standards are meant for only the highest level roads.

Although some respondents believe that access management standards are essential for all county and municipal roads, a higher proportion of respondents find that such standards are useful only for the important county and municipal roads. Importance of local roads is perceived by the respondents mostly regarding traffic volume, crash frequency, the nature of abutting properties, and the intersection with state highways.

The survey showed that there is little support among county and municipal officials for an extension of NJDOT's authority over county and municipal roads. Only 4% of the respondents perceived legislation to extend NJDOT's authority as useful, and 18% believed there was any need for an extension of NJDOT's oversight. However, a majority of the respondents believed the need for coordination/dialogue with NJDOT on matters related to access management. The need for technical assistance to local

governments from NJDOT was also clear from the survey responses. In sum, dedicated funding to local governments, coordination/dialogue between NJDOT and local governments, and the provision of technical know-how from NJDOT to local governments appear to be highly essential for the successful development and implementation of access management standards or guidelines for local roads.

The results of the second-round survey revealed that the existing spacing criteria vary among agencies. It can be difficult to recommend uniform standards or criteria to all local agencies. As a home-rule state, local governments have their flexibility in adapting spacing criteria to their local conditions. Most local agencies consider multiple criteria when determining spacing recommendations, including road functional class and posted speed limits, etc.

The second-round survey results indicate strong interests in state-local collaboration in joint highway improvement projects that involve both state routes and local roads. The local agencies are willing to develop project-based or case-by-case spacing criteria with state DOTs.

The second-round survey also explores the factors impeding the state-local collaboration and potential strategies to promote the collaboration. Significant impedance factors include the institutional barriers that lead to the lack of relationship and the understanding of agency procedures in collaboration, the limitation in the budget, resources, and personnel, and the lack of early communications in projects. The local agencies also consider the training and assistance programs can help them gain a better understanding regarding NJDOT criteria, code, and procedures for better collaboration. Incentives in local-aid projects are also appealing options for the state the develop their own access criteria.

CASE STUDIES

The primary objective of the case studies was to examine how the stakeholders and out-of-state interviewees would resolve real-life problems encountered by the NJDOT when transportation improvement projects are implemented at intersections of state highways and local roads. The research team examined five case study sites from recent projects undertaken by the NJDOT and created generic scenarios so that they could be provided to the stakeholders and out-of-state interviewees through an online

survey. Based on coordination between stakeholder panel and NJDOT, these locations were selected for further evaluation, considering following issues:

- Geographical and land use representations
- Availability of safety, mobility, and community data
- Severity of safety, mobility, and community development issues caused by access management
- Types of access management locations
- Difficulty of the access management implementation under the current regulations and state of practice

By considering all these issues, the selected site locations include: Route 9 and Lacey Rd. (Block 314); Route 9 and Lacey Rd. (Block 282); Route 72 (Block 75, Lot 4.02); and US 130 (Block 128, Lot 3&4). To evaluate the aforementioned issues, the research team established the following main steps for each case study location:

1. Analyze the existing safety, mobility, and community development issues
2. Identify key challenges and opportunities for local access management improvement
3. Summarize case study files (e.g., permits, debate, legal, and appeal activities, and general summary only)
4. Summarize the findings and lessons learned from the case study

Steps 2 and 3 are the critical steps towards understanding the actual challenges and issues in current local access management practices and the difficulties of coordination between state and local agencies in a Home Rule state. Based on the key findings and lesson learned through the last step, the research team provides appropriate recommendations on related local access management regulations and implementation procedures. For the analysis of safety, mobility, and community development, the research team took advantage of the existing data sources available at CAIT including the New Jersey Department of Transportation (NJDOT) Safety Voyager database, the New Jersey Division of Highway Traffic Safety (NJDHTS) Crash Analysis Tool (CAT), NJDOT AADT Traffic Count Book, Google Maps Travel Time, and Zoning and Parcel Data. The following section describes the evaluated case studies in more details.

Location 1: Route 9 and Lacey Rd., Block 314 (Ocean County)

Location 1 is located in the North West Quadrant (NWQ) of the intersection of Lacey Road/County Road 614 and US Highway Route 9/North Main Street, as shown in Figure 3. This site is currently occupied and operating as a TD Bank.

Figure 3. Route 9 and Lacey Rd., Block 314

State route (Route 9)

In the northern quadrant of the intersection along Route 9, the intersection is a five (5) lane road with concrete raised median dividing the directional traffic. There are two (2) northbound lanes, and three (3) southbound lanes, including two (2) through lanes and a forced right turn that is created by a concrete triangle median. Approximately 235 feet north of the intersection, a gap in the concrete median creates a dedicated turn-around lane onto Route 9 northbound. Further north, Route 9 is two (2) lanes with a lane each for east- and westbound traffic, which increases to three (3) approximately 850 feet from the southbound approach towards the intersection. Primary site has two ingress/egress points –one along Route 9. Figure 4 illustrates the mobility data for this location including recurrent bottlenecks and traffic volume. Recurrent bottlenecks are illustrated in Google Recurrent Traffic Patterns while traffic volumes are Annual Average Daily Traffic (AADT) reported from New Jersey Traffic Monitoring System. The volume data are calculated based on counts of a 48-hour period, and the latest AADT updates are selected for analysis.

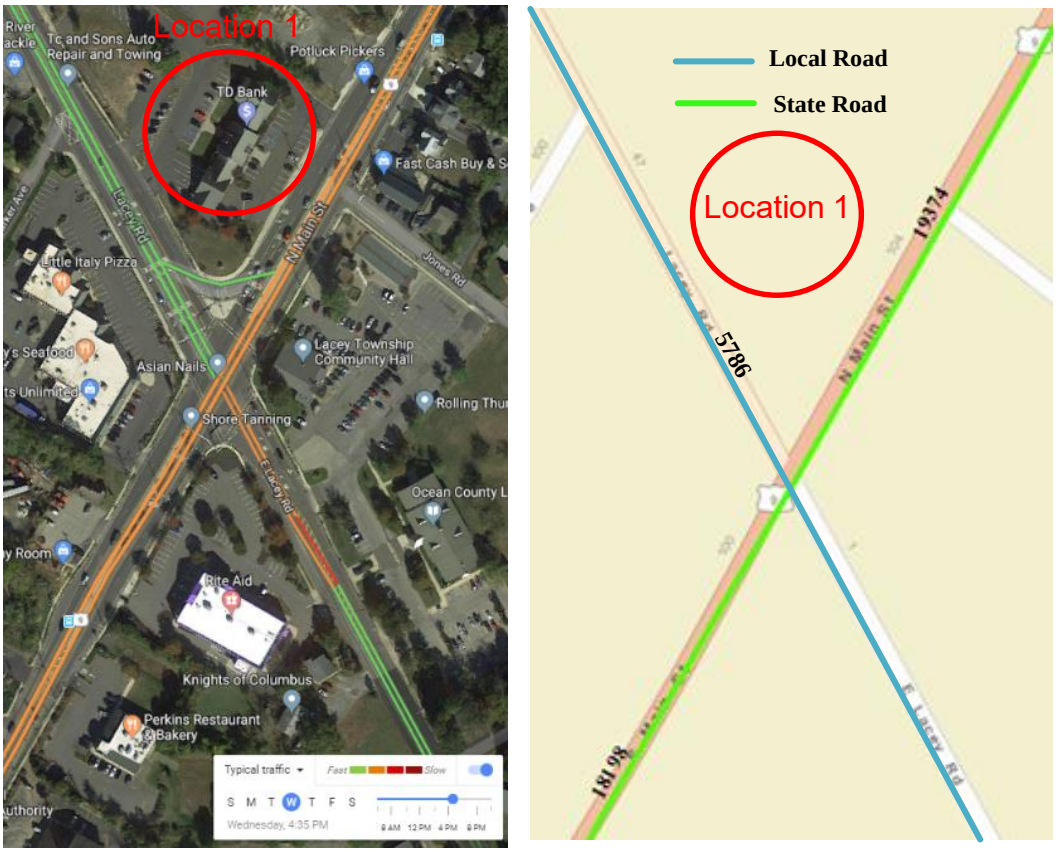

Figure 4. Recurrent bottleneck (Left) and NJDOT AADT traffic count (Right) - Route 9 and Lacey Rd.

