GREENWICH ROAD TRAFFIC STUDY

HARDWICK, MASSACHUSETTS

Submitted to:
TOWN OF HARDWICK, MASSACHUSETTS
Board of Selectmen
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EXECUTIVE SUMMARY

This traffic impact study (TIS) documents existing roadway and traffic characteristics of the Greenwich Road corridor in Hardwick, Massachusetts. The data and findings of this TIS provides a basis for the Town of Hardwick to consider potential actions to address identified areas of concern relative to travel safety along Greenwich Road.

The traffic study leads to a brief overview of potential route alternatives, geometric improvements, traffic controls and heavy vehicle restrictions/management for discussion purposes that are aimed at improving travel safety along Greenwich Road in Hardwick.

The study concludes that existing roadway and traffic conditions on Greenwich Road are not conducive to safe travel by heavy commercial trucks. Ideally, historic travel routes through Ware – specifically North Street and Greenwich Road – provide the best available alternatives for commercial heavy vehicles (particularly transfer trucks) to access the Hardwick Landfill. These routes are urban collector roads that provide a relatively direct route to/from the landfill from Route 9/32, and provide sufficient width, geometry, traffic controls and pavement condition to safely support commercial heavy vehicles. These routes in Ware have historically served the landfill since approximately 1968 through 2005.

In lieu of written consent by Ware to use these routes for commercial heavy traffic to/from the landfill, MDM recommends that a combination of safety improvements be evaluated and implemented along Greenwich Road. Heavy truck management practices, combined with proposed roadway and geometric improvements and traffic controls, provide a reasonable approach to addressing safety needs of the Greenwich Road corridor in Hardwick. Alternatively, the Town may consider reconstruction of the upper portion of Patrill Hollow Road; although this alternative presents a more complicated and less cost-effective solution than the Greenwich Road enhancements above.
1.0 INTRODUCTION

This traffic impact study (TIS) documents existing roadway and traffic characteristics of the Greenwich Road corridor in Hardwick, Massachusetts. The data and findings of this TIS provides a basis for the Town of Hardwick to consider potential actions to address identified areas of concern relative to travel safety along Greenwich Road.

A primary contributor to heavy commercial vehicle travel on Greenwich Road is the Hardwick Landfill, located on Patrill Hollow Road. As such, specific attention is given to quantifying the landfill operations including historical routes used to serve the facility, existing traffic generation characteristics and existing travel patterns and travel restrictions/truck management policies.

The traffic study leads to a brief overview of potential route alternatives, geometric improvements, traffic controls and heavy vehicle restrictions/management for discussion purposes that are aimed at improving travel safety along Greenwich Road in Hardwick.
1.2 STUDY METHODOLOGY

This traffic study consists of several components. The first component documents existing conditions in the transportation study area including an inventory of roadway geometry, land uses, and observed traffic volumes. Traffic characteristics of the Hardwick Landfill are also documented based on manual counts, landfill truck logs and operational information provided by Casella Waste Systems – owner/operator of the Hardwick Landfill. Next, future year traffic conditions are forecast that account for other planned area developments, normal area growth, and potential expansion of the landfill. Finally, a brief overview of potential safety-related improvement actions are presented that serve as a framework for planning future safety-related transportation needs for Greenwich Road in Hardwick.

1.3 STUDY AREA

The study area for this TIS includes several roadways identified in consultation with the Town as being critical connecting roads leading to Greenwich Road and that are relevant to long-range planning for safety improvements for the Greenwich Road corridor. Study roadways are shown on Figure 1 and include the following:

- Greenwich Road from State Route 32A to the Ware town line (primary study route)
- State Route 32/32A in Hardwick from Greenwich Road to Route 9 in Ware
- Greenwich Road in Ware from the Hardwick town line to Pleasant Street
- North Street in Ware from Route 32 to Pleasant Street
- Pleasant Street in Ware from North Street to Greenwich Road

The selected study roadways also currently provide (or have historically provided) primary means of access/egress to the most significant commercial traffic generator in the Town of Hardwick – the Hardwick Landfill.
2.0 **EXISTING CONDITIONS**

Characteristics of the existing roadway system in the study area, including a more detailed assessment of traffic, roadway conditions and safety characteristics of Greenwich Road in Hardwick are presented in this section. This section also describes operational characteristics of the Hardwick Landfill.

### 2.1 Roadway Descriptions

**Greenwich Road (Hardwick, Massachusetts)**

Greenwich Road in Hardwick, Massachusetts is a two-lane roadway under Town jurisdiction. This roadway is classified as a rural minor collector by the Massachusetts Executive Office of Transportation Planning Department (EOT). Greenwich Road extends approximately 7.5 miles from the Ware-Hardwick town line to the intersection with Hardwick Road (Route 32A) in Hardwick. The only posted speed limits are in the vicinity of Hardwick Road, which designate a 30 mph limit heading west from Route 32A and 25 mph approaching Route 32A.

