11.0 Land Use, Livability, Sustainability and Environment

11.1 Introduction

Transportation and land use planning are strongly connected. Transportation systems impact important local land use decisions, which ultimately influence a region’s connectivity and economic vitality. If land uses are not appropriately designed to ensure the most effective and efficient use of public infrastructure, facilities and systems, the transportation system will not work well and may impede economic growth, feasibility of expansion and opportunity.

Typical of many Maine arterial highways, commercial and residential development pressures along the major highways result in increasing friction from driveways and entrances. Development presents local economic opportunities but also reduces mobility while raising transportation costs for businesses and commuters, affects the efficient delivery of municipal services, and results in a higher number of entrance-related vehicle crashes.

Maine’s population and jobs are spreading out of urban centers and into suburban areas. The typical, low density development pattern separates residential areas from business and shopping requiring more commuting between destinations. Sprawling development and isolating housing from commercial and retail centers are at the root of an inefficient transportation system. The car has become the only option for getting around, and there are unintended consequences as a result. Most households have more than one car per household. People are taking more and longer trips for shopping and recreation. There are relatively few alternatives to vehicle travel in the suburban and rural areas, and safe pedestrian and bicycle routes are not always available.

Zoning that leads to urban sprawl and the separation of jobs, housing and retail creates traffic congestion, makes it hard to provide transit, and reduces the accessibility of jobs. The impact of expanding rural residential development is already being felt by transportation and social service providers in the region. Aging residents living in relatively remote rural homes are creating a challenge for transit and paratransit providers and will require creative solutions to effectively serve an increasingly dispersed elderly and disabled population.

11.2 Livable Communities

The U.S. Department of Transportation (DOT) defines livable communities as “places where transportation, housing and commercial development investments have been coordinated so that people have access to adequate, affordable and environmentally sustainable travel options.” The most successful, and desirable, transportation systems result from planned land use designed with attention to density, diversity and distance between land uses and design which preserves the character of the community or region. These considerations have the objective of managing traffic, reducing congestion, and increasing options for moving traffic along corridors.

**Density of development** is a predictor of the viability of buses and other alternative forms of transportation. Transit is feasible when residential land use is developed with three to five units per acre, with viability of improved service frequency and route design, and with land use development.

**Diversity and distance between land uses** refers to mix of uses within half a mile of residences. The traditional neighborhood, which is predominantly residential interspersed with non-residential amenities frequented by residents (e.g., stores, restaurants, schools, parks, places of worship, etc.), offers a mixture
of uses in close enough proximity to each other that daily activities could easily be accomplished by walking, biking or otherwise traveling on a local street.

**Design** or “sense of place” is anything which captures the character of the unique combination of elements that define a place and give it a distinct identity to those who live, work, or visit it. (Figure 11.1)

When a street can be easily accessed by walking, biking, and transit, it attracts a wider variety of people to it than if it is only within reach of those with a car. Streets that function as places prioritize the pedestrian. People lingering and walking along a street make it a more vital and vibrant place. Pedestrian-friendly streets often have shorter block lengths, which facilitates more encounters and interactions among people and creates better access and egress points to the street.

**11.3 Transportation Alternatives**

There is growing interest in Maine to promote transportation alternatives for daily travel needs. In order for alternative transportation to be viable, land use and development must provide for public spaces and streetscapes that are inviting for pedestrians while still providing adequate car access; encourage individuals to walk between home, work, shopping, and recreation; create safe and direct bicycle and pedestrian routes; connect neighborhoods with workplaces, shops, schools, and other destinations; and provide for and connect with transit service that is reliable, convenient, and reasonably time and price competitive with driving a car.

**Ridesharing**

GO Maine is the statewide commuter services program sponsored by MaineDOT and the Maine Turnpike Authority. There are a total of 5,528 members of the GO Maine rideshare community and 166 reported commuting to destinations within 20 miles of Bangor. The green place markers on the map (Figure 11.2) show the location of commuters’ residence and the red place markers show place of employment or school within a 30 mile radius of Bangor. The map also depicts the location of park and ride lots and electric vehicle charging stations.
Car Sharing

Car share services replace an estimated 20 passenger vehicles for every car share vehicle operated. Car sharing service is a relatively new concept which allows for hourly and daily shared use of a vehicle. These services are currently only available in locations of the State south of the BACTS area.