As it can be seen, Route 9 has an AADT of 18,198 vehicles per day. Compared to the local road, Route 9 experienced more delays during the afternoon peak hour. Figure 5 also illustrates the AADT condition before and after the access modification. Based on this figure, the traffic on state route slightly increased from 18,199 vehicles per day to 19,374 vehicles per day after the access modification.

Figure 5. ADDT Condition for Location 1, before (Left, Apr. 2013) and after (Right, Oct. 2017)

Local Road (Lacey Rd.)

In the western quadrant of the intersection along Lacey Road, the intersection is a five-lane wide road, with one (1) lane through lane travelling eastbound, and four (4) westbound lanes, including a dedicated right turn towards Route 9 southbound, a dedicated through lane for Lacey Road eastbound, and two (2) dedicated left turn lanes towards Route 9 northbound. Westerly past the intersection, the road is four (4) lanes with two (2) lanes each for east- and westbound traffic.

Primary site has two ingress/egress points – one along Lacey Road. There are two additional access points along Lacey Road that appear to function as one-way entry and exit to a parking area with 45-degree spaces separate from the primary parking area surrounding the building. Block 314, Lot 7 directly adjacent to the northeast is vacant with a demolished building, and only foundation and existing pavement are remaining on site. The site is connected to Location 1 and has access via the existing drive aisles, which may add additional right and left turns to Lacey Road and right turns from Lacey Road into the site if it ever becomes operational again.

There are several issues associated with this location including:

- Tenants wanted the driveway to remain open for right turns and concerned about that customers cannot make left turns onto and from Route 9 when using the proposed driveway. DOT refused left-turn plan from Owners Engineer. Figure 4 illustrates the locations of existing and proposed driveways.
- Consulting firm offered up signage options that would help ameliorate TD Banks issues with the new traffic configuration, including informing patrons of how to exit, and signage for motorists on Lacy Road about how to best access TD banks. DOT Rejected signage on Route 9, accepted internal signage for exiting motorists

Regarding the mobility, according to Figure 5, Lacey Road has an AADT of 5,786 vehicles per day and does not experience significant delays at this location. It should be noted that due to the lack of AADT data for before access modification on the Lacey road, it was not possible to compare the traffic condition with respect to access modification.

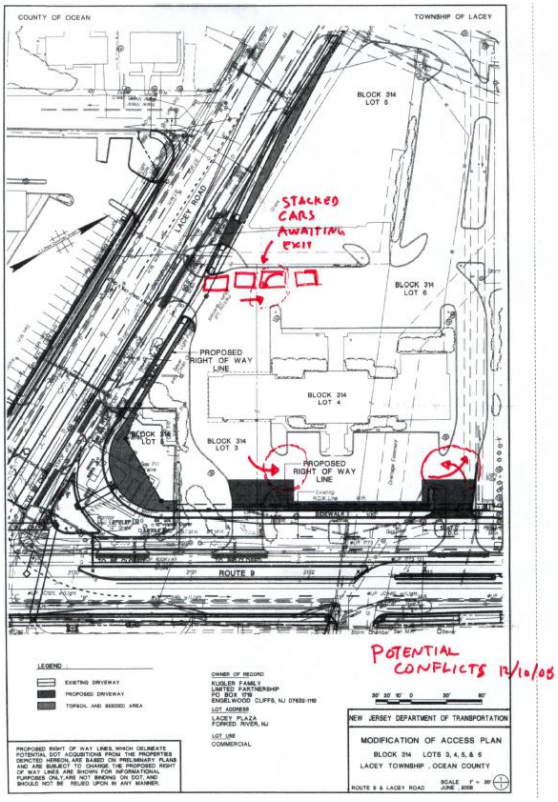

Figure 6. Locations of existing and proposed driveways

Location 2: Route 9 and Lacey Rd., Block 282 (Ocean County)

Location 2 is located in the South East Quadrant (SEQ) of the intersection of Lacey Road/County Road 614 and US Highway Route 9/North Main Street, as shown in Figure 7. This site is currently occupied and operating as a drive-through Rite Aid pharmacy. The site has ingress/egress points along both Lacey Road (local Road) and Route 9 (State route). It should be noted that the property owner was concerned about losing the parking spaces. NJDOT reviewed the access plan, and it does not warrant the loss of parking. Figure 8 shows the zoning map of the intersection of Lacey Road and Route 9.

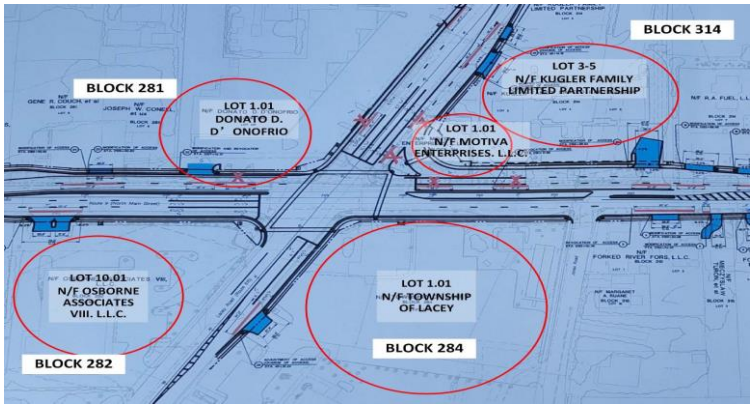

Figure 7. Route 9 and Lacey Rd., Block 282

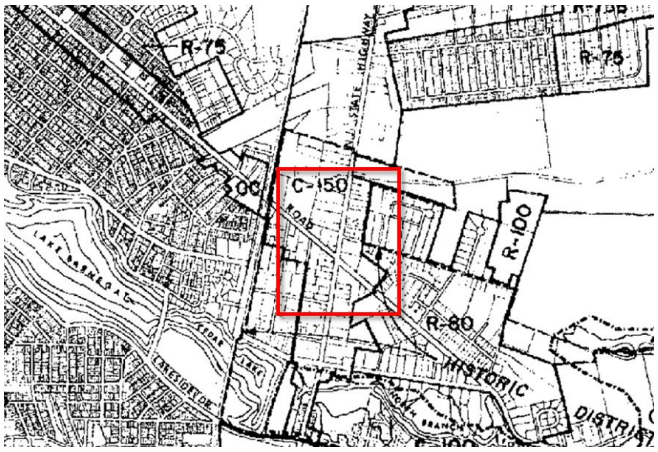

Figure 8. Zoning Map of Lacey Township (C-150 Zone)

State route (Route 9)

In the southern quadrant of the intersection along Route 9, the intersection is a five (5) lane road with concrete raised median dividing the directional traffic. There are two (2) southbound lanes, and three (3) northbound lanes, including a through lane, through/right turn lane and dedicated left turn lane Approximately 235 feet north of the intersection, a gap in the concrete median creates a dedicated turn-around lane onto Route 9 northbound. Further south, Route 9 decreases to a two (2) lane road with a lane each for east- and westbound traffic, approximately 380 feet from the intersection. Access from Route 9 can only be achieved by a right hand turn when traveling northbound; there is concrete raised median that prevents left turns from the southbound lane. Similarly, leaving the site, only Route 9 can only be achieved by a right hand turn into the northbound lane. Figure 9 illustrates the mobility data for location 2 including recurrent bottlenecks and traffic volume. As it can be seen, Route 9 has an AADT of 18,198 vehicles per day.