Zoning along Greenwich Road under current Zoning Bylaws (the “Bylaws”, as amended through March 2001) is R-60 - Rural Residential District and R-40 - Neighborhood Residential District. The intent of these districts is for “moderate density residential purposes and agricultural pursuits”. These districts do allow commercial, retail and light manufacturing uses by special permit only; Municipal uses are allowed by right in these districts.
Consistent with zoning, Greenwich Road provides access to residences, farms, access to the Quabbin Reservoir (via Gate 43) and the Muddy Brook Wildlife Management Area. Existing land uses along Greenwich Road are primarily residential and farm uses, with a very limited number of commercial/retail uses that include a winery and a barber shop. The Hardwick Landfill serves a municipal function for Hardwick and surrounding towns and represents the most significant commercial use on Greenwich Road in Hardwick.

Greenwich Road in Hardwick generally provides an 18 to 22-foot wide travel width with an alignment that is often winding with grades of 5-12 percent. Pavement conditions range from fair to poor, with significant pavement cracking and depressions along several segments. Vertical and horizontal curves are also present that combine with roadside banks and vegetation to substantially reduce sight lines to oncoming traffic. Effective travel widths are also reduced along various segments due to roadside washout to less than 18 feet – a condition that was observed by MDM to worsen under wintertime conditions when snow and ice are present. A more specific accounting of these characteristics is presented below.

Specific Areas of Safety Concern – Greenwich Road (Hardwick)

MDM has identified several specific areas of concern relating to travel safety along Greenwich Road in Hardwick based on field observations and measurements conducted in March, June and September 2006. A summary of specific travel safety concerns are as follows, and are shown on Figure 2:

- Pavement Deterioration Zones

Several extended portions of Greenwich Road exhibit substantial pavement deterioration that includes roadway cracking and depressions – most notably just north of Patrill Hollow Road and south of Lyman Road. Exhibit A depicts a typical roadway section under wintertime conditions. As shown, roadway depressions are subject to water pooling/freezing that reduces effective travel widths on roadways.
Narrow Roadway Widths.

A notable reduction in effective roadway width exists approximately 1.5 miles north of Route 32A Road – in the vicinity of the Muddy Brook crossing. **Exhibit B** depicts a roadway width of approximately 13 feet, the result of large trees located on either side of Greenwich Road. This same area is subject to washout and deteriorating pavement conditions as described in the subsequent section.
Several additional locations of narrow roadway width along Greenwich Road are noted on Figure 2, where effective travel widths are reduced by conditions such as roadside washout and vary from 16 to 18 feet. Wintertime snow and ice accumulation was observed to further reduce effective travel widths. The reduced travel width is of particular concern in cases where larger commercial vehicles are present (10 ton carrying capacity or greater). Exhibit C and Exhibit D depict conditions with large commercial vehicles present along roadway segments with effective widths of approximately 20 feet.
Roadway Curvature & Sight Lines

There are numerous curvilinear sections of Greenwich Road that combined with roadway grade and/or narrow roadway width raise safety concern. Two specific areas where roadway curvature is of particular concern are in the vicinity of Sessions Road – within 1 mile of Route
32A – and at Gate 43 – just over 2 miles from Route 32A.

**Exhibit E** shows the southerly approach to the Sessions Road intersection, where roadway grade is approximately 5-7 percent and sight lines are obstructed by a horizontal curve to the left and roadside embankment. Likewise, **Exhibit F** shows the northerly approach to the curve (on a downgrade) with obstructed sight line due to vegetated embankment.
Exhibit G and Exhibit H show the northerly and southerly approaches to a curve at Gate 43 that exhibit limited sight distances due to an embankment and vertical curve. Vehicles traveling southerly periodically encroach on the embankment to avoid oncoming vehicles as evidenced by the tire wear.
Washout Zones

The lack of a surface drainage system along Greenwich Road and the presence of vegetative embankments and/or culvert crossings results in notable “washout” areas that lead to deteriorating pavement conditions and that reduce effective travel widths. The most notable washout areas are at the Muddy Brook crossing (approximately 1.5 miles north of Route 32A) and at the curve just north of Sessions Road. Exhibit I and Exhibit J show the Muddy Brook culvert crossing, where extensive pavement deterioration and sedimentation indicate periodic washouts. Exhibit K shows slope stabilization (rip rap stones) intended to reduce washout impacts.

Exhibit I
Muddy Brook Culvert
Exhibit J
Muddy Brook Culvert Washout Zone

Exhibit K
Slope Stabilization near Sessions Road Curve
Greenwich Road (Ware, Massachusetts)

Greenwich Road in Ware, Massachusetts is a two-lane, north-south roadway under local jurisdiction. This roadway is classified by the EOT as a rural minor collector from the Ware-Greenwich town line until it becomes an urban collector near Sorel Road. The segment of Greenwich Road in Ware extends from Willow Street to the Ware-Hardwick town line, and then extends through Hardwick as described earlier. Greenwich Road in Ware is generally characterized by gently rolling terrain and an average roadway width of approximately 22 feet. Greenwich Road in Ware has a posted speed limit of 35 mph along most of its length and has a posted speed limit of 25 mph in the most southerly portion in Ware (southbound). A typical segment of Greenwich Road in Ware is shown in Exhibit L.

![Exhibit L](Greenwich Road, Ware – Typical Road Segment)

Land uses along Greenwich Road in Ware are a mix of residential and commercial uses; commercial uses include a restaurant, a storage facility, and a fill/gravel/loam company. A cemetery is also located along Greenwich Road as depicted to the left on Exhibit L.