**ZipCar** offers service at the campuses of University of New England in Biddeford, Bowdoin College in Brunswick, Bates College in Lewiston and Colby College in Waterville.

**Uhaul Car Share** offers service at Southern Maine College and five other locations within the City of Portland.

Alternative Fuels

Alternative fuels are derived from sources other than petroleum, and largely create less pollution than gasoline or diesel. Most alternative fuels are produced domestically (reducing dependence on imported oil), and some are derived from renewable sources. In the BACTS area, alternative fuel stations readily available to the public are electric vehicle charging and liquefied petroleum.
Electric vehicles are the most common alternative fuel vehicle utilized in Maine. Hybrid and electric vehicles accounted for slightly more than one percent of the 1,604,088 vehicles registered in Maine during calendar year 2016.

There are 120 public alternative fueling stations in Maine. The majority of those stations are electric vehicle (EV) charging stations. Of the 107 public EV charging stations in Maine, 102 are located in the southern part of the State and there is only one public EV charging station north of the BACTS area located at Baxter State Park in Millinocket. In the BACTS area, there are four locations with public EV charging stations (one in Bangor with two outlets, two in Brewer with a total of nine outlets, and one in Orono with one outlet).

Other public alternative fueling stations in Maine include 11 liquid propane gas (LPG) stations. Two LPG fueling locations are in the BACTS area, one in Hampden and the other in Bangor. Maine has two biodiesel (BD) fueling locations, both located outside of the BACTS area. (Figure 11.3)

<table>
<thead>
<tr>
<th>Fuel Type Code</th>
<th>Station Name</th>
<th>Street Address</th>
<th>City</th>
<th>Availability</th>
<th>EV Connector Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric</td>
<td>Darling’s Nissan</td>
<td>114 Sylvan Rd</td>
<td>Bangor</td>
<td>Dealership business hours</td>
<td>J1772 CHADEMO</td>
</tr>
<tr>
<td>Electric</td>
<td>Dunkin Donuts</td>
<td>271 State St</td>
<td>Brewer</td>
<td>24 hours daily</td>
<td>J1772</td>
</tr>
<tr>
<td>Electric</td>
<td>Ruby Tuesday - Tesla</td>
<td>5 Walton Dr</td>
<td>Brewer</td>
<td>24 hours daily; for Tesla use only</td>
<td>TESLA</td>
</tr>
<tr>
<td>Electric</td>
<td>University of Maine</td>
<td>35 Flagstaff Rd</td>
<td>Orono</td>
<td>24 hours daily</td>
<td>J1772</td>
</tr>
<tr>
<td>Liquefied Petroleum</td>
<td>Propane Inc.</td>
<td>490 Broadway</td>
<td>Bangor</td>
<td>24 hours daily; training and card key required</td>
<td>NA</td>
</tr>
<tr>
<td>Liquefied Petroleum</td>
<td>RH Foster Energy - Foster Kardlock</td>
<td>110 Mecaw Rd</td>
<td>Hampden</td>
<td>24 hours daily</td>
<td>NA</td>
</tr>
</tbody>
</table>

Electric Vehicle Corridor

Several major interstate highways including I-95, were designated as alternative-fuel corridors by the U.S. Department of Transportation, recognizing the state support for electric vehicles (EV) in the region and setting the stage for the expansion of electric vehicle travel in the northeast and mid-Atlantic. In Maine, I-95 was designated in the section from Kittery to Augusta to build support infrastructure for alternative fuel vehicles (Figure 11.4).

https://www.afdc.energy.gov/states/me
11.4 Complete Streets

Complete Streets are those designed and operated to enable safe access by all users. They are designed to make it easy to cross the street, walk to shops or transit stations and bicycle to work. Implementing a Complete Streets approach may require changes to transportation planning, design, maintenance and funding decisions but can lead to cost savings and improved safety for all users.