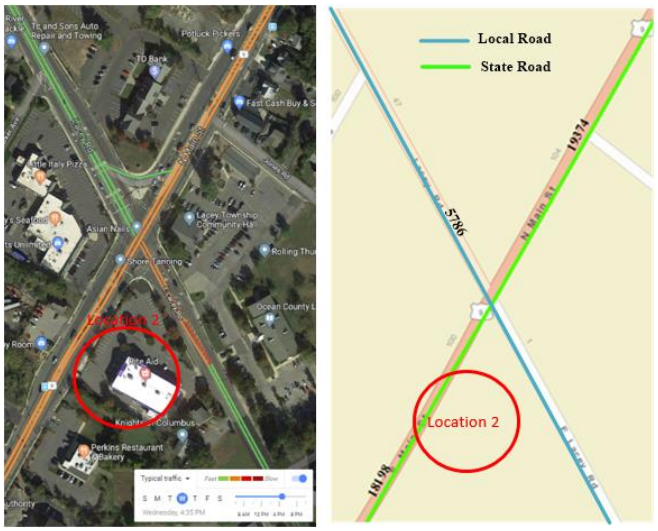

Figure 9. Recurrent bottleneck (Left) and NJDOT AADT traffic count (Right) - Route 9 and Lacey Rd.

Local Road (Lacey Road)

At the eastern quadrant of the intersection along Lacey Road, the intersection is a three-lane road, with one (1) through lane travelling westbound, and a two (2) eastbound lanes, including a dedicated left turn towards Route 9 southbound and through/right turn lane for Lacey Road westbound/Route 9 northbound. Easterly past the intersection, the road is two (2) lanes with a lane each for east- and westbound traffic. Access from Lacey Road can be achieved by both left-hand turns when traveling westbound and right-hand turns when traveling eastbound. There is striping leading into the left turn queue lane at the signalized intersection. However, this area can still be used to turn into the site. It appears that, when leaving the site, there is a right turn only arrow to guide drivers from making a left turn out to westbound lanes of Lacey Road, however, there are no physical barriers such as concrete raised median that would prevent a left turn from being made. According to Figure 5, although Route 9 has a higher traffic volume, Lacey Road at the south of Route 9, around Location 2, encounters a significant delay at 5 p.m. compared with other sections of roads. The delay on the local road could be due to the queue on left turn lane and the volume out of access opening at Location 2.

Figure 10 shows total crashes that occurred in locations 1 and 2 from 2006 to 2016. During this period, 118 crashes occurred including one fatal crash, seven moderate injury, 26 pain, and 84 property damage injury crashes, as shown in Figure 11.

Figure 10. Total crashes at the intersection of Route 9 and Lacey Rd.

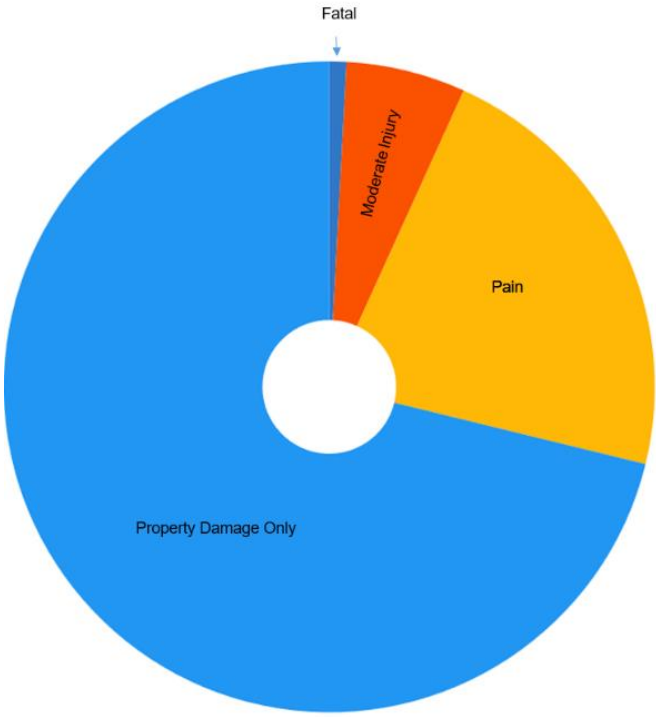

Figure 11. Total crashes based on severity- Route 9 and Lacey Rd.

Table 22 also show the total number of crashes that occurred during the same time interval. According to this table, state route had 96 crashes while local road expereinced 22 crashes.

Table 22 - Total Crashes at the intersection of Route 9 and Lacey Rd.

Year	Total Crash	State Route	Local Road
2006	15	12	3
2007	14	14	0
2008	12	10	2
2009	12	11	1
2010	16	11	5
2011	6	4	2
2012	11	8	3
2013	6	4	2
2014	10	10	0
2015	7	5	2
2016	9	7	2
Total	118	96	22

Location 3: Route 72, Block 75, Lot 4.02 (Ocean County)

Location 3 is located on Route 72, and the site is currently occupied and operating as a TD Bank. Primary site has three ingress/egress points – one along Washington Avenue and two along Doc Cramer Boulevard. It was suggested that all these three driveways are closed and replaced with two new driveway – one along Route 72 and another one along the Martin Truck Jr. Boulevard, as shown in Figure 12. There are several issues associated with this location including:

- Tenant wanted to keep West Road open. If closed, vehicles would follow an indirect and longer path to enter the MacDonald's. DOT did not agree with owner's traffic analysis. The analysis did not warrant leaving West Road open.
- Tenant wanted a sign of on Relocated West Road. The owner must approach the Township on this issue.

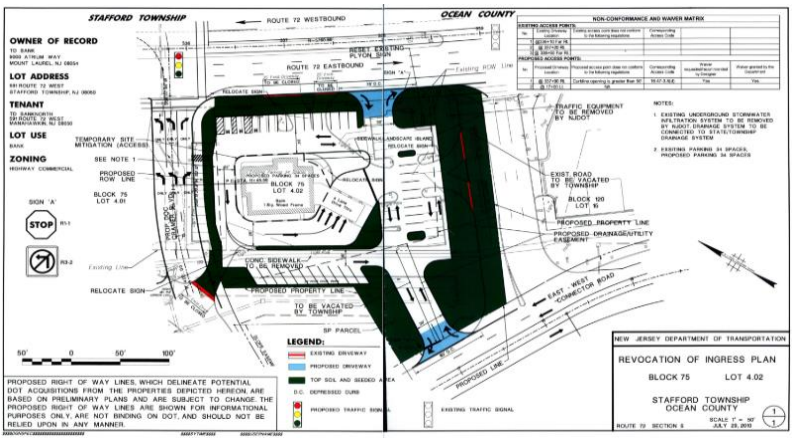

Figure 12. Route Block 75, Lot 4.02

State Route (Route 72)

Figure 13 illustrates the mobility data for location 3 including recurrent bottlenecks and traffic volume. Recurrent bottlenecks are illustrated in Google Recurrent Traffic Patterns while traffic volumes are Annual Average Daily Traffic (AADT) reported from New Jersey Traffic Monitoring System. The volume data are calculated based on counts of a 48-hour period, and the latest AADT updates are chosen for analysis. Route 72 has an AADT of 44,307 vehicles per day. Based on this figure, Route 72 does not experience significant delay at this location.