Hardwick Road (Route 32A)

Hardwick Road (Route 32A) in Hardwick, Massachusetts is a two-lane, north-south roadway under State jurisdiction. This roadway is classified by EOT as a rural major collector. Hardwick Road extends from Church Street (Route 32) to Greenwich Road in Hardwick and has posted speed limits ranging from 30 to 35 mph. The roadway has paved shoulders, guardrails along some segments, and has designated passing zones. Hardwick Road is relatively straight and flat with some gentle rolling terrain and grades of less than 5 percent.
A typical segment of Hardwick Road is shown in **Exhibit M**.

Zoning along Hardwick Road under current Bylaws is R-40: Neighborhood Residential District. The intent of these districts is for “moderate density residential purposes and agricultural pursuits”. Accordingly, land uses along Route 32A is residential and farm uses.

**Route 32 (between North Street and Church Street)**

Route 32 between North Street in Ware, Massachusetts and Church Street in Hardwick, Massachusetts is a two-lane roadway under State jurisdiction. This segment of roadway is classified by EOT as an urban other principal arterial. This roadway consists of East Main Street, East Street and Gilbertville Road in Ware, Massachusetts and Main Street in Hardwick, Massachusetts. Posted speed limits range from 20 mph to 50 mph, including passing zones in some segments. A portion of the roadway extends through the downtown Ware area which consists of a signalized intersection, curbside parking, and up to two lanes in each direction. Route 32 provides paved shoulders along most of its length, with roadway width of more than 26 feet. A typical road segment along Route 32 is shown in **Exhibit N**.
Land uses along Route 32 are a mix of residential, municipal and commercial uses that vary significantly in density among various segments. Within the section of Hardwick known as Gilbertville, municipal services buildings are present along with various businesses (restaurants, etc); Route 32 in downtown Ware is a highly commercial corridor with various commercial, retail, restaurant and business uses located in close proximity to the road.

**North Street**

North Street in Ware is a two-lane, north-south roadway under local jurisdiction. The portion of North Street included in the study area extends from East Main Street (Route 32) to Pleasant Street. This roadway is classified by EOT as an urban collector. The roadway is 30 feet wide, and provides curbside parking spaces along the westerly side of the road. The posted speed limit on North Street is 25 mph. Sidewalks are provided along both sides of the street, and the roadway intersects East Main Street (Route 32) at a traffic signal. A typical segment of North Street in Ware is shown in Exhibit 0.
Land uses along North Street are commercial and institutional and include a restaurant, Ware Police Department, salon, hospice and church.

**Pleasant Street**

Pleasant Street in Ware is a two-lane, east-west roadway under local jurisdiction. The portion of Pleasant Street in the study area extends from North Street to Greenwich Road. This roadway is classified by EOT as an urban collector. The roadway is 25 feet wide with sidewalks located along both sides of the road. The posted speed limit on Pleasant Street is 25 mph. A typical segment along Pleasant Street is shown in **Exhibit P**.
Land use along this roadway include residences, a youth center and a cemetery.

**Patrill Hollow Road (Lower)**

The portion of Patrill Hollow Road currently providing access to the Hardwick Landfill, referred to in this study as “Lower” Patrill Hollow Road, is a gravel-packed roadway that varies in width from 16 to 24 feet. This portion of Patrill Hollow Road is approximately 1.5 miles long between Greenwich Road and the Hardwick Landfill and is maintained by Cassella Waste Systems by repairing washouts and re-grading. As only a limited number of residences are located along the road, this portion of Patrill Hollow Road essentially serves as a landfill “driveway” with little other notable vehicle activity. The roadway alignment is gently winding with grades ranging from flat to approximately 6 percent. A typical segment of Lower Patrill Hollow Road is shown in Exhibit Q.
Patrill Hollow Road (Upper)

The portion of Patrill Hollow Road located north of the Hardwick Landfill is currently closed to through traffic due to the year 2000 closure of a bridge crossing the Muddy Brook. This portion of Patrill Hollow Road, referred to as “Upper” Patrill Hollow Road in this study, provides access to only a limited number of residences. Upper Patrill Hollow Road is a gravel-packed roadway that varies in width from 12 to 14 feet along most of its length, except for a short stretch near Greenwich Road which is paved and slightly wider (22 feet). The roadway alignment is gently winding with steep grades ranging from approximately 6 to 12 percent along most of the gravel-packed portion of road. Roadside obstructions including large boulders and steep embankments preclude widening unless extensive construction is conducted. A typical segment of Lower Patrill Hollow Road is shown in Exhibit R. The currently closed bridge crossing the Muddy Brook, which is also located within the Muddy Brook Wildlife Management Area, is shown in Exhibit S.
Exhibit R
Upper Patrill Hollow Road Typical Road Segment

Exhibit S
Closed Bridge Crossing at Muddy Brook
2.2 EXISTING ROADWAY TRAFFIC VOLUMES

Traffic count data for Greenwich Road, Patrill Hollow Road and Route 32A were collected in June 2006 using automatic traffic recorders (ATRs) to quantify daily and hourly trends and vehicle classification. In addition, manual turning movement counts (TMCs) were conducted between the hours of 7 AM and 7 PM at two locations to classify and quantify truck traffic using Greenwich Road in the study area. These locations include the Greenwich Road/Route 32A/Petersham Road/Barre Road intersection and the Greenwich Road/Patrill Hollow Road/Thayer Road intersection. The location of ATRs and TMCs in the study area are shown on Figure 3. A tabulation of recorded daily and hourly traffic volumes for each of the count locations is presented in Table 1 and is summarized below.