The intent of a Complete Streets policy is to ensure that transportation projects are planned and designed to meet the needs of every user regardless of age, ability or mode of travel and provide safe and efficient access to the transportation system. Addressing the needs of bicyclists, motorists, pedestrians, and transit users early in the system planning process is cost-effective, efficient, and critical to the development of a balanced and safe transportation system.

MaineDOT strongly supports a multimodal transportation system, and recognizes that pedestrian and bicycle infrastructure such as sidewalks, bicycle lanes, separated facilities, transit stops, ADA-accessible routes, and travel lanes are important elements of the transportation system. Such a multimodal system is crucial to the safety and economic vibrancy of businesses, villages, downtowns, neighborhoods, and rural areas. Compliance with the MaineDOT Complete Streets policy applies to all relevant projects, regardless of the reason the project was initiated that are funded (in full or in part) by MaineDOT. This includes Metropolitan Planning Organization and Local Project Administration Program projects.

11.5 Stormwater

The environmental costs related to stormwater, wetlands, endangered species, and other regulations can clearly affect the overall cost of transportation projects. Failure to integrate stormwater requirements early in the project development process can cause project delays, leading to additional costs.

11.6 Livability and Sustainability

Livability is about tying the quality and location of transportation facilities to broader opportunities such as access to good jobs, affordable housing, quality schools, and safe streets. Sustainable transportation provides exceptional mobility and access to meet development needs without compromising the quality of life of future generations. Livability and Sustainability can be addressed together since a strategy for pursuing one will often be appropriate for the other.

BACTS promotes the development of transportation options that support livability and sustainability by including non-automobile modes in its evaluation of potential highway projects for the BACTS Transportation Improvement Program (TIP). Through the TIP project evaluation criteria and project scoring, projects that support alternative modes and their integration into the transportation system score higher and are more likely to be funded. As an example, a highway project that includes sidewalks, provisions for transit, or bicycling would score additional points over the same project that did not. In addition, a highway project at a location that already has provisions for alternative modes also gets credit for those modes in its scoring as a potential highway project.

The strategy of implementing Access Management along highway corridors can preserve the highway’s capacity so that mobility is not compromised, access to destinations is made safer, and investment in public and private infrastructure is protected. Site access along highways is controlled by local municipal ordinance and the MaineDOT’s traffic movement permitting process. BACTS is frequently invited to participate in the traffic movement permitting process. Some BACTS communities have developed successful access management plans for significant corridors, such as Brewer’s Wilson Street.
11.7 Transportation Operations

BACTS has recognized for decades that traffic congestion occurs more frequently throughout the day and on more roadways than in the past. Funding for major new highway and transit capacity projects is limited, and it often takes years to plan and construct the new infrastructure necessary to reduce this congestion. At the same time, much of the traffic delay on roadways is caused by inefficient or nonexistent traffic control devices, crashes, weather conditions, special events, and other factors that require more immediate solutions and are not solved solely through transportation infrastructure.

BACTS has developed some transportation system management and operations strategies in the planning process designed to optimize the performance of the transportation system. They allow for a more immediate response to traveler concerns than capacity projects offer while improving the reliability, security, and safety of the multimodal transportation system.

One of these initiatives is the outcome of concerns about quick and efficient response to traffic incidents along the Interstate 95 corridor through Maine. Regional stakeholder groups are being created to bring those involved together to craft regional plans that will address the Incident Management issues in each region in a coordinated and thorough way.

BACTS’ efforts to assist in the management and operations of existing transportation systems are becoming ever more important for several reasons. Travel demand continues to increase and the amount of new infrastructure that can be developed is limited. The worsening of congestion is impacting mobility, the environment and economic productivity, and highlights the need for attention in transportation planning.

11.8 Climate Change

As more scientific evidence supports the climate change phenomenon, various groups in the public and private sectors are paying more attention to its long-term harmful effects on both the natural and human environment. The harmful effects of climate change can affect the quality of life, or livability, and sustainability of a community, region, and state. Livability is inclusive of many factors that influence a community and its residents’ quality of life.

There are two ways of looking at the links between transportation and climate change - how transportation systems affect the climate and how climate change is likely to influence the various modes of the transportation system.