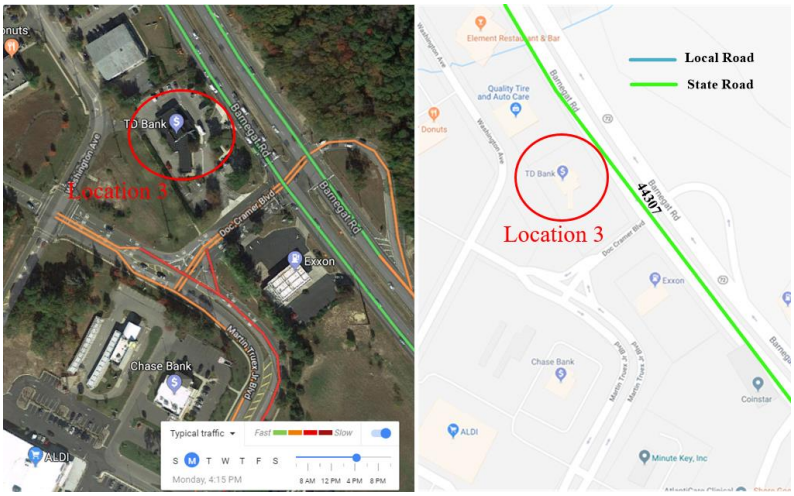

Figure 13. Recurrent bottleneck (Left) and NJDOT AADT traffic count (Right)-Route 72, Block 75

Local Road (Doc Cramer Boulevard)

According to Figure 14, at this location, local road encounters a significant delay around 5 pm. The recurrent bottleneck illustrates a major delay on local roads, which could be caused by the significant traffic getting off/to Route 72. It should be noted that local road at this location has no AADT records.

Figure 14 shows total crashes that occurred at location 3 from 2006 to 2016. During this period, 103 crashes occurred including one incapacitating injury, three moderate injury, 11 pain, and 88 property damage injury crashes, as shown in Figure 15.

Figure 14. Total crashes- Route 72, Block 75

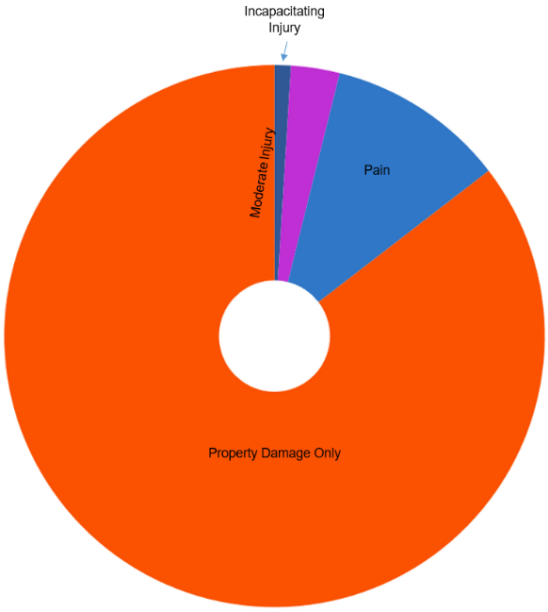

Figure 15. Total crashes based on severity- Route 72, Block 75

Table 23 also shows the total number of crashes that occurred during the same time interval. According to this table, state route had 99 crashes while local road experienced six crashes.

Table 23 - Total crashes- Route 72, Block 75

Year	Total Crash	State Route	Local Road
2006	2	2	0
2007	4	4	0
2008	9	8	1
2009	13	13	0
2010	11	10	1
2011	10	6	4
2012	8	8	0
2013	16	16	0
2014	11	11	0
2015	11	11	0
2016	8	8	0
Total	103	97	6

Location 4: US 130, Block 128, Lot 3&4 (Camden County)

Location 4 is near a roundabout connecting US Route 130 and Broadway, and the site is currently occupied and operating a restaurant and bar. Primary site has two driveways along Route 130 and a couple of driveways along Old Salem Road. It was suggested that all driveways along Route 130 are closed, as shown in Figure 16. There are several issues associated with this location including:

- The owner is concerned about the loss of parking lot. NJDOT stated that many of existing parking stalls were deed "non-conforming" or not residing inside the property boundary. There were 51 existing conforming parking spaces and 11 non-conforming parking spaces.
- The proposed design will leave 24 conforming parking spaces with a net loss of 27 conforming parking spaces.

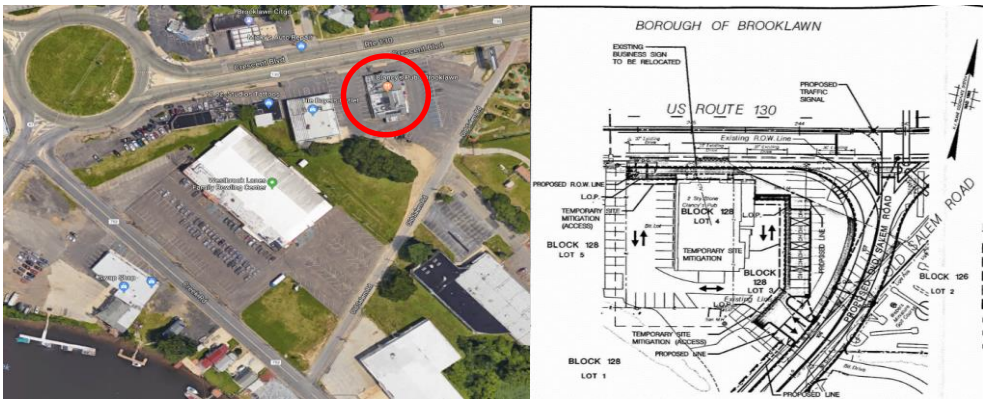

Figure 16. US 130, Block 128, Lot 3&4

There is no online available zoning maps or GIS files for this location. The zoning use for the land is a mix of commercial and residential, typical for the neighborhood, with higher traffic across creek road. Bowling alley could be helped by consolidating multiple driveways and other entry points along Creek Road and Old Salem Road.

State Route (US 130)

Figure 17 illustrates the mobility data for location 4 including recurrent bottlenecks and traffic volume. Recurrent bottlenecks are illustrated in Google Recurrent Traffic Patterns while traffic volumes are Annual Average Daily Traffic (AADT) reported from New Jersey Traffic Monitoring System. The volume data are calculated based on counts of a 48-hour period, and the latest AADT updates are selected for analysis. US Route 130 has an AADT of 26,371 vehicles per day. Based on this figure, Route 130 does not experience a significant delay at this location.

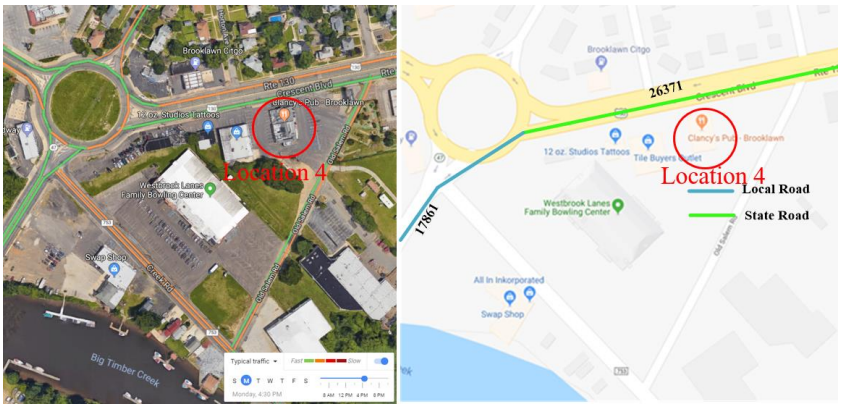

Figure 17. Recurrent bottleneck (Left) and NJDOT AADT traffic count (Right)- US 130, Block 128

Local Road (Old Salem Road)

According to Figure 18, Creek Road and Old Salem Road have medium delays, which could be caused by access issues and traffic diverting from both US Route 130 and Broadway. It should be noted that local road at this location has no AADT records. Figure 18 shows total crashes that occurred at location 5 from 2006 to 2016. During this period, 209 crashes occurred including seven moderate injury, 38 pain, and 164 property damage injury crashes, as shown in Figure 19.