Table 1
EXISTING ROADWAY DAILY TRAFFIC-VOLUME SUMMARY

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<tr>
<td>Hardwick Rd (Route 32A) south of Greenwich Rd</td>
<td>1,478</td>
<td>106</td>
<td>7%</td>
</tr>
<tr>
<td>Greenwich Rd east of Patrill Hollow Rd</td>
<td>435</td>
<td>51</td>
<td>12%</td>
</tr>
<tr>
<td>Patrill Hollow Rd east of Greenwich Rd</td>
<td>188</td>
<td>110</td>
<td>59%</td>
</tr>
<tr>
<td>Greenwich Rd south of Hardwick Pond Rd (Ware)</td>
<td>1,543</td>
<td>164</td>
<td>11%</td>
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1 Two-way daily traffic expressed in vehicles per day.
2 The daily two-way, heavy vehicle percentage; includes all FHWA vehicle class 4 and larger vehicles.

As summarized in Table 1, daily traffic volumes range from a high of 1,543 vehicles per day (vpd) on Greenwich Road in Ware and 1,478 vpd on Route 32A in Hardwick to 435 vpd on Greenwich Road in Hardwick. Patrill Hollow Road, which primarily serves traffic associated with the Hardwick Landfill, has under 200 vpd.

Truck activity on area roadways were recorded as a subcategory of vehicles in the ATRs, and are classified using the FHWA Type F Vehicle Classification Scheme (see Appendices). For simplicity, “trucks” in the tabulated summary presented in Table 1 represent all larger commercial vehicles ranging from a school bus to a multi-axle articulated tractor trailer. A detailed tabulation of specific FHWA classified vehicles is presented in ATR printouts in the Appendices. As summarized in Table 1, truck activity on area roadways ranges from 11 to 12 percent of daily traffic on Greenwich Road (51 vpd on Greenwich Road in Hardwick east of the Hardwick Landfill and 164 vpd on Greenwich Road in Ware). Route 32A carries approximately 106 truck trips per day, or 7 percent of all daily traffic on that roadway. Patrill
Hollow Road carries 110 truck trips per day, representing 59 percent of all vehicles traveling that roadway per day.

A more detailed description and graphical presentation of recorded total and truck traffic patterns for the above roadways is presented below.

**Greenwich Road (Hardwick)**

Daily and hourly traffic volumes were obtained on Greenwich Road just west of Route 32A, with tabulated data of vehicle classification presented in the Appendices. Figure 4 presents an hourly summary of traffic activity for all vehicles and for truck trips as a sub-category along Greenwich Road east of Patrill Hollow Road. A summary of characteristics is as follows:

- Daily traffic volume on Greenwich Road east of Patrill Hollow Road is approximately 435 vpd, of which 51 vpd are trucks (i.e., vehicles ranging from small dump trucks and buses to larger articulated tractor trailers).
- Hourly traffic flow ranges from approximately 20-40 vehicles per hour (vph) between the hours of 6 AM and 6 PM, with a peak occurring between 4 PM and 5 PM with 44 vph.
- Hourly truck activity ranges from 4-8 vph between the hours of 6 AM and 4 PM, primarily associated with the Hardwick Landfill.
- Hourly vehicle activity is less than 15 vph before 6 AM and after 5 PM, with little or no hourly truck activity during these early morning and evening hours.

**Greenwich Road (Ware)**

Daily and hourly traffic volumes were obtained on Greenwich Road just south of the Hardwick Town Line (Hardwick Pond Road vicinity), with tabulated data by vehicle classification presented in the Appendices. Figure 5 presents an hourly summary of traffic activity for all vehicles and for truck trips as a sub-category along Greenwich Road in Ware. A summary of characteristics is as follows:

- Daily traffic volume on Greenwich Road in Ware is approximately 1,543 vpd, of which 164 vpd are trucks (i.e., vehicles ranging from small dump trucks and buses to larger articulated tractor trailers).
- Hourly traffic flow ranges from approximately 80-115 vehicles per hour (vph) between the hours of 6 AM and 6 PM, with a peak occurring between 4 PM and 5 PM with 132 vph.
- Hourly truck activity generally ranges from 9-18 vph between the hours of 6 AM and
4 PM with a peak of 24 vph between noon to 1 PM.

- Hourly vehicle activity is less than 100 vph before 6 AM and after 5 PM, with truck activity of only 2-4 vph during early morning and evening hours and no truck activity between 11 PM and 4 AM.

**Hardwick Road (Route 32A)**

Daily and hourly traffic volumes were obtained on Hardwick Road (Route 32A) just south of Greenwich Road, with tabulated data by vehicle classification presented in the Appendices. **Figure 6** presents an hourly summary of traffic activity for all vehicles and for truck trips as a sub-category along Hardwick Road in Hardwick. A summary of characteristics is as follows:

- Daily traffic volume on Hardwick Road is approximately 1,478 vpd, of which 106 vpd are trucks (i.e., vehicles ranging from small dump trucks and buses to larger articulated tractor trailers).