The climate change that the world is currently experiencing is now generally accepted by experts in the field to be associated with elevated levels of so-called greenhouse gases (GHG). Efforts are underway around the world to reduce emissions of GHG. However, even if excess GHG emissions were eliminated by the end of the century, climate change would continue, because the already accumulated elevated levels of GHG would persist for thousands of years unless further efforts were made to actively scrub GHG from the atmosphere.

Transportation is not only a major contributor to GHG emissions, but also will be significantly affected by the results of climate change.
11.9 National Perspective

Transportation Research Board Report 290 makes the following observations:

Climate Change Impacts of Greatest Relevance for U.S. Transportation

- **Increases in very hot days and heat waves.** It is highly likely (greater than 90 percent probability of occurrence) that heat extremes and heat waves will continue to become more intense, longer lasting, and more frequent in most regions during the 21st century. In 2007, for example, the probability of having five summer days at or above 43.3°C (110°F) in Dallas was about 2 percent. In 25 years, this probability increases to 5 percent; in 50 years, to 25 percent; and by 2099, to 90 percent.

- **Increases in Arctic temperatures.** Arctic warming is virtually certain (greater than 99 percent probability of occurrence), as temperature increases are expected to be greatest over land and at most high northern latitudes. As much as 90 percent of the upper layer of permafrost could thaw under more pessimistic emission scenarios. The greatest temperature increases in North America are projected to occur in the winter in northern parts of Alaska and Canada as a result of feedback effects of shortened periods of snow cover. By the end of the 21st century, projected warming could range from as much as 10.0°C (18.0°F) in the winter to as little as 2.0°C (3.6°F) in the summer in the northernmost areas. On an annual mean temperature basis for the rest of North America, projected warming ranges from 3.0°C to 5.0°C (5.4°F to 9.0°F), with smaller values near the coasts.

- **Rising sea levels.** It is virtually certain (greater than 99 percent probability of occurrence) that sea levels will continue to rise in the 21st century as a result of thermal expansion and loss of mass from ice sheets. The projected global range in sea level rise is from 0.18 m (7.1 in.) to 0.59 m (23.2 in.) by 2099, but the rise will not be geographically uniform. The Atlantic and Gulf Coasts should experience a rise near the global mean, the West Coast a slightly lower rise, and the Arctic Coast a rise of only 0.1 m (3.9 in.). These estimates do not include subsidence in the Gulf and uplift along the New England Coast. Nor do the global projections include the full effects of increased melting of the Greenland and Antarctic ice masses because current understanding of these effects is too limited to permit projection of an upper bound on sea level rise.

- **Increases in intense precipitation events.** Intense precipitation events are highly likely (greater than 90 percent probability of occurrence) to become more frequent in widespread areas of the United States.

- **Increases in hurricane intensity.** Increased tropical storm intensities, with larger peak wind speeds and more intense precipitation, are projected as likely (greater than 66 percent probability of occurrence). No robust projections concerning the annual global number of tropical storms have yet emerged from modeling studies, but more detailed analyses focused on the Atlantic Ocean suggest no significant increases in the annual number of Atlantic tropical storms.

11.10 Regional Perspective

Based on the national perspective (above), quoted from TRB report 290, and Maine’s Climate Future (University of Maine); Maine is likely to be affected by climate change as follows:
There will be a strong trend in Maine toward warmer and generally wetter conditions in all four seasons over the 21st century with the exception of summer precipitation. Projected increases in both temperature and precipitation tend to be greatest in the north, and least along the coast. These warming trends imply a significant shift in the regional hydrology, from a snowmelt-dominated regime to one that shows significant runoff during winter. This shift, coupled with projected precipitation increases in winter, will likely pose challenges for flood mitigation.

**Vulnerability of Transportation Infrastructure**

Although a recent study has evaluated some types of economic impact of sea-level rise for coastal York County (Colgan and Merrill 2008), there has not been a statewide assessment of the impact of climate change on Maine’s infrastructure.