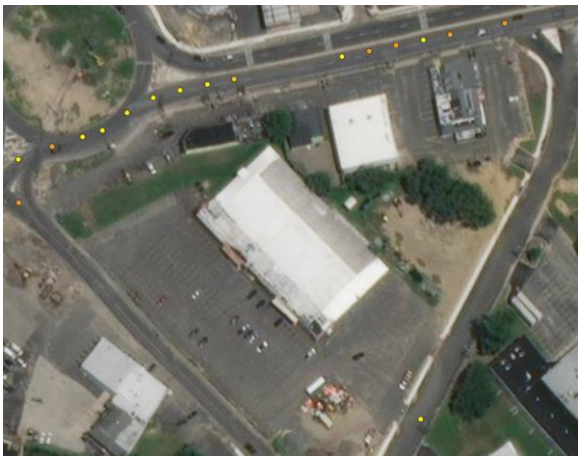

Figure 18. Total crashes- US 130, Block 128

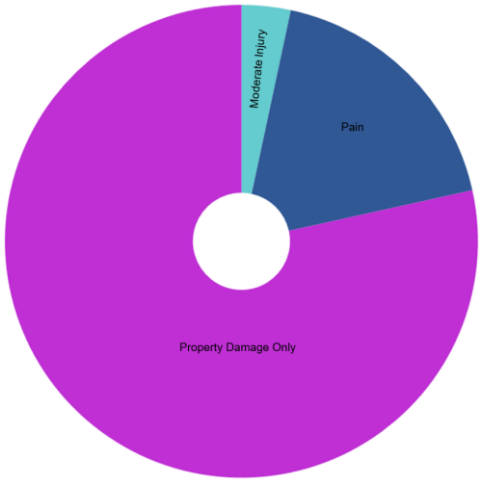

Figure 19. Total crashes based on severity- US 130, Block 128

Table 24 also shows the total number of crashes that occurred during the same time interval. According to this table, state route had 206 crashes while local road experienced three crashes.

Table 24 - Total crashes- US 130, Block 128

Year	Total Crash	State Route	Local Road
2006	23	22	1
2007	27	27	0
2008	21	21	0
2009	19	19	0
2010	19	19	0
2011	25	25	0
2012	17	16	1
2013	4	3	1
2014	20	20	0
2015	11	11	0
2016	23	23	0
Total	209	206	3

Current Spacing Conditions at All Locations

As a final step, the team reviewed the existing spacing conditions at the above locations. NJ Access Code defines the corner clearance as “the distance between the end of the curb return of the intersecting street and the beginning of the curb return or beginning of the depressed curb for the driveway.” Table 25 illustrated the current corner clearance and median opening condition for all locations. The corner clearance is measured through Google Earth, which is the distance between centerlines of the driveway and the intersecting road. Median opening condition indicates whether left turns entering driveways is enabled.

Table 25 - Current corner clearance and median opening condition

Location Number	Access Location	Corner Clearance (feet)	Median Opening Condition	Meet NJDOT Code or Not
1	State Route Access	326	No	Yes
	Local Road Access	220	Yes	Yes
2	State Route Access	407	No	Yes
	Local Road Access	278	Yes	Yes
3	State Route Access	114	No	Yes
	Local Road Access	57	Yes	No (100ft minimum from NJDOT)
4	State Route Access	264	No	Yes
	Local Road Access	118	Yes	Yes

Summary of Major Findings

The case study evaluations provided an excellent opportunity for the role of access management strategies concerning safety, mobility, community development, etc. The results demonstrated that in most cases the tenants were concern about losing parking spaces and access to their properties as result of access management improvement projects. Moreover, the results showed that these site locations experience a significant delay at afternoon peak hour. Furthermore, safety analyses revealed that these locations experience a relatively high crash frequency. A summary of each case study is described as follow:

- ***Location 1 and 2 (Route 9 and Lacey Rd.):*** The tenant wanted the driveway to remain open for access to its property and was concerned about losing access to and from the main road, Route 9, and parking spaces. This location experiences a significant delay at afternoon peak hour, around 5:00 p.m. Moreover, this location had experienced an average of ten crashes over an 11-year period (2006 to 2016). Route 9 has a posted speed limit of 45 miles per hour.

Based on Table 29, the minimum required corner clearance for this location is 100 ft., considering NJDOT's code/regulations/ordinance. The distance from the corner in this location is 326 ft for state route without median opening and 220 ft for local road with median opening (no median). Both numbers are higher than the required minimum corner clearance suggested by NJDOT. Location 2 has a corner clearance of 407 ft on state route without median opening and 278 ft for local road with median opening. Both numbers are still greater than the minimum distance from corner recommended by the NJDOT. It should be noted that these distances did not meet the suggested minimum distance from corner by peer state DOTs and TRB Access Management Manual.

- ***Location 3 (Route 72, Block 75, Lot 4.02):*** The tenant wanted to keep the accesses to its property open. This location also experiences a significant delay at afternoon peak hour. At this location, local road encounters a significant delay around at afternoon peak hour. Moreover, at this location, an average of ten motor vehicle crashes occurred over the same period. Route 72 has a posted speed limit of 55 miles per hour.

Based on Table 29, the minimum required corner clearance for this location is 100 ft., considering NJDOT's code/regulations/ordinance. The distance from the corner in this location is 114 ft without median access for state route and 57 ft with median opening (no median) for local road. The corner clearance on state is higher than the required minimum corner clearance distance suggested by NJDOT but not the peer state DOTs and TRB Access Management Manual. The corner clearance for local roads is smaller than the required minimum corner clearance in NJ standards.

- ***Location 4 (US 130, Block 128, Lot 3&4):*** The owner was concerned about losing parking spaces. This location has a recurrent bottleneck in afternoon peak hour and

had experienced a higher crash frequency— an average of 19 crashes over the same period.

Route 130 has a posted speed limit of 45 miles per hour, so the minimum required corner clearance for this location is 100 ft., as shown in Table 29. The corner clearance in this location (264 ft.) for state route without median opening met the required minimum corner clearance distance suggested by NJDOT but not the AASHTO Sight Distance and TRB Access Management Manual. The corner clearance on local road at this location is 118 ft with median opening (no median) also met the required minimum set by NJDOT but not minimums suggested by some other DOTs, AASHTO and TRB guidelines.

SUMMARY OF EXISTING ACCESS SPACING CRITERIA

In this section, we summarize the access spacing and corner clearance criteria reviewed from AASHTO and TRB guideline, peer state DOTs, and the survey on the state of practice in NJDOT and NJ local governments. The access spacing and corner clearance are summarized based on Road Functional Class and Road Posted Speed Limit to accommodate different classification methods in different spacing criteria. Table 26 and Table 27 provide the details. It should be noted that the criteria in Table 26 is used for determining the conforming lot, which is measured between the lot centerline and the centerline of the next adjacent, non-single-family residential lot. The actual minimum distance for access spacing (driveway separation) is 24 feet, with an edge clearance criterion (distance from the property line) of 12 feet, i.e., 12 + 12 = 24.