- Hourly traffic flow ranges from approximately 65-115 vehicles per hour (vph) between the hours of 6 AM and 6 PM, with peaks occurring between 3 PM and 4 PM and 6 PM and 7 PM with approximately 115 vph.

- Hourly truck activity generally ranges from 5-10 vph between the hours of 6 AM and 4 PM with a peak of 13 vph between 3 PM to 4 PM.

- Hourly vehicle activity is less than 100 vph before 6 AM and after 6 PM, with truck activity of only 1-5vph during early morning and evening hours.

**Patrill Hollow Road**

Daily and hourly traffic volumes were obtained on lower Patrill Hollow Road, with tabulated data by vehicle classification presented in the Appendices. **Figure 7** presents an hourly summary of traffic activity for all vehicles and for truck trips as a sub-category along Lower Patrill Hollow Road, which primarily serves as the access to the Hardwick Landfill. A summary of characteristics is as follows:

- Daily traffic volume on Lower Patrill Hollow Road is approximately 188 vpd, of which 110 vpd are trucks (i.e., vehicles ranging from small dump trucks and buses to larger articulated tractor trailers).

- Hourly traffic flow generally ranges from approximately 15-20 vehicles per hour (vph) between the hours of 6 AM and 4 PM, with a peak occurring between noon and 1 PM with 28 vph.
Hourly truck activity generally ranges from 10-16 vph between the hours of 7 AM and 4 PM with a peak of 22 vph between noon to 1 PM.

Hourly vehicle activity is less than 10 vph before 7 AM and after 4 PM, with little or no truck activity during early morning and evening hours.

2.3 **HARDWICK LANDFILL OPERATIONS**

The Hardwick Landfill represents the single largest generator of commercial truck activity on Greenwich Road in Hardwick. As such, a detailed accounting of landfill operations, including travel routes and traffic generation characteristics is presented in this section. Landfill operations presented below represent a synthesis of landfill information provided by Casella Waste Systems, Inc. and supported by observations of traffic at the landfill conducted by MDM in June 2006.

**Overview**

The Hardwick Landfill is located on Patrill Hollow Road in Hardwick, just off of Greenwich Road approximately 1.4 miles north of the Hardwick/Ware town line (refer to **Figure 1** for site locus). Operations began at the Hardwick Landfill on or around 1968. In 1995, the Hardwick Landfill obtained approval from the Massachusetts Department of Environmental Protection to increase the amount of solid waste it could accept to an average of 300 tons per day. Casella acquired the Hardwick Landfill in the spring of 2003. The numbers and types of trucks delivering waste to the Hardwick Landfill have remained approximately the same since 1995, except for a period of time when the Hardwick Landfill temporarily closed from some time in 2000 to May 2003.

The landfill accepts both construction and demolition (C&D) debris and municipal solid waste (commonly known as household waste). As a result of a statewide restriction on disposal of certain C&D waste at landfills effective July 1, 2006, the Hardwick Landfill now accepts less C&D waste than in past years.

The landfill’s hours of operation are 7:00 AM to 4:00 PM, Monday through Friday, and 7:00 AM to 11:30 AM on Saturdays. The Hardwick Landfill is Open to Hardwick residents only on Saturdays. The Hardwick Landfill is closed on Sundays and certain legal holidays.

**Landfill Travel Routes**

Travel routes serving the Hardwick Landfill are presented graphically in **Figure 1**, and include roadways in Ware, New Braintree and Hardwick. Routes to/from the Hardwick Landfill include Greenwich Road through the Town of Ware (which connect to Route 9/32 in the downtown area via North Street and Pleasant Street), and Greenwich Road in Hardwick.
Access to the Hardwick Landfill from the north on Upper Patrill Hollow Road in Hardwick is not possible as the bridge leading to the Hardwick Landfill has been closed since 2000.

Due to its proximity to Route 9/32 to the south, most of the waste delivered by heavy vehicles to the landfill prior to January 2, 2006 was transported through the Town of Ware. Trucks destined for the Hardwick Landfill traveling eastbound on Routes 9 or 32 typically turned off the state highway in the center of Ware and proceeded on North Street to Greenwich Road. The waste trucks continued northbound on Greenwich Road to Patrill Hollow Road to the landfill. Trucks destined for the Hardwick Landfill traveling westbound on Routes 9 or 32 typically turned onto Pleasant Street just before the Ware town center. The trucks continued on Pleasant Street which becomes Greenwich Road just north of the residential area surrounding the town center. They continued on Greenwich Road to Patrill Hollow Road to access the landfill.

**Truck Types**

Trucks generally range in size from one-ton resident trucks to local collection trucks (known as front or rear loaders or "packers") to larger "transfer trailers", typically the size of a tractor trailer truck. Smaller vehicles served by the landfill include pickup trucks and vehicles with small trailers, typically contractor and resident vehicles.

