NATIONAL TRANSPORTATION SAFETY BOARD
Office of Railroad, Pipeline, and Hazardous Materials Investigations
Washington, D.C. 20594

Survival Factors

Group Chairman's Factual Report of the Investigation[1]

– Railroad Equipment Crashworthiness[2] –

Report Date: December 13, 2022

A. Accident Information

NTSB Number:	RRD22MR010
Location (Jurisdiction):	Mendon, MO (Chariton County)
Date / Approx. Time of Accident:	June 27, 2022 / 12:43 (p.m.) CDT[3]
Brief Synopsis:	Amtrak intercity passenger train collision with a highway vehicle (dump truck) at highway / rail grade crossing, and subsequent derailment
Train Equipment Owner / Operator:	Amtrak / Amtrak
Railroad (Property Owner):	BNSF
Accident Site (Location):	BNSF, Main Line, Track #2, Marceline Subdivision, Chicago Division, at (approximately) MP 363.8

Note – most photographs and video images obtained by the Survival Factors / Crashworthiness investigation are not included in this report, due to the volume of materials, the diverse formats of the digital media, as well as confidentiality considerations. A separate report containing these materials and their public release documentation will be prepared and placed in the docket.

[1] Generally described, NTSB investigations are conducted pursuant to the criteria cited under 49 CFR Part 831.

[2] This Survival Factors / Crashworthiness investigation report exclusively addresses the elements and factors of the railroad equipment crashworthiness (locomotive and passenger railcars).

[3] Central Daylight Time

B. Synopsis of the Accident

See Synopsis narrative, as compiled by the Investigator-in-Charge, which is available in the NTSB public docket.

Table of Contents

Select abbreviations and acronym nomenclature used in this report

~	approximate, or approximately
BNSF	Burlington Northern Santa Fe Railway
CFR	Code of Federal Regulations (see https://www.ecfr.gov/)
ref	reference, or in referenced to
FRA	Federal Railroad Administration (see https://railroads.dot.gov)
MO	Missouri
ROW	right-of-way [in the context of railroad trackage]
SF	Survival Factors [NTSB investigation Group]
US DOT	U.S. Department of Transportation
USGS	United States Geological Survey (see [Internet] https://www.usgs.gov/)
Volpe Center	Volpe National Transportation Systems Center (https://www.volpe.dot.gov)

C. **Technical Working Group Participants**[4]

[4] Participants of the Survival Factors (SF) / Crashworthiness - Technical Working Group include [1] the Group Chairperson (NTSB investigative staff), [2] participants as designated by the Party to the Investigation [organizations / entities], pursuant to the criteria of 49 CFR 831.11, and [3] potentially other individuals as designated by other organizations / entities that the Crashworthiness Group Chairperson deems necessary and appropriate to participate in the SF / Crashworthiness Group investigation.

Richard M. Downs, Jr., PE
Crashworthiness - Group Chairperson
NTSB / RPH-40
Washington, DC

Turan Kayagil, MD, FACEP
Medical Officer
NTSB / RE-1
Washington, DC

Jeffrey A. Rogers
Senior Mechanical Engineer / Rolling Stock Engineering
National Railroad Passenger Corporation (aka Amtrak)
Beech Grove, IN

Jeffrey Apple
MP&E - Northern Virginia (District 2) / Office of Safety - MP&E
Federal Railroad Administration (FRA)
Washington, DC

D. **Details of the Investigation**[5]

1.0 Relevant Background Factors / Information

1.1 Accident Scenario / Brief Summarized Overall Characterization of the Event [6, 7]

The accident involved the collision, and subsequent derailment, of an eastbound, Amtrak® intercity passenger train, with a northbound, 5-axle, commercial-use dump truck [highway vehicle], which was transporting a heavy load of cargo (stone), which was traversing a rural, passive, highway / railroad grade crossing, in the path of the oncoming train.

The Amtrak passenger train, having a timetable designation as Train Number 4 (of the 25th)[8], initiated its service-run in Los Angeles, CA, and had a scheduled destination of Chicago, IL.[9]

---

[5] Data and documentation of the investigation, as accrued from, or as made available to the investigation by the individual participants of the Crashworthiness Group, and/or data / documentation as made available to the investigation by other contributors (as individually noted), is described in this report section.

[6] This narrative, which exclusively addresses information relevant to the railroad equipment crashworthiness perspective of the investigation (i.e., vehicle dynamics / occupant kinematics), was compiled based upon information supplied by witness(es) and/or supporting evidence at the accident scene, and as further described in this report, as identified by NTSB investigative staff (Crashworthiness Technical Working Group - Chairperson), as supported by the participants of the Crashworthiness Technical Working Group.

[7] Note – left and right locational reference indicators are relative to the forward direction of travel (of the train).

[8] The designation "(25)" indicates the train began operation (at the originating station) on the 25th day of the month.

[9] For further information detail on the train, see [Internet) https://www.amtrak.com/southwest-chief-train.

The Amtrak train Consist was comprised of, in sequence, two diesel-electric locomotives (at the lead-end of the train), a baggage car, and seven passenger railcars. Based upon passenger and crewmember manifest information supplied by Amtrak, there were 271 passengers, and 12 Amtrak crewmembers on board the train at the time of the accident.

The impact of the front of the lead locomotive of the train, with the left / rear side-panel structure of the dump truck, resulted in the deflection of the dump truck to the left side of the track, as the train continued through the grade crossing. The dump truck separated from contact with the locomotive, and came to rest immediately adjacent to, to the northeast of, the grade crossing intersection. The sole occupant [the driver] of the dump truck sustained fatal injury as a result of the collision.

Upon the dump truck separating contact with the lead locomotive of the train, momentum resulted in the continued movement of the train along the track, which also resulted in the derailment of the train, with the train coming to rest further-on down the track, to the right of the track, essentially aligned with the track. The train operator / engineer (who was the sole occupant of the lead locomotive of the train) had applied the emergency brakes, in which the lead end of the lead locomotive of the train came to rest about 1,286 feet to the east[10] of the grade crossing.[11]

The front bulkhead structure of the lead locomotive of the train sustained collision impact damage, but remained intact, in which the lead locomotive otherwise did not sustain significant damage. The lead locomotive derailed upright, the second locomotive derailed leaning slightly to the right, the baggage car derailed leaning to the right at about a 45º list, in which the subsequent seven passenger railcars all derailed, all coming to rest fully on their right sidewall panels. The lower-level window assemblies, on the right sidewall panels of the seven passenger railcars, all sustained ground-impact damage, to various degrees of severity. There was no fire damage sustained by the train.

1.2 Topic-Points Reviewed by the Crashworthiness - Technical Working Group[12]

1.2.1 Amtrak – Passenger Railcar / Carbody Crashworthiness[13]

- Carbody Sidewall - Structural Integrity / Intrusion Resistance
- Sidewall Window Assembly[14] - Securement Integrity (Retention)

[10] Timetable directional [orientation] references are cited in the report, in which, at this location, because the track is actually configured in a southwest / northeast orientation, the actual compass orientation is northeast.

[11] Due to momentum, as a moving train cannot immediately stop upon an emergency braking application, the stopping distance was identified to be consistent with the stopping distance of a train of that weight and type of operation (i.e., a passenger train), and consistent with the observed prevailing weather condition (i.e., 'dry' track).

[12] Topic-points as identified by NTSB investigative staff (SF / Crashworthiness Group Chairperson), as sourced to the evidence / facts obtained and identified during, and subsequent to, the on-scene phase of the investigation.

[13] i.e., features / structural elements of the subject passenger railcar(s), as visually examined, and/or as documented by the investigation.

[14] i.e., refers to a 'non-emergency use' passenger railcar service window.

1.2.2 Regulation

- Passenger Equipment Safety Standards (49 CFR Part 238) – Relative to Passenger Railcar / Carbody Crashworthiness, and associated / contributory regulations (as further described).

1.3 Locality of the Accident / Civil Jurisdiction, and Property Identification

The accident occurred at a highway / railroad, at-grade crossing intersection, located at the intersection of County Route 113[15], and trackage of the Burlington Northern Santa Fe Railway (BNSF). The railroad track, as configured within the railroad right-of way (ROW) in this area, is property of, and is operated by the BNSF[16]. The track at the accident location is referred to, by the railroad, as the Main Line, Track number 2, on the Marceline Subdivision, of the Chicago Division, in which the accident occurred at railroad milepost[17] (MP) 363.8 [18]. The accident site, which is situated in an unincorporated locality of Chariton County, is located in a predominantly agricultural-production (commercial farming) region. The nearest populated municipal jurisdiction is the City of Mendon[19], the municipal boundary of which is/was located about three miles to the northeast of the accident site.

1.4 Railroad Property Owner / Host Railroad (BNSF) - Background

Amtrak Train Number 4 (of the 25th) operated on track owned by the BNSF at this location, under an "overhead trackage rights" agreement[20].

The BNSF is a standard gauge[21], common-carrier, Class I freight railroad[22], with corporate headquarters located in Fort Worth, TX[23]. The BNSF operates approximately 32,500 route-miles of track covering 28 states across the western two-thirds of the United States, and three Canadian provinces. Dispatching of trains operating on the BNSF at this location, including Amtrak, is provided by the BNSF utilizing a train dispatch facility, located in Fort Worth, TX.

---

[15] This roadway is also locally referred to as Porche Prairie Avenue.

[16] ref, and for further information, see [Internet] https://www.bnsf.com.

[17] A Milepost (MP) refers to point along the railroad line that identifies a dimensional distance, in miles, relative to the designated origin reference point.

[18] As a precise location, the BNSF indicated that, this grade crossing was located at MP 363.876, as identified in track charts (of the railroad).

[19] Population 163; ref, 2020 US Census; for further information, see [Internet] https://data.census.gov/cedsci/profile/Mendon_city,_Missouri?g=1600000US2947288

[20] A common agreement among railroads, where a railroad owning track allows another railroad the right to operate on that track. The railroad owning the track is referred to as the host railroad.

[21] U.S. "standard gauge" track is 56.5 inches (143.5 cm) between the rails, as measured on straight track.

[22] ref., as defined in, 49 CFR 1201.1-1 Classification of Carriers

[23] ref, and for additional information, see [Internet] http://www.bnsf.com/bnsf-resources/pdf/about-bnsf/fact_sheet.pdf.

See Railroad Operations Group - Factual Report for additional information detail on the host railroad.

1.5 Accident Train - Background

The accident train was owned and operated by the National Railroad Passenger Corporation, in which the company also refers to itself as Amtrak® [24], in which the train was being operated [traveling] on property of the BNSF Railway (BNSF), which is designated as the "host" railroad.

1.5.1 Amtrak - Brief Summary – Operational Background[25]

As described by the company, "Amtrak, the national rail operator … [operates on] approximately 21,400 route-miles of track in 46 states, the District of Columbia, and three Canadian provinces. Amtrak operates more than 300 trains each day, to more than 500 destinations. Amtrak is the operator of choice for state-supported corridor services in 17 states and four commuter rail agencies." [26] Amtrak operates a total of 15 long-distance (intercity) trains.[27]

1.5.2 Accident Train - Brief Summary

The accident train was an eastbound intercity passenger train, which was assigned an operational designation of Train 4 (25) [28], having a marketing designation of "The Southwest Chief®", in which the train was operated by crewmembers employed by Amtrak. The train initiated its service-run in Los Angeles, CA, on June 25th, and had a scheduled destination of Chicago, IL, on June 27th. [29] The Amtrak train consist was comprised of, in sequence, two diesel-electric locomotives (at the lead-end of the train), a baggage car, and seven passenger railcars. Based upon passenger and crewmember manifest information supplied by Amtrak, the investigation determined there were 271 passengers and 12 Amtrak crewmembers on board the train at the time of the accident.

1.6 Accident Site Characterization – Pre-Accident

1.6.1 Overall Physical Configuration of the Accident Site[30]

[24] The formal name designation of the company is the National Railroad Passenger Corporation, in which the company universally, for sales / marketing purposes, refers to itself as Amtrak.

[25] ref, and for further information, see [Internet] https://www.amtrak.com/about-amtrak.html, and as further described.

[26] ref, and for additional information, see [Internet] http://www.amtrak.com/about-amtrak/amtrak-facts.html.

[27] ref, and for further information see [Internet] https://www.amtrak.com/routes.html

[28] Amtrak trains have a 'departure date' associated with the timetable 'train number' designation; for the subject train, the departure date (from its initiating / origination station) was June 25.

[29] For further information detail on the train, see [Internet) https://www.amtrak.com/southwest-chief-train.

[30] Description based upon pre-, and post-recovery examination of the accident site by the Crashworthiness Group (in which the overall characteristics of the site likely had not changed since prior to the accident), and aerial imagery of the site [recorded prior to the event], as shown in [Internet] https://www.google.com/maps/.

Generally described, the accident occurred on railroad trackage property that was owned / operated by BNSF, in which the collision occurred on Main Track number 2, which is the southern-most track of the double-track BNSF mainline that is located in this area. The BNSF Main Track in this area is configured generally in an east/west orientation, in which Main Track number 2, which closely parallels the adjacently located Main Track number 1, is tangent (straight) and has an approximately level grade. In the area proximate to the accident site, the distance between the centerlines of Main Track 2 and Track 1 measured about 14 feet.

The track-bed surface of the railroad ROW, proximate to the accident site, was elevated above the prevailing ground-level terrain by about 10 feet. A shallow drainage ditch, containing standing water to a few inches in depth, was located along the southern edge of the elevated railroad ROW, in the area proximate to the accident site. The area proximate to the accident site (i.e., as situated on both sides of the railroad ROW) was comprised principally of agricultural-production activity (commercial farming[31]), which was conducted on private property. County Route 113, in the area proximate to the grade crossing intersection, was an unpaved roadway.

See Railroad Operations Group - Factual Report for additional information detail on the physical configuration of the accident site.

1.6.2 Map of Accident Site

A copy of an annotated segment of a USGS topographic (survey) map[32], describing the general area proximate to the accident site, is provided in Exhibit 1 of this report.

1.7 Highway Vehicle (Dump Truck) – General Description[33]

The highway vehicle, as operated by the driver (and sole occupant) of the vehicle, which was transporting a load of cargo (stone), was a 2007 Kenworth, Model W900B, five-axle, commercial dump truck, which consisted essentially of a conventional chassis cab [vehicle platform], upon which an open box bed (sometimes referred to as a ‘dump box’, or a ‘dump bed’) was installed.

See the Highway Factors - Factual Report for additional information detail on the vehicle.

2.0 Accident Train

2.1 Train Consist and Select Technical Specifications[34]

[31] i.e., corn production

[32] Excerpt from United States Geological Survey (USGS) topographic survey map, [Quadrangle map ref] Mendon, MO, [dated] 2021 (7.5 Minute Series, original scale 1:24,000); ref, and for further information, see [Internet] https://ngmdb.usgs.gov.

[33] Source: Vehicle Factors - Group Chairman’s Factual Report

[34] Source: description of the accident train was sourced to observations by NTSB investigative staff (during, and subsequent to the on-scene phase of the investigation), and data as offered by Amtrak, and as further described.

The Amtrak train Consist was comprised of, in sequence, two diesel-electric locomotives (at the lead-end of the train), a baggage car, and seven passenger railcars.

A tabulation, describing the train Consist List, and select Technical Specifications of the Amtrak train equipment, is provided in Exhibit 2.

2.2 Technical Drawings / Diagrams of the Train Consist Railcars

General arrangement engineering drawings, and floorplan diagrams, of the train Consist railcars were made available to the investigation by Amtrak, which are provided in Exhibit 3.

See Railroad Operations and Human Performance Group - Factual Report for additional information detail on the railroad equipment.

2.3 Superliner® Passenger Railcar Design

All of the passenger railcars in the train were of the Superliner® passenger railcar design.

2.3.1 Overall Design Configuration

The passenger railcars in the train Consist were comprised of Superliner® I and Superliner® II cars. Superliner I cars were manufactured by the Pullman Standard Company and delivered to Amtrak in 1979-1980, inclusive. Superliner Il cars were manufactured by Bombardier Transportation, Inc. and delivered to Amtrak in 1994-1995, inclusive. Both the Superliner I and Superliner II cars were of similar structural design, and were constructed of stainless steel. Generally described, the Superliner cars, both series, are/were bi-level, consisting of an upper-level and a lower-level passenger compartment, as well as ‘end-doors’ which are/were fitted to both ends of the railcar (to afford access between coupled railcars). The cars also incorporate a vestibule area [compartment] in the lower-level, center [area] of the railcar, which are/were fitted with a staircase (to afford access between the car floor levels), in which the vestibule is also fitted with the main service doors as situated on both sides of the railcar. The Superliner cars measure 85 ft 0 inch in length, 10 feet 2 inch in width, and 16 feet 2 inch in height.

2.3.2 Crashworthiness / Structural Design Configuration

The structural design of Superliner car bodies, both series, utilize structural components to help resist sidewall intrusion under impact loading. These components included: side posts (the main vertical structural elements in the sides of a rail vehicle), side sill members (that portion of the underframe or side at the bottom of the rail vehicle side wall), attachments to cross member [structural] elements, and exterior sheathing (sheet metal panels that comprise the outer layer of the carbody sidewall structure). Upper-level and lower-level floor cross-member attachments provided additional bracing. Technical specifications for side strength loading of Superliner I and Superliner II railcar designs are as stipulated in the Association of American Railroads (AAR) Standard S-034-69, Specifications for the Construction of New Passenger Equipment Cars.

2.3.3 Passenger Railcar – Select Regulatory Requirements

Regulation prescribed under 49 CFR Part 238 Passenger Equipment Safety Standards, are applicable to passenger railroad equipment (i.e., railcars), which include the following select criteria.

- 49 CFR 238.3 Applicability. The regulation is applicable to passenger equipment ordered on or after September 8, 2000, or placed in service for the first time on or after September 9, 2002.

The investigation observed that because the "Superliner I" and Superliner II" series of railcars [involved in the accident] were first placed in service prior to the applicability date of the regulation (i.e., 1975-1981, inclusive, and 1991-1996, inclusive), these railcars were not subject to the noted 49 CFR 238.3 Applicability regulation. In other words, the railcars were exempt under the "grandfather" provisions of the regulation.

- 49 CFR 238.217 Side Structure. This regulation addresses strength criteria for carbody side structure to resist, for example, intrusion by an object into the occupied space of the carbody. Elements of the regulation include: criteria for side post and corner brace components, a minimum section moduli or thickness dimensions for side structure components, and dimensional requirements for side panel sheathing.

See further § 3.0 Regulation of Railroad Passenger Car Equipment, which addresses other regulatory considerations addressed in the investigation.

2.3.4 Superliner Structural Crashworthiness Design Criteria - Relative to Current Regulatory Requirements (49 CFR 238 Subpart C)

A review was conducted (during a previous NTSB investigation involving Amtrak Superliner railcars[35]), comparing the structural crashworthiness technical criteria of Amtrak's Superliner I and Superliner II railcar designs (which were designed / manufactured to the specification of AAR Standard S-034-69, Specifications for the Construction of New Passenger Equipment Cars), as compared against the technical specification of current regulation (i.e., under 49 CFR 238.217 Side Structure). The review identified that while the Superliner cars were constructed prior to the issuance of 49 CFR Part 238 Passenger Equipment Safety Standards, they were constructed in compliance with the structural strength requirements of the AAR standard S-034-69, Specifications for the Construction of New Passenger Equipment Cars. Further, the AAR Standard S-034-69 Specifications for the Construction of New Passenger Equipment Cars was observed to have similar side structure technical requirements as found in regulation under 49 CFR 238.217 Side Structure.

[35] Ref, and for further information, see NTSB Accident Report NTSB/HAR-12/03: Highway-Railroad Grade Crossing Collision, US Highway 95, Miriam, NV, June 24, 2011; available at [Internet] https://www.ntsb.gov/investigations/AccidentReports/Reports/HAR1203.pdf.

3.0 Regulation of Railroad Passenger Car Equipment[36]

3.1 Overall Provisions

Generally described, relative to the topic-points reviewed [being addressed] by the Crashworthiness Group investigation, regulation of railroad passenger car equipment is addressed under regulation provisions of the U.S. Department of Transportation (US DOT), as promulgated by the Federal Railroad Administration (FRA), as follows.

- 49 CFR Part 229 Railroad Locomotive Safety Standards
- 49 CFR Part 223 Safety Glazing Standards - Locomotives, Passenger Cars and Cabooses
- 49 CFR Part 238 Passenger Equipment Safety Standards

3.2 Provisions of Tier I Operation

The passenger railroad equipment of the train involved in the accident operated under the Tier I operational definition criteria[37], referring to a maximum [permissible] train operation speed[38], as stipulated under the provisions of 49 CFR Part 238 Passenger Equipment Safety Standards.

Generally described, regulation of Tier I passenger railroad equipment (i.e., of the train involved in the accident), relative to the topic-points reviewed [being addressed] by the Crashworthiness Group investigation, are addressed under the provisions stipulated in the regulations, as follows.

- 49 CFR 223.3 Application [of safety glazing]
- Appendix A to Part 223 [Safety Glazing Standards]
- 49 CFR 238.209 Forward end structure of locomotives, including cab cars and MU locomotives.
- 49 CFR 238.217 Side structure
- 49 CFR 238.221 Glazing

3.3 Language of 49 CFR 238.221 Glazing - Tier I Operation

The language of the regulation under 49 CFR 238.221 Glazing, operating under the Tier I definition criteria, is as follows.

- 238.221 Glazing.

---

[36] Ref, and for further information, see 49 CFR 238 Passenger Equipment Safety Standards; available at [Internet] https://www.ecfr.gov/current/title-49/subtitle-B/chapter-II/part-238, and as further described.

[37] Ref, and for further information, see 49 CFR 238.5 Definitions, see then Tier I; available at [Internet] https://www. ecfr.gov/current/title-49/subtitle-B/chapter-II/part-238#238.5.

[38] i.e., under the 49 CFR 238.5 definition, “Tier I means operating at speeds not exceeding 125 mph.”.

(a) Passenger equipment shall comply with the applicable Safety Glazing Standards contained in part 223 of this chapter, if required by that part.

(b) Each exterior window on a locomotive cab and a passenger car shall remain in place when subjected to:
  (1) The forces described in part 223 of this chapter; and
  (2) The forces due to air pressure differences caused when two trains pass at the minimum separation for two adjacent tracks, while traveling in opposite directions, each train traveling at the maximum authorized speed.

3.4 Language of 49 CFR 238 - Glazing Securement Provisions of Tier II and Tier III Operation

In addition to regulation of the passenger railroad equipment of the train involved in the accident (i.e., the Tier I definition, as described above), the investigation identified language of the regulation under 49 CFR Part 238, which addressed passenger railroad equipment that is operated under the Tier II[39] and Tier III[40] operational definition criteria[41], as follows (note - the prescriptive language of both regulations were identical).

3.4.1 Tier II

- 49 CFR 238.421 Glazing

  "Glazing securement. Each exterior window on a passenger car and a power car cab shall remain in place when subjected to:
  (1) The forces due to air pressure differences caused when two trains pass at the minimum separation for two adjacent tracks, while traveling in opposite directions, each train traveling at the maximum authorized speed; and
  (2) The impact forces that the glazed window is required to resist as specified in this section."

3.4.2 Tier III

- 49 CFR 238.721 Glazing

  "Glazing securement. Each exterior window on a passenger car and a power car cab shall remain in place when subjected to:
  (1) The forces due to air pressure differences caused when two trains pass at the minimum separation for two adjacent tracks, while traveling in opposite directions, each train traveling at the maximum authorized speed; and

[39] i.e., under the 49 CFR 238.5 definition, "Tier II means operating at speeds not exceeding 125 mph means operating at speeds exceeding 125 mph but not exceeding 160 mph.".

[40] i.e., under the 49 CFR 238.5 definition, "Tier III means operating in a shared right-of-way at speeds not exceeding 125 mph and in an exclusive right-of-way without grade crossings at speeds exceeding 125 mph but not exceeding 220 mph.".

[41] Ref, and for further information, see 49 CFR 238.5 Definitions, then Tier I; available at [Internet] https://www.ecfr.gov/current/title-49/subtitle-B/chapter-II/part-238#238.5.

(2) The impact forces that the glazed window is required to resist as specified in this section."

4.0 Accident Equipment Damage Characterization / Site Wreckage Distribution, and Relevant Factual Data

4.1 Time of the Event Occurrence[42]

The investigation identified the collision / derailment occurred at about 12:43 (p.m.) CDT[43], on June 27, 2022.

4.2 Train Speed at the Time of Collision[44]

The train was traveling at a reported speed of about 87 mph at the time of the accident (i.e., the moment of impact).

4.3 Approximate Point of Collision and Location Where Train Came to Rest[45]

The approximate point of collision was identified to be the northbound lane of the Route 113 grade crossing, at the point of intersection with the # 2 Main Track. The investigation identified that the left front bulkhead area of the lead locomotive made [collision] contact with the area proximate to the left / rear sidewall panel of the 'open box bed' of the dump truck, in which the open box bed was oriented to the south of the dump truck cab. Measurement identified that the front of the lead locomotive came to rest about 1,286 feet to the east of the grade crossing.

See Technical Reconstruction Group - Factual Report for additional information detail on the accident site.

4.4 Pre-recovery Examination / Damage Characterization

A pre-recovery examination of the railroad equipment, correspondingly involved [highway] vehicle(s), and the accident site, is conducted by the investigation prior to disturbance of the equipment, vehicle(s), and/or the site.[46] This is performed to accurately identify and document the degree of damage as had been sustained by the evidentiary artifacts, as damage to the equipment / vehicles, and disturbance of the site, can readily occur during the equipment recovery and site restoration process. Correspondingly, damage(s) as sustained by the

[42] Source: locomotive event recorder download data.

[43] Central Daylight Time

[44] Source: locomotive event recorder download data.

[45] Location(s) based upon evidentiary artifact data identified during the on-scene phase of the Crashworthiness investigation.

[46] Data notations of the examination activities are recorded in the Field Notes Logbook of the Crashworthiness Technical Working Group Chairperson, and other notation methods as engaged by the supporting participants of the Crashworthiness Technical Working Group, as subsequently described in the Field Notes Report of the Crashworthiness Group Chairperson.

environment (i.e., soil / terrain areas) proximate to the accident site, are also documented, to the extent possible, during the pre-recovery examination activity (e.g., skid marks on pavement, 'ground scars' at the site, displaced / damaged railroad track, or other displaced fixed objects). Recovery of evidentiary artifacts from the site may also potentially occur.

4.4.1 Summarized Damage Characterization – Railroad Equipment

The Crashworthiness Group conducted a pre-recovery equipment examination of the accident train on June 28, 2022, while the railroad equipment remained at the accident scene (i.e., where the train came to rest), in which a tabulation, describing the observed damage sustained by the accident train, is provided in Exhibit 4.

4.4.2 Summarized Damage Characterization – Highway Vehicle

The Crashworthiness Group conducted a cursory pre-recovery visual examination of the highway vehicle on June 28, 2022, while the wreckage of the highway vehicle remained at the accident scene, in which a tabulation, briefly describing the observed damage sustained by the highway vehicle, is provided in Exhibit 5.

See Vehicle Factors Group - Factual Report, and the Technical Reconstruction Group - Factual Report, for additional information detail on the vehicle, and the pre-recovery location / condition.

4.4.3 Summarized Characterization – Site Condition

A Technical Reconstruction Group was established at the scene, to support the investigation in the documentation of the wreckage distribution, as identified in the wreckage debris field at the accident site.

Annotated aerial imagery[47], as sourced to [developed by] images obtained by the Technical Reconstruction Group, describing the wreckage debris field, was prepared by the investigation, which is provided in Exhibit 6.

4.5 Post- recovery Examination / Damage Characterization - Railroad Equipment

A post-recovery examination of the railroad equipment is conducted by the investigation, to the extent possible, to appropriately / accurately document the accident-relevant information, upon relocation of the railroad equipment to an appropriate / safe / secure site.[48] During this activity, the time can be taken to more closely examine / document (and potentially recover) any

[47] Source: aerial imagery, as made available to the investigation, from responded UAV [unmanned aerial vehicle] resources (also referred to as aerial 'drones'), to which annotated data (describing select attributes / physical elements of the site) are correspondingly inserted in the image.

[48] In which data notations of that examination activity are recorded in the Field Notes Logbook of the Crashworthiness Technical Working Group Chairperson, and other notation methods as engaged by the supporting participants of the Crashworthiness Technical Working Group.

additional damage details and artifact characteristics, beyond that damage as had been identified during the pre-recovery examination activity.

4.5.1 Summarized Damage Characterization – Locomotives

The pre-recovery equipment examination identified that the collision damage sustained by the lead locomotive was confined to the left / front bulkhead structure (in which the bulkhead structure remained intact), in which no damage was also observed to have been sustained to the locomotive Operator's Cab[49]. Additionally, negligible damage was also observed to have been sustained by the (unoccupied) second locomotive[50]. Accordingly, as a measure of time-resource conservation[51], a post-recovery examination of the two locomotives was not deemed necessary to support this investigation.

4.5.2 Summarized Damage Characterization – Baggage Car / Passenger Cars

Upon the railroad equipment (i.e., specifically the baggage car, and the seven passenger railcars) having been relocated to a site that was deemed appropriate / safe / secure for the post-recovery equipment examination to be conducted[52], the Crashworthiness Technical Working Group conducted a post-recovery equipment examination of the railroad equipment on June 29, 2022, in which a tabulation, describing the observed damage sustained by the accident train, is provided in Exhibit 7.

4.6 Evidentiary Artifact(s) Recovered in the Wreckage Debris Field

No evidentiary artifact(s) were recovered during the field investigation activities of the Crashworthiness Technical Working Group.

5.0 Injury Data – Medical and/or Pathology[53]

[49] i.e., the structural integrity of the Operator's Cab was not compromised.

[50] i.e., also, typically, a crashworthiness investigation does not focus resources on examination of unoccupied railroad motive power [locomotives] or rolling stock [passenger railcar] equipment.

[51] Field investigations must prudently utilize the time available to conduct equipment examination activities in a time-efficient manner, focusing on examination of perishable evidence, in pursuit of gathering data on the key topic-points / issue-points as identified during the field investigation process.

[52] An equipment recovery / technical contractor (hired by the railroad) was brought in to recover the subject derailed railroad equipment, utilizing heavy equipment ('sidewinder' tracked-dozers, and other lifting-crane equipment), which involved 'up-righting' and transporting the individual railcars a short distance (several hundred feet) to a temporary staging area, to the immediate south of the accident site (i.e., a corn field, in which the cultivated crop was cleared, to provide a suitable level / dry work area), to accommodate the equipment examination activity.

[53] Note – the Railroad Equipment Crashworthiness investigation, and correspondingly this Factual Report, addresses [i.e., compiles briefly summarized] injury / fatality data of occupants on board the train (at the time of the accident), in which also, typically, very limited injury / fatality data of other persons, which may have also been involved in the accident (e.g., a highway vehicle driver), are correspondingly addressed in the Crashworthiness Factual Report.

The investigation identified there were 271 passengers, and 12 Amtrak crewmembers on board the train at the time of the accident.[54] One other person, the driver [sole occupant] of the highway vehicle [dump truck], was involved in the accident.[55]

5.1 Count of Injured Persons

Three train passengers and the driver of the highway vehicle were fatally injured. The investigation further identified a total of 146 other persons (train passengers and crewmembers) were transported to a total of 14 medical facilities [hospitals], for medical evaluation and/or treatment.[56, 57] One of the fatally injured passengers was also transported to a hospital, resulting in a total count of 147 persons that were transported.

5.2 Fatalities

Select / preliminary data was identified by the investigation, which is briefly summarized as follows.

Two Female Train Passenger Decedents[58]

Post-accident, two female passengers were found in the lower-level vestibule of [Lounge] Car 33046, in which [reportedly] first responders employed hand-shoveling to gain access to the decedents. The hand-shoveling was necessary for the removal of a significant amount of track ballast / soil that was found to have accumulated inside the vestibule, in which the right-side exterior door [panel], proximate to the accumulated track ballast / soil, was found to have been pushed inward and deformed. The autopsy cause of death for both female passengers was compression asphyxia.[59]

Male Train Passenger Decedent

[54] Data source: Amtrak passenger and crewmember manifest documentation [transmittal file ref. Copy of AMTRAK TRAIN 4_NTSB MANIFEST_AUG 24 2022_V8. xlsx], as made available by Amtrak to NTSB Transportation Disaster Assistance.

[55] Data source: Missouri State Highway Patrol, Missouri Uniform Crash Report, Case number 220336881; see further NTSB - Highway / Vehicle Factors - Factual Report.

[56] Data source: Amtrak's Record of Hospital Transports [transmittal file ref. MHA_AMTRAK DERAILMENT 6-27-22_draft.xlsx] , and [list of] Hospitals Treating Those Injured in the Amtrak Train Derailment in Missouri, June 27, 2022 [transmittal file ref. Hospitals and Ambulance Services [rev 10-19-2022].docx], as made available by Amtrak to NTSB Transportation Disaster Assistance.

[57] The FRA [Party participant] identified to the investigation, that the FRA / Volpe Center [investigative team] could not verify the number of passenger[s] / crew injured, and hospitals [to which] they were transported.

[58] Data source: Field Interview Notes of NTSB Medical Officer [as a supporting participant of the Crashworthiness Technical Working Group], of interview discussion with the Chariton County Coroner, as incorporated in the Railroad Equipment Crashworthiness Group - Field Notes [report] documentation, and photo-documentation [of the decedent's location] as reviewed by the Crashworthiness Group Chairperson and Medical Officer, and as further described.

[59] Data source: select data of the Boone / Callaway County Medical Examiner's Office autopsy reports provided by the Chariton County Coroner, as obtained by the NTSB Medical Officer.

The investigation did not definitively identify the post-accident locational circumstance(s) of the male passenger decedent (i.e., where he was found, and corresponding extrication from the railcar). This person was transported by helicopter to University Hospital – University of Missouri Health Care. The autopsy cause of death for this person was blunt force trauma to the thorax.[60]

Male Truck Driver Decedent

See Highway / Vehicle Factors - Factual Report, and Medical Specialist - Factual Report, for further information.

E. **Authorship**[61]

Compiled by: // s // Date Dec. 13, 2022
Richard M. Downs, Jr., P.E.
Mechanical Engineer (Crashworthiness)
Crashworthiness – Technical Working Group Chairperson
System Safety Division (RPH-40)

Supervisory review: // s // Date Nov. 02, 2022
Robert J. Beaton, Ph.D., CPE
Chief, System Safety Division (RPH-40)

List of Exhibits

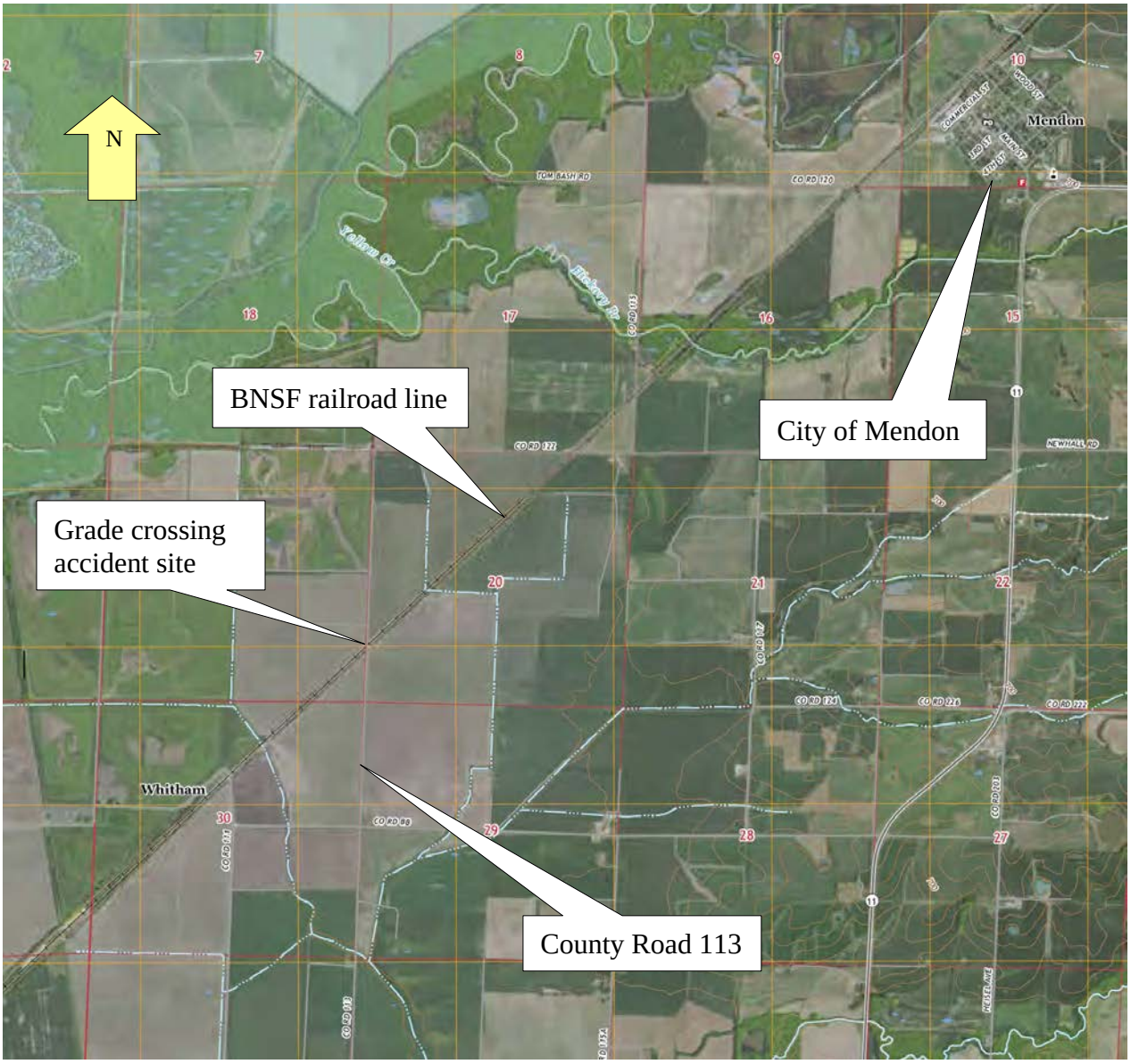
1. Annotated segment of a USGS topographic (survey) map
2. Summarized technical specifications of the Amtrak train equipment
3. Engineering diagrams of the passenger railcars
4. Pre-recovery Railroad Equipment Examination – Summarized Damage Characterization
5. Pre-recovery Highway Vehicle Examination – Summarized Damage Characterization
6. Annotated Aerial Imagery of the Wreckage Debris Field
7. Post-recovery Baggage Car / Passenger Cars Examination – Summarized Damage Characterization

– End of Exhibits List –

[60] Ibid – see Footnote 59.

[61] NTSB Medical Officer, Dr. Turan Kayagil, additionally provided direct support to the Crashworthiness Technical Working Group investigation, as correspondingly cited in this report.

Exhibit 1. Annotated Segment of USGS Topographic (Survey) Map, Proximate to Accident Site[1, 2]



[1] Excerpt from United States Geological Survey (USGS) topographic survey map, [Quadrangle map ref] Mendon, MO, [dated] 2021 (7.5 Minute Series, original scale 1:24,000); ref, and for further information, see [Internet] https://ngmdb.usgs.gov.

[2] Annotation by NTSB (Crashworthiness Group Chairperson) to describe approximate accident site location.

Exhibit 2. Amtrak Train 4 (25) – Consist List, and Select Technical Specifications[1]

Select abbreviations and acronym nomenclature used in this Exhibit

~ approximate, or approximately
AAR Association of American Railroads
CFR Code of Federal Regulations [context of FRA regulation]
ft feet [dimension]
Ref reference, or in reference to
Seq. Sequence (number, in the train Consist)

Seq.	Equipment type	Amtrak Road Number	Manufacturer – model / built date	Configuration / Operational Feature(s) / other considerations	Length	Weight (lbs.) [2]	Regulation / Standard (FRA / AAR)
1	Locomotive	133	GE [3] – P42DC / Dec 2000	Cab occupied [only] by train operator / engineer	69 ft 0 inch	268,000	49 CFR Part 229, Subpart D
2	Locomotive	166	GE [4] – P42DC / May 2001	Unoccupied operator's cab	69 ft 0 inch	268,000	49 CFR Part 229, Subpart D

[1] Source: description of the accident train was sourced to observations by NTSB investigative staff (during, and subsequent to the on-scene phase of the investigation), and data as made available to the investigation by Amtrak, and as further described.

[2] Locomotive weight cited per manufacturer's specification ['builders' plate']. Passenger railcar weight cited for both the unloaded and loaded configuration, except as noted.

[3] GE Transportation Systems, with corporate offices and manufacturing facility located in Erie, PA; the company currently is a division of [owned by] Wabtec Corporation; ref, and further information, see [Internet] https://www.wabteccorp.com/locomotive.

[4] Ibid – see Footnote 3.

3	Baggage	61053	CAF [5] – Viewliner II / Aug 2015	Unoccupied / baggage only	85 ft 4 inch	119,000 ['dry'/ empty] [6]	49 CFR Part 238
4	Transition Sleeper	39045	Bombardier [7] – Superliner II / July 1996	Principally a non-revenue railcar used by train crewmembers while performing their duties (i.e., provides sleeping rooms, operational supplies storage, and office accommodations for train crewmembers during a trip), in which some rooms (not in use by train crew) are available for use by revenue passengers. In Train 4 (25), the first 8 sleeping rooms at the aft-end of the car were in revenue [passenger] use. The car can accommodate a maximum of 41 occupants (passengers + crew). Floorplan arrangement is similar to Superliner II sleeper cars (as further described in this Tabulation). Car can accommodate 31 persons upper level, 10 persons lower level,	85 ft 0 inch	156,085 170,355 loaded	AAR S-034-69

[5] CAF, i.e., Construcciones y Auxiliar de Ferrocarriles, S.A., located in Guipúzcoa, Spain, in which the railcar construction occurred at a manufacturing facility in Elmira, NY; ref, and further information, see [Internet] https://www.caf.net/en/ soluciones/proyectos/index.php.

[6] Baggage car [estimate of] 'loaded' weight was not available.

[7] Bombardier Transportation was a rolling stock manufacturer, with manufacturing operations located in Plattsburgh, NY, which was acquired by Alstom SA, which is located in Saint-Ouen-sur-Seine, France; ref, and further information, see [Internet] https://www.alstom.com/solutions/rolling-stock.

				totaling 41 occupants [passengers / crew] (max). Generally described, the 4 Captain's chairs, which are fitted to the [lower level] crew area, are generally removed. Each compartment (i.e., roomettes, etc.) has a two-piece [sidewall] window, with each window measuring 24 inches [height] by 66 inches [overall length]. The car is also fitted with smaller, square-shaped windows, measuring 24 inches by 24 inches. A staircase is provided at one end of the car, to provide access from the upper level of the railcar, to the lower level end-door of the railcar.			
5	Sleeper	32104	Bombardier [8] – Superliner II / July 1994	Car fitted with sleeping rooms (compartments), consisting of 14 roomettes, 5 bedrooms on the upper level, and a family bedroom, and an ADA accessible lavatory on the lower level. Car can accommodate 44 passengers (max).	85 ft 0 inch	160,275 172,605 loaded	AAR S-034-69

[8] Ibid [see footnote 7].

				Each compartment (i.e., roomettes, etc.) has a two-piece [sidewall] window, with each window measuring 24 inches [height] by 66 inches [overall length]. The car is also fitted with smaller, square-shaped windows, measuring 24 inches by 24 inches.			
6	Diner	38060	Bombardier [9] – Superliner II / July 1995	A dining area, fitted with 18 fixed-in-place dining tables that can seat 4 occupants per table, comprises most of the upper level, and a 'galley' (kitchen / food preparation area / food storage lockers) comprises