Table 26 - Criteria of access spacing and corner clearance based on posted speed limit

Criteria	**Agency**	**Posted Speed Limit (mph)**						
		25	**30**	**35**	**40**	**45**	**50**	**55**
Minimum Access Spacing	Minimum Access Separation (feet)							
	NJDOT(C)	105	125	150	185	230	275	330
	Goochland, VA(G)	125	125	125	245	440	660	660
	TXDOT(G)	200	200	250	305	360	425	425
	FLDOT(G)	245	245	245	245	245	440	440
	Mercer, NJ (C)	150	200	250	300	350	400	400
	Morris, NJ(C)	300	350	425	475	525	600	600
	AASHTO Sight Distance	280 (240*)	335 (290)	390 (335)	445 (385)	500 (430)	555 (480)	610 (530)
	TRB-Manual**	330	330	330	330	660	660	880
	NJ Survey***	150-300	200-350	250-425	300-475	350-525	400-600	400-600
Minimum Corner Clearance	Minimum Distance from Corner (feet)							
	NJDOT(C)	50	50	100	100	100	100	100
	Goochland, VA(G)	Same as Access Spacing						
	TXDOT(G)	Same as Access Spacing						
	FLDOT(G)	Same as Access Spacing						
	NJ Survey	Same as Access Spacing						

Notes: (C) stands for Code/Regulations/Ordinance; (G) Stands for Guidelines/Manual/Standards; * for right-turn-only access points with median blockage; ** TRB Access Management Manual; *** based on the second round of survey on NJ local governments.

Table 27 - Criteria of access spacing and corner clearance based on road functional class

Criteria	Agency	Road Functional Class				
		Major Arterial	**Minor Arterial**	**Major Collector**	**Minor Collector**	**Local Road**
Minimum Access Spacing	Minimum Access Separation (feet)					
	UDOT(C)	1000	500	350	200	150
	WSDOT(G)	1320	660	330	250	125
	PADOT(G)	600	400	200	NA	NA
	Goochland, VA(G)	660	660	440	245	125
	Corpus Christi, TX(G)	450	450	325	325	125
	Powhatan, VA(G)	625(>45mph) 440(<45mph)	625(>45mph) 440(<45mph)	440 (>45mph) 245(<45mph)	440(>45mph) 245(<45mph)	245(>45mph) 200(<45mph)
	Sarasota, FL (G)	660(<45mph) 1320(>45mph)	660(<45mph) 440(>45mph)	660(<45mph) 440(>45mph)	440(<45mph) 245(>45mph)	440(<45mph) 245(>45mph)
	NJ Survey	56-250	56-250	56-250	56-250	56-250
Minimum Corner Clearance	Minimum Distance from Corner (feet)					
	UDOT(C)	Same as Access Spacing				
	WSDOT(G)	Same as Access Spacing				
	PADOT(G)	Same as Access Spacing				
	Corpus Christi, TX(G)	125	125	75	75	50
	Goochland, VA(G)	Same as Access Spacing				
	Powhatan, VA(G)	Same as Access Spacing				
	NJ Survey	25-75	25-75	25-75	25-75	25-75

Notes: (C) stands for Code/Regulations/Ordinance; (G) Stands for Guidelines/Manual/Standards

Due to different definitions on the access spacing from agencies, values summarized in Table 26 and Table 27 may has some minor deviations. Table 28**Error! Reference source not found.** summarizes the measurements on access spacing and driveway return radius from different agencies. The measurements are classified into two types, including 1) edges of curbline opening, and 2) edges of pavement. To be consistent with NJDOT's measurement, all values of type 2 need to minus twice of the Driveway Return Radius, as illustrated in Figure 20.

Table 28 - Measurement criteria of access spacing of different agencies

Agencies	Measurements of Access Spacing	Measurement Types	Driveway Return Radius (ft)
NJDOT(C)	between curbline openings	1	/
Goochland, VA(G)	edges of pavement	2	12-20[1]
TXDOT(G)	edges of pavement	2	15-30[2]
FLDOT(G)	edges of pavement	2	25-35[3]
UDOT(C)	inside points of curvature of the radius	1	/
WSDOT(G)	edges of pavement	2	10-30[4]
PADOT(G)	edges of radius	1	/
Corpus Christi, TX(G)	edges of pavement	2	3-30[5] 3-15(residential)
Powhatan, VA(G)	edges of pavement	2	24-50[1]
Sarasota, FL (G)	edges of pavement	2	25-35[3]

Notes: 1. VDOT, APPENDIX B – SUBDIVISION STREET DESIGN GUIDE.

2. TXDOT, Roadway Design Manual, Section 3: Driveway Design Principles.

3. FLDOT, Driveway Information Guide.

4. WSDOT, Design Manual, Chapter 1340, Driveways.

5. Corpus Christi MPO, Access Management Study.

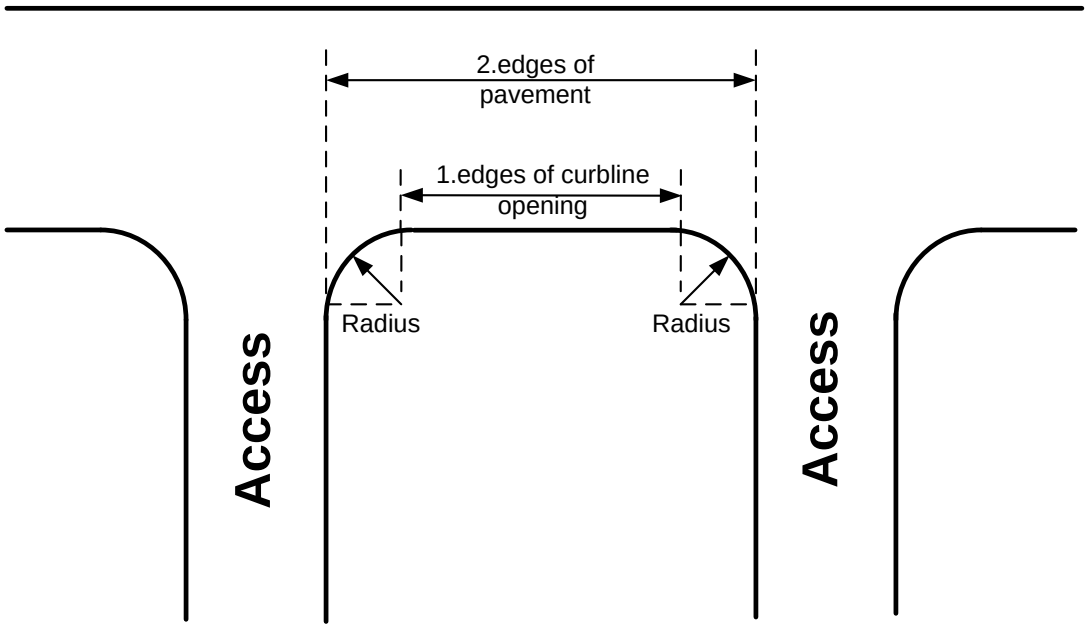

Figure 20. Access spacing measurement types

There are also other factors that cannot be summarized into a table that should be considered:

- Land Use: Single-family residential access is given a more lenient value on corner clearance by NJDOT, with a minimum of 12 feet while minimum of 50 to 100 feet.
- Unclassified Road: For roads that are not classified into Road Functional Class, access spacing can be determined solely based on posted speed limit. Goochland County in Virginia defines 125 feet access spacing for roads with Posted Speed Limit smaller than 35mph, 245 feet access spacing for roads with Posted Speed Limit larger than 35mph
- Stopping sight distance: Access spacing criteria from many agencies are using criteria developed by AASHTO, which calculates access spacing according to safe sight distance.
- Median: The type of Median considered by WSDOT where access spacing cannot be obtained due to property size or conflicting land use or conflicting traffic volumes or operational characteristics, as shown in Table 7.