Some climate changes will be beneficial for Maine’s transportation system; the expected decrease in the length and severity of the winter season will likely reduce the cost of snow and ice control, provide safer travel conditions, and lengthen the construction season. However, depending upon location, roads, bridges, and other transportation infrastructure may become vulnerable to chronic or acute failure. Flooding and erosion associated with major storms may cause road washouts, rendering transportation infrastructure inoperable for long periods of time and requiring unplanned and high-cost replacement and repair (MaineDOT 2008).

The Maine Emergency Management Agency (MEMA) has designated certain roads as Emergency Evacuation routes. The routes have distinctive blue signage and are intended to expedite the evacuation of coastal areas of Maine in the event of severe weather, such as a tsunami. The evacuation routes are intended to guide traffic fleeing the affected areas into safer, unaffected regions. The routes were developed cooperatively with the county emergency management agencies and the Maine Department of Transportation.

Maintaining the integrity and continuity of evacuation routes passing through the BACTS area is critical to the public safety of residents and visitors to eastern Maine. Unintentional or purposeful severance of an evacuation route should be avoided during planning, project development and construction.

While there is a lot of focus on the direct effects of climate change, such as flooding due to sea level rise (SLR), very little attention has been paid to the tertiary effects, such as population migration. This has begun to change. Researchers at the University of Georgia have published county level preliminary work showing where people displaced by SLR effects will migrate.

It appears that, due to topography, there will be little direct impact of SLR on this part of Maine. However, Penobscot County could be a receiving county with a forecast of in-migration of up to 50,000 persons. Such a forecast can only be considered preliminary and will likely be refined.

Using the forecast as an estimate for magnitude, it would appear that a significant investment in public infrastructure such as, transportation, drainage, and sewerage, would be required.

**Reducing GHG Emissions**

Efforts to reduce GHG emissions from transportation are essentially the same as those used to address ground level ozone precursors. Notwithstanding the global extent of elevated GHG levels and the small geographic extent of the BACTS area, reduction of GHG emissions need to be focused on the reduction of use of GHG generating fuel and the increased use of alternative fuels that produce less or no GHG.
Goals/Objectives/Strategies

The Transportation Research Board of the National Academy of Sciences has made the following recommendations: inventory critical infrastructure such as coastal roads, railways, transit systems, and runways to assess their vulnerability to flooding due to severe storms and sea-level rise; factor anticipated climate change into investment and land-use planning decisions; integrate evacuation and emergency response to extreme weather events into transportation operations; and develop and implement monitoring technologies to give advance warning of infrastructure failures due to water levels, waves, and wind (TRB 2008).

Regardless of contentious debate about cause of Climate Change, it would seem that a prudent course would be to prepare for its reasonably foreseeable effects. For example, areas that would likely flood first in a scenario that envisioned a general rise in sea level are readily identifiable. Areas in the BACTS area that have been flooded historically would be candidates for inclusion in the vulnerable areas list. For example, in Downtown Bangor, the areas immediately adjacent to the Kenduskeag Stream.

The map above (Figure 11.5) shows areas that would be inundated if there were a 5ft flood. Analysis of tides, storm surges, and elevated sea level, indicates that the likelihood of a 5 ft. flood before 2020 is 10%, and before 2030 is 30%. The likelihood of there being a 5ft. flood before 2060 is 100%.

In addition to the impacts on network connectivity of flooding, there would be other effects that would not be so immediate or visible. Repeated or prolonged inundation of soils compromises the load bearing capacities of soils and foundations. The stability of structures in or beside flooded areas could be brought in to doubt.

Flooding related to tides and storm surges, though significant, may not be the most disruptive flooding that may be experienced. Heavy downpours also cause problems. The extent of these sporadic events may be limited, but depending on the locations, they may have large impacts on traffic flow. The areas most vulnerable are those that historically have already experienced flooding. For instance, Wilson
Street, Brewer has flooded on several occasions in recent times. In those cases, the rain was so heavy that it accumulated on the pavement to a depth of several inches.

Also, intense heavy rain over short time periods can reduce slope stability, causing mud slides. (RT1A Dedham Summer 2015). While intense rain events are undoubtedly inconvenient and can cause hazards to travelers, mitigation can be relatively low cost such as diversions and barricades. Permanent solutions will be more expensive.