**Landfill Travel Restrictions**

On November 16, 2005, the Town of Ware Board of Health adopted regulations prohibiting any person transporting solid waste by truck, except solid waste collected in Ware, from using any roadways in Ware other than state highway Routes 9 and 32 (the "Regulations"). The Town of Ware began enforcing the Regulations on January 2, 2006. As a result, trucks destined for the Hardwick Landfill from the south are re-routed north to Route 32A in Hardwick, which connects to Greenwich Road at the Hardwick Common north of the landfill. Trucks destined for the Hardwick Landfill travel for approximately 1.9 miles on Route 32 in Ware from the point at which Routes 9 and 32 intersect. They then continue on Route 32, passing through the town of New Braintree briefly before entering the Gilbertville village of Hardwick on Route 32A. The trucks pass through the center of Hardwick, turning left onto Greenwich Road at the Hardwick Common. Trucks then travel on Greenwich Road for approximately 6 miles to Patrill Hollow Road to access the landfill. This route represents approximately 6.5 miles of additional travel distance to the landfill relative to the historic route used through Ware.

As a result of the Regulations, Casella voluntarily adopted measures to ease the transition to the new truck route through Hardwick. Commencing on January 2, 2006 and for approximately three months afterward, Casella had an escort vehicle leading the transfer trailers from Greenwich Road in Hardwick Center to the landfill. Casella no longer uses the escort vehicle. In addition, at the request of the Town of Hardwick Landfill Oversight
Committee, including the Board of Health members, during the school year Casella did not have transfer trailers traveling on Greenwich Road during times that school buses were on the road picking up or dropping off students. According to Casella, all truckers transporting waste to the Hardwick Landfill were requested to abide by this restriction; however, some packer trucks may not have done so. During the winter months of this year Casella at times staged the transfer trailers coming from its affiliated facilities to avoid having multiple trucks on Greenwich Road.

**Observed Hardwick Landfill Traffic Characteristics**

Traffic characteristics of the Hardwick Landfill are based on hourly traffic activity observed during June 2006 at Patrill Hollow Road, as well as truck logs provided to MDM by Casella for the latest available 1-year period of operation. Detailed hourly count data for the count period is provided in the Appendices. A summary of traffic characteristics is presented below.

**Daily and Hourly Traffic Generation**

Daily trips to/from the Hardwick Landfill for the period from 7 AM to 4 PM (the landfill operating hours) are summarized below. **Figure 8** presents a summary of the total observed daily truck trips and patterns generated by larger commercial vehicles, including packer trucks and transfer trucks.

- A total of 153 vehicle-trips (74 entering and 79 exiting) were observed on Lower Patrill Hollow Road between the landfill operating hours of 7 AM and 4 PM.

- Approximately half of all observed landfill-generated trips (80 vehicle-trips) were trucks ranging in size from small dump trucks to articulated transfer trucks. The balance of trips were by smaller vehicles including pick-up trucks and resident vehicles.

- Approximately 32 percent of observed trips (64 vehicle-trips) were by larger commercial vehicles including packer trucks and transfer trucks.

- Articulated transfer trucks (the largest truck type generated by the landfill) account for a total of 24 trucks trips (12 entering and 12 exiting) at the landfill, all entering/exiting via Greenwich Road to the north. This comports with current truck restrictions in the Town of Ware and subsequent re-routing of trucks to Greenwich Road in Hardwick.

- Packer trucks account for a total of 36 truck trips (18 entering and 18 exiting) at the landfill between 7AM and 4PM. The vast majority of these packer trips were generated to/from Greenwich Road to the south – likely associated with trips originating from Ware.
Hardwick Landfill Seasonal Variation

Seasonal characteristics of truck activity at the Hardwick Landfill are determined based on tonnage and truck logs provided by Cassella for the latest one-year period of operations. Comparison of average monthly landfill tonnage provides a reasonable basis for estimating average and maximum truck activity at the landfill for purposes of this study. Figure 9 presents a graphical summary of monthly landfill activity, with a summary as follows:

□ Average landfill activity between June 2005 and June 2006 is 9,000 tons of solid waste per month.

□ Average tonnage accepted at the landfill between January 2006 and June 2006 ranged from 6,000 to 8,000 tons per month. This reduced level of landfill activity reflects Casella’s statement that less C&D waste is being accepted at the landfill, and that the landfill is now accepting approximately 30 percent less waste than its operating permit allows.

□ Landfill activity during June 2006 (the count period presented in this study) was approximately 7,000 tons.

□ Peak landfill activity occurred during August 2005, with up to 14,000 tons of solid waste per month. This represents activity that is up to twice the average levels currently occurring at the facility.

In summary, the above seasonal characteristics indicate that truck activity for the Hardwick Landfill based on observed June data represents an appropriate “typical” operating scenario for current landfill operations. However, potential exists for increased truck activity based on the Hardwick Landfill permit to accept approximately 30 percent more waste than occurred in June 2006. Peak truck activity for the landfill has potential for being notably higher than observed.
3.0 FUTURE CONDITIONS

This section estimates potential future traffic conditions along Greenwich Road over a 10-year planning horizon. The following sections provide an overview of area growth trends, as well as potential traffic increases associated with the Hardwick Landfill.

3.1 BACKGROUND TRAFFIC GROWTH

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

3.1.1 Historical Area Growth

Historical traffic volumes published by MassHighway for Town of Hardwick and regional travel routes in the study area indicate an average 1 percent annual growth rate. The traffic volumes and growth rate calculation are provided in the Appendix.