RECOMMENDATIONS

Based on the outcome of the studies conducted in the project, the research team made several recommendations regarding the local access management for highway improvement projects involving intersections between state routes and local roads.

- **Intersection Access Spacing and Corner Clearance Criteria**

Based on the results of the literature review and surveys, the following tables (Tables 29 and 30) are provided as a reference for creating standards, code, or guidelines for the targeted state and local road intersections.

Table 29 - Summary of prevailing criteria of access spacing and corner clearance based on posted speed limit

Criteria	Agency	Posted Speed Limit (mph)						
		25	30	35	40	45	50	55
Minimum Access Spacing	Minimum Access Separation (feet)							
	Peer State DOTs	125-245	125-245	125-250	245-305	245-440	440-660	440-660
	AASHTO Sight Distance	280 (240*)	335 (290)	390 (335)	445 (385)	500 (430)	555 (480)	610 (530)
	TRB-Manual**	330	330	330	330	660	660	880
	NJ Local Agencies	150-300	200-350	250-425	300-475	350-525	400-600	400-600
Minimum Corner Clearance	Minimum Distance from Corner (feet)							
	NJDOT(C)	50	50	100	100	100	100	100
	Peer State DOTs	Same as Access Spacing						
	NJ Survey	Same as Access Spacing						

Notes: (C) stands for Code/Regulations/Ordinance; (G) Stands for Guidelines/Manual/Standards; * for right-turn-only access points with median blockage; ** TRB Access Management Manual

Table 30 - Summary of the prevailing criteria of access spacing and corner clearance based on road functional class

Criteria	Agency	Road Functional Class				
		Major Arterial	Minor Arterial	Major Collector	Minor Collector	Local Road
Minimum Access Spacing	Minimum Access Separation (feet)					
	Peer State DOTs	450-1320	450-660	200-440	200-325	125-150
	Peer non-NJ local agencies	440-1320	440-660	245-660	245-440	125-440
	NJ Survey	56-250	56-250	56-250	56-250	56-250
Minimum Corner Clearance	Minimum Distance from Corner (feet)					
	Peer State DOTs	Same as Access Spacing				
	Corpus Christi, TX(G)	125	125	75	75	50
	NJ Survey	-	25-75	25-75	25-75	25-75

Notes: (C) stands for Code/Regulations/Ordinance; (G) Stands for Guidelines/Manual/Standards

As shown in the summary table, the corner clearance requirements that are typically applied are less than the recommended values in the manual and spacing guidelines. The difference reflects historic practices. The minimal spacing and clearance increase with the speed limits and functional classes. Other factors considered include volume, median (Table 7), and crash history. The details of the impact of these factors can be found in Table 27.

- **Project-Specific Access Management Criteria for State-Local HIPs**

As illustrated in previous tables, the literature search and survey did not point to a single uniform parameter that is used by all local agencies. Geographical, historical, and behavioral differences can lead to different engineering assessment and judgment results in selecting parameters used in the criteria. However, in local agency surveys, there is strong support towards establishing project-specific or case-specific criteria and waivers. Furthermore, when local counties and municipalities have their own criteria and guidelines, those agencies are willing to collaborate with the NJDOT to establish particular criteria and guidelines even if the local access code and guidelines may be less restrictive than the state code. Establishing such project-specific standards, criteria, and guidelines in state-local highway improvement projects can help 1) assess major safety and mobility benefits for public outreaching, 2) identify major impacts and alleviation methods on property owners (such as removal of parking space, right-of-way, etc.), and 3) establish agreement and documentation to help avoid potential legal disputes.

- **Early Communication in Major State-Local Projects**

The case studies and surveys of local agencies also reveal that early communication is a crucial aspect of the access management in major state-local collaborative highway improvement projects. In the multiple previous cases, the research team noted that NJDOT access management departments were involved very early in the initial planning stages. However, the local agencies and the general public are not fully aware of the access management impact, especially in retrofit situations. This is more likely to lead to disputes, complaints, and unnecessary delay in the overall project progress. It is recommended that the early communication from NJDOT access management department should include the followings:

1) written agreement between NJDOT and local agencies regarding the required access spacing criteria;
2) preliminary assessment of the major safety, mobility, and economic development impact for public outreaching;
3) detailed discussion on the potential impact of the agreed spacing criteria on property owners and roadway infrastructure of local government.

- **Proactive Planning for Medium and Long-Term Corridor Improvement Projects**

One proactive strategy identified during the communication with officials from other state DOTs is the establishment of corridor agreements for medium and long-term highway improvement projects identified through the transportation planning process at MPOs (metropolitan planning organization) and state DOTs in transportation plans such as STIP (Statewide Transportation Improvement Plan, 4 years forward) and LRSTP (Long-Range Statewide Transportation Plan, 20 years forward). Such corridor agreements can become guidelines for project-specific guidelines. Criteria from such agreement can also help identify properties, and local infrastructures that may be affected and the public notifications and communications can start years early to allow property owners and related agencies to prepare and adapt to major changes forward.

- **Communication during in State-Local HIPs**

Establishing the communication channels during the project period can also promote the collaboration between state and local agencies on access management issues. The communication involves not only the NJDOT access management departments and local agencies but also different departments at state DOTs, MPOs, local agencies, and the general public. In some of the cases studied, access management is brought in to do problem-solving rather than proactively involved in project planning. This may lead to confusion regarding the construction of design elements and the late-revealing of access management impact. Tackling such institutional barriers will require sufficient training and education on related stakeholders to understand access management issues in project planning and the procedures, contacts, and documentation to address those issues.

- **Incentives to Local Governments to Promote Establishing Local Access Management Standards**

This is another strategy proposed by the project team inspired by the communication with officials from other state DOTs. The NJ survey indicates that majority of the counties and municipalities do not have standards or code but rather operate using general criteria or engineering judgment. This creates issues when legal disputes arise from access management actions. The lack of written code and standards can lead to legal disputes which add financial burden and project delay to both NJDOT and local agencies. The team proposes the incentives in project evaluation in local-aid project competitions. Those local agencies who took the effort to develop their own access management criteria will receive credits in their project review.

- **Long-Term Workshop and Training Program through Project Stakeholder Panel**

The project has assembled a large stakeholder panel and communication list with stakeholders in local access management around NJ. The panel can continue to be active in establish and augment communication and organizing training programs between NJDOT and local governments regarding local access management. In the Florida DOT survey, the benefits of co-training between state DOT officials and local agencies on access management have resulted in improved efficiencies and strong relationship between state and local agencies in the access management issues in collaborative highway improvement projects.

CONCLUSIONS

In an effort to examine how access management could be implemented on local roads in New Jersey, especially roads that intersect state highways, this research conducted an extensive review of pertinent publications, including state codes, state guidelines, local government regulations and guidelines, and works by consultants and academics. The team interacted with a Stakeholder Committee of New Jersey professionals that was set up, interviewed officials from 13 state departments of transportation (DOT), conducted a survey of local government officials from New Jersey and undertook several case studies.