Design elements that may need to be addressed to reduce vulnerability to intense rain events:

- culvert size
- slope gradients
- enclosed drainage design, open drainage design
- impermeable surface area regulation
- pavement design

11.11 Future Conditions and Issues

Responding to the challenges of climate change and the establishment of livable and sustainable communities requires a long range effort because the challenge will still be there well beyond the lifetime of this particular long range plan. Yet it is possible that strategies can be implemented in the short term that will eventually position the Greater Bangor Area so that it can maintain and improve its economic vitality and livability, while reducing local impacts from climate change. In fact, some immediate factors are already playing a part in adapting the transportation system to meet the challenges. The increasing costs of gasoline and other user costs promote the use of alternatives, as does the ageing of the population. The resulting changes in traveler behavior will exploit existing supportive policies, services and infrastructure, and demand more.

A regular, systematic monitoring of travel demand and the condition of BACTS infrastructure will enable officials to anticipate and plan for impacts to our transportation system resulting from climate change.

11.12 Recommendations

- To achieve regional transportation goals, BACTS must work with local governments, agencies and other local-level stakeholders to encourage better coordination of transportation and land use.
- Encourage municipalities to adopt and implement Complete Streets policies
- Participate in local livable communities programs
- Encourage future development policies that preserve key natural features and the small town/rural character of most of the corridor while promoting economic prosperity;
- Develop checklist and urge municipal planners and leaders to integrate consideration of public transit needs, complete street design and stormwater mitigation requirements early in project development and prior to the approval process to avoid project delays, inefficient or inaccessible developments, and additional project implementation costs
- Promote measures that remove or minimize major traffic bottlenecks and safety hazards in the region’s service centers;
- Encourage municipal coordination with adjacent municipalities to recognize the important link between land use transportation mobility.
- Integrate Complete Streets considerations more thoroughly into project selection evaluation and funding, to ensure that prioritized projects are those that do the most to meet a comprehensive set of regional goals that include safety, public health and equity.
• Promote alternative modes; transit, van pool, carpool, walk, and bike.
• Promote land use policies that are supportive of alternative modes such as Transit Oriented Developments, higher density developments, and mixed use developments.
• Assist with the Bangor region Incident Management group.
• Survey weather related vulnerabilities of existing infrastructure.
• Develop projects and policies to reduce weather vulnerabilities.
• Incorporate climate vulnerability criteria into project selection, design, specifications.
• Monitor climate effects on infrastructure.

Municipal Comprehensive Plans and Land Use Ordinances

City of Bangor

Land Use Ordinance: https://ecode360.com/6891121?all=true

Town of Bradley


City of Brewer

Land Use Ordinance: http://brewermaine.gov/planning/land-use-code/

Town of Hampden


Town of Hermon

Land Use Ordinance: http://library.amlegal.com/nxt/gateway.dll/Maine/hermon_me/townofhermonmainecodeofordinances?f=templates$fn=default.htm$3.0$vid=amlegal:hermon_me

Town of Milford

City of Old Town

1995 Comprehensive Plan:  
*2016 Comprehensive Plan:  
*2016 Comprehensive Plan retrieved from the Maine Department of Agriculture, Conservation and Forestry website.
Land Use (Zoning) Ordinance:  
http://oldtownftp.bizcompasscloud.com/City%20Website/Documents/Code%20Enforcement/Zoning%20Ordinance.PDF

Town of Orono

2014 Comprehensive Plan:  
http://orono.org/DocumentCenter/View/683  
http://orono.org/DocumentCenter/View/684
Land Use Ordinance:  
https://library.municode.com/me/orono/codes/code_of_ordinances?nodeId=PTIIOR_CH18LAUS

Town of Orrington

Land Use Ordinance:  

Penobscot Indian Island Reservation

Land Use/Comprehensive Plan:  
https://www.narf.org/nill/codes/penobscot/ch10.PDF

Town of Veazie

Land Use Ordinance:  
http://www.veazie.net/Public_Documents/VeazieME_Charter/Section%202015