3.1.2 Landfill Traffic Growth

The most significant potential source of traffic growth along Greenwich Road in Hardwick is the expansion of the Hardwick Landfill. It is MDM’s understanding that the landfill is only currently permitted to accept an average of up to 300 tons of solid waste per day. However, recent studies of potential landfill expansion have been provided by Casella that suggest potential for increased truck activity for the landfill within the next 10 years (subject to state approvals).
In a report entitled “Hardwick Landfill Expansion, Development Impact Assessment” dated June 2004\(^1\), future expansion of the Hardwick Landfill is assessed for a scenario that more than doubles the existing landfill operations to an average of 750 tons of solid waste per day. Large truck generation estimates in the June 2004 study indicate a growth in large truck generation from 10-12 trucks per day (mostly transfer trucks) under existing landfill operations to 30-32 large trucks per day under expanded operations. These estimates do not include additional activity generated by smaller vehicles, which account for over half the vehicle types currently traveling to/from the Hardwick Landfill based on June 2006 observations.

### 3.2 SUMMARY OF POTENTIAL TRAFFIC GROWTH

Traffic growth along Greenwich Road in Hardwick is projected to be modest over the next 10 years ranging from 40 to 50 vehicle-trips per day based on historical trends. More significantly, in the event the Hardwick Landfill were granted a permit to expand its operations to 750 tons per day of average solid waste capacity, large truck generation (articulated transfer trucks) would likely more than double on Greenwich Road in Hardwick from the current 12 vehicles per day to 30 vehicles per day (60 vehicle-trips). In addition to larger commercial truck increases, landfill expansion would also be likely to increase smaller commercial and residential vehicles based on observed (June 2006) landfill traffic characteristics. Simple extrapolation of existing landfill trends suggests these increases could exceed 120 vehicle trips per day (including larger truck trips described above).

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4.0 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes safety concerns related to travel on Greenwich Road in Hardwick, and presents a range of potential actions that serve as a starting point in planning future safety-related transportation needs for Greenwich Road. Potential actions presented herein are intended only for planning and discussion purposes; detailed evaluation of specific safety measures, permitting requirements and potential costs are beyond the scope of this traffic study and are subject to further engineering assessment.

4.1 SUMMARY

Greenwich Road in Hardwick is a rural minor collector that is characterized by narrow, winding alignment with steep grades and several segments that have limited sight distance. Pavement conditions are generally poor and subject to areas of roadside “washout” that severely impair two-way travel along several segments. As a roadway that is located within Hardwick’s R-40 and R-60 zoning districts, the roadway is intended to serve “moderate density residential purposes and agricultural pursuits”. None-the-less, daily travel on Greenwich Road in Hardwick is comprised of significant proportion of large commercial truck activity (12 percent of daily traffic volumes, or more than 50 truck trips per day). The majority of these vehicles are associated with the Hardwick Landfill, a prominent commercial use that has operated since approximately 1968.

A notable concern related to travel safety on Greenwich Road is the presence of large commercial vehicles that carry in excess of 10 tons of material and that require effective travel widths and stopping distances that exceed those available along many segments of Greenwich Road.

The regular presence and volume of larger commercial vehicles is relatively new to Greenwich Road to the north of the Hardwick Landfill, notably occurring from January 2006 to present. Regulations imposed by the Town of Ware restrict these larger landfill-bound trucks from the more direct (and historically utilized) Greenwich Road route to the south.
through Ware, requiring a 6 + mile route diversion through Hardwick and along Greenwich Road. Notable is that the historic landfill travel routes in Ware are urban collector roadways that not only provide a more direct route to/from the Hardwick Landfill from regional arterials (Route 9 and Route 32), they provide greater effective travel widths and do not present any notable geometric or safety constraints that otherwise exist along the current route – Greenwich Road in Hardwick.

Any future expansion of the Hardwick Landfill, which is subject to State permitting and approval, would further impact Greenwich Road in Hardwick by more than doubling the volume of large commercial vehicles to nearly 100 vehicle-trips per day during weekdays.

4.2 **POTENTIAL SAFETY-RELATED ACTIONS**

Evaluation of Greenwich Road roadway and traffic characteristics indicates the need for an heavy-vehicle travel exclusions and/or implementation of a range of safety-related improvements that range from geometric and traffic control enhancements to adoption of heavy vehicle restrictions and/or management policies aimed at minimizing potential vehicle conflicts with larger vehicles. A brief overview of route alternatives, geometric improvements, traffic controls and heavy vehicle restrictions/management are presented below for discussion purposes.

4.2.1 **Heavy Commercial Vehicle Route Exclusion**

Under the State’s Standard Municipal Traffic Code of 1987, Section 10A-9, a truck exclusion from a municipal way may be authorized provided a suitable alternative route is available. Such an alternative route is required to have an effective width and pavement structure which can safely accommodate the additional truck traffic, and must meet one of the following conditions:

1. Lie wholly within the community making application,
2. Lie partially in an adjacent community but only on State Highway, or
3. Lie partially in an adjacent community but have the adjacent community’s written approval.

Warrants for a heavy commercial vehicle exclusion include roadways serving 5-8 percent of volume as trucks, reduces utilization of the roadway and is cause for substantial reduction in capacity or safety; and that the condition of pavement structure of the route to be excluded indicates that further repeated heavy wheel loads will result in severe deterioration of the roadway.

Roadway and traffic assessment of Greenwich Road in Hardwick indicates that warrants for a commercial heavy vehicle exclusion are supported. However, there are no alternative routes
that meet the conditions specified under (1) through (3) above, barring written consent of the Town of Ware to continue use or historic travel routes in Ware. Alternatively, Upper Patrill Hollow Road could serve as an alternative, but would require substantial widening and rehabilitation of the Muddy Brook bridge crossing to present a realistic alternative.

In summary, designation of a commercial heavy vehicle truck exclusion on Greenwich Road north of Patrill Hollow Road is supported by roadway and traffic conditions and corresponding Warrants, but is not feasible unless (a) the Town of Ware provides written consent to use North Street and Greenwich Road for heavy vehicle access to Hardwick Landfill or (b) substantial improvements are constructed along Upper Patrill Hollow Road to provide safe access to/from the Hardwick Landfill.

In lieu of a truck exclusion, the Town may wish to consider a combination of actions including geometric and traffic control enhancements and heavy vehicle management policies aimed at improving travel safety and minimizing potential vehicle conflicts with larger vehicles. Potential measures are presented below.

### 4.2.2 Roadway & Geometric Improvements

Several potential roadway and geometric enhancements include the following:

- Shoulder hardening/widening to provide minimum effective travel width of 22 feet.
- Embankment re-grading to enhance sight lines (two locations).
- Structural pavement evaluation, reclamatation and reconstruction to support commercial heavy vehicle wheel loadings.

### 4.2.3 Traffic Controls

Traffic controls may improve safety (in combination with roadway and geometric improvements above) by enhancing driver awareness of hazardous driving conditions, presence of commercial truck activity, roadway delineation and travel speed advisory. Potential traffic controls include the following:

- *Advisory speed plaques.* The existing speed limit on most portions of Greenwich Road is 30 mph. Field observations by MDM indicate that actual travel speeds are often higher than the regulatory limit (based on the “car following” technique for randomly sampled vehicles). The Town may wish to consider placing advisory speed plaques of 25 mph at select locations along Greenwich Road – a more appropriate travel speed along many of the winding or sight-impaired sections of roadway between Upper Patrill Hollow Road and Lower Patrill Hollow Road.
□ **Advance warning signs.** Advance warning signs including “Sharp Curve Ahead”, reflectorized warning chevron signs (at curves), “Narrow Road Ahead” and “Trucks” are advisable at appropriate locations along Greenwich Road. Sign standards specified in the current version of the *Manual of Uniform Traffic Control Devices* are recommended.

□ **Pavement markings.** Centerline pavement markings, designated “No Passing” zones and shoulder markings will enhance driver guidance on Greenwich Road and in combination with geometric improvements and warning signs stand to improve travel safety along Greenwich Road.

### 4.2.4 Heavy Vehicle Management Policies

Initial (voluntary) measures adopted by Casella for heavy truck management provide a reasonable means of improving heavy vehicle travel safety along Greenwich Road – particularly in combination with roadway and geometric improvements and traffic control measures described conceptually above. These measures include:

□ **Advance vehicle escorts.** Providing a smaller advance vehicle with warning devices (flashing yellow beacons) to proceed larger commercial vehicles (transfer trucks). The escort vehicle would meter vehicle travel speeds to advisory limits to/from the Hardwick Landfill and provide advance visual warning to oncoming vehicles – particularly along roadway segments that have impaired sight lines and restricted travel widths.

□ **Scheduled Truck Activity.** During inclement weather (when excessive rain, snow or ice may be present), consider scheduling transfer truck arrivals to avoid multiple trucks on Greenwich Road (unless platooned).

□ **Time-of-Day Restrictions.** Restrict the scheduling of transfer trucks during periods when school bus activity is present on Greenwich Road – typically 7:00-8:00 AM and 2:30-3:30 PM.

Existing roadway and traffic conditions on Greenwich Road are not conducive to safe travel by heavy commercial trucks. Heavy truck management practices, combined with proposed roadway and geometric improvements and traffic controls above, provide a reasonable approach to addressing safety needs of the Greenwich Road corridor in Hardwick.

### 4.3 CONCLUSIONS

Existing roadway and traffic conditions on Greenwich Road are not conducive to safe travel by heavy commercial trucks. Ideally, historic travel routes through Ware – specifically North
Street and Greenwich Road – provide the best available alternatives for commercial heavy vehicles (particularly transfer trucks) to access the Hardwick Landfill. These routes are urban collector roads that provide a relatively direct route to/from the landfill from Route 9/32, and provide sufficient width, geometry, traffic controls and pavement condition to safely support commercial heavy vehicles. These routes in Ware have historically served the landfill since approximately 1968 through 2005.

In lieu of written consent by Ware to use these routes for commercial heavy traffic to/from the landfill, MDM recommends that a combination of safety improvements be evaluated and implemented along Greenwich Road. Heavy truck management practices, combined with proposed roadway and geometric improvements and traffic controls, provide a reasonable approach to addressing safety needs of the Greenwich Road corridor in Hardwick. Alternatively, the Town may consider reconstruction of the upper portion of Patrill Hollow Road; although this alternative presents a more complicated and less cost-effective solution than the Greenwich Road enhancements above.