The review of practices demonstrated that access management practices vary substantially from state to state. While a small number of states have access management codes, most other states have guidelines only. In almost all cases, the codes are pertinent to state highways only. In addition, model ordinances have been developed in some states that can be used by local governments.

The meetings with the Stakeholder Committee revealed that there is considerable support among New Jersey professionals for access management on major local roads. They indicated that the state code standards are not always directly applicable local roads, because of which there is a need to develop guidelines and standards that are suited to specific local governments.

The interviews with the state DOT officials also demonstrated that their approaches to access management vary substantially. Like New Jersey, they are mostly concerned about state highways, although many acknowledged facing local-road issues like New Jersey. The interviews provided some insights and recommendations that may be pertinent to New Jersey. Perhaps the most pertinent practices in other states that are important to New Jersey are (a) corridor agreements between local governments and state DOTs, (b) training of local government professionals on access management, (c)

establishing communication channels between local offices of state DOTs and local governments, and (d) funding local governments to develop their own access management guidelines with standards. On the whole, the interviews indicated that proactive measures are important to address local access management issues.

Like the Stakeholder Committee meetings, the survey of local government officials revealed that there is considerable support for access management on local roads in New Jersey. However, the survey also showed that lack of funding and staff training on access management are two critical barriers faced by local governments interested in developing local access management guidelines and standards. The survey further revealed that local governments are willing to have communication with NJDOT regarding such efforts, but they are not willing to delegate the power of local road access management to the state. The survey revealed a gap in coordination between local governments and NJDOT regarding matters related to access management.

On the basis of the learning through the various tasks, the following major recommendations can be made:

1) Based on the literature review and survey feedback, the team summarized prevailing intersection spacing criteria that can be considered by NJDOT and local governments to consider regarding state and local road intersections in collaborative highway improvement projects.
2) Develop project-specific access management criteria including intersection spacing criteria at any state and local road intersections in highway improvement projects involving both NJDOT and local governments to help guide the project efforts related to access management and provide the basis for potential disputes.
3) Reach an early project-specific agreement between NJDOT and local governments on the standards, guidelines, and criteria of access management to apply in the project and communicate early on their potential implications to local agencies and property owners especially if they imply any potential loss of parking, road access, right-of-way, etc.
4) Adopt proactive measures such as corridor agreements with local governments at corridors with highway improvement projects in the next 5 or 10 years according to the state highway improvement plan of local MPOs and NJDOTs, and specify the spacing criteria for state and local road intersections on selected corridors.
5) Develop communication channels between divisional offices of NJDOT and local governments so that all concerned parties are aware of planned projects and developments long before the projects and developments materialize.
6) Provide incentives to local governments, especially those having major roads intersecting with highways, to develop their guidelines through funding, training, and expert assistance.

7) Use the Stakeholder Committee established through this research to develop and augment communication and training programs between NJDOT and local governments regarding access management on local roads.

Future Work

Future work of this study includes multiple aspects. First, the development of semi-automated screening tools and GIS overlays that can help identify and assess problematic locations based on state or local intersection spacing criteria. Such a tool will help accelerate the identification and assessment of the potential impact of highway improvement designs on access management. This can help expedite the design process and allow proactive approaches to be taken and clear communication to be carried out by NJDOT and local agencies. Second, explore the establishment of a co-training program for related departments in NJDOT and local agencies. Such training program will provide training on1) general knowledge.2) prevailing standards and design concepts, 3) institutional procedures, and 4) real-world practice on past state and local access management projects. Third, this study focuses on the local access management issues related to intersections between state and local roads. Other types of access management scenarios can also be explored.

REFERENCES

1. Dixon, K.K., et al., *Access Management Application Guidelines*. 2014.
2. Williams, K.M., et al., *Access management manual*. 2014.
3. Aashto, A., *Policy on geometric design of highways and streets.* American Association of State Highway and Transportation Officials, Washington, DC, 2001. **1**(990): p. 158.
4. *Access Management Manual*, M. DOT, Editor. 2012.
5. *POLICY and STANDARDS for the Design of Entrances to State Highways* N.Y.S. DOT, Editor. 2015.
6. VADOT, *Access Management Regulations*. 2013.
7. VADOT. *Road Design Manual*. 2016; Available from: http://www.extranet.vdot.state.va.us/locdes/Electronic_Pubs/2005%20RDM/RoadDesignCoverVol.1.pdf.
8. VADOT. *Frequently Asked Questions*. 2014; Available from: http://www.virginiadot.org/VDOT/Info/asset_upload_file519_62098.pdf.
9. UTDOT, *Access Management*, in *R930-6*. 2013.
10. Caltrans. *Access Management Plan*. Available from: http://www.ca-hwy17amp.org/.
11. Caltrans, *Highway Design Manual*. 2012.
12. TNDOT, *Roadway Design Guidelines*. 2015.
13. TNDOT, *Research Need Statement: TDOT Access Management Guidance* 2015.
14. PennDOT, *Access Management Model Ordinances for Pennsylvania Municipalities Handbook*. 2006.
15. INDOT, *Access Management Guide*. 2009.
16. Sweger, B.A., *Kentucky Model Access Management Ordinance*. 2004.
17. *The Access Management Guidebook*, M. DOT, Editor. 2001.
18. *Iowa Primary Highway Access Management Policy*, in *Code 761-Chapter 112 (306A)*, I. DOT, Editor. 2012.
19. Maze, T., *Access Management Handbook*. 2000, Iowa DOT.
20. Stamatiadis, N., et al., *Access management for Kentucky.* 2004.
21. Center, K.T., *Quantification of the Benefits of Access Management for Kentucky*. July 2006.
22. MNDOT. *Access Management Manual*. 2008; Available from: http://www.dot.state.mn.us/accessmanagement/resources.html.
23. *Draft Model Access Management Overlay Ordinance*, M. DOT, Editor. 2004.
24. Koepke, F.J. and H.S. Levinson, *Access management guidelines for activity centers*. 1992.
25. Gluck, J.S., H.S. Levinson, and V.G. Stover, *Impacts of access management techniques*. 1999: Transportation Research Board.

26. Rose, D.C., et al., *NCHRP Report 548: A guidebook for including access management in transportation planning.* Transportation Research Board, Washington, DC, 2005.
27. Gluck, J. and M. Lorenz, *NCHRP SyntheSiS 404: State of the practice in highway access management.* Transportation Research Board, Washington, DC, 2010.
28. Engineers, I.o.T., *Access Management: A Key to Mobility and Safety*. 2004, Institute of Transportation Engineers and the Federal Highway Administration: Washington, D.C.
29. Cunningham, C.M., et al., *Economic Effects of Access Management Techniques in North Carolina*. 2010, North Carolina Department of Transportation, Research.
30. Howe, R., *Improving Collaboration and Consensus Building in the Coordination of Access Management and Land Use in Corridor Planning*. 2015, Virginia Center for Transportation Innovation and Research.
31. Hopes, C. *Regional Implementation of Access Management*. in *Transportation Research Board 91st Annual Meeting*. 2012.
32. Williams, K.M. and V.G. Stover. *Access Management for Small and Medium-Sized Communities*. in *Eighth National Conference on Transportation Planning for Small and Medium-Sized Communities*. 2002.
33. Williams, K., *Engaging Local Governments and Land Use Planners in Access Management.*
34. Gluck, J., et al., *Access management: The challenge of retrofit theory versus reality.* Transportation Research Record: Journal of the Transportation Research Board, 2005(1931): p. 117-118.
35. Frawley, W. and W. Eisele, *Implementing a program for access management in Texas: Lessons learned.* Transportation Research Record: Journal of the Transportation Research Board, 2004(1895): p. 163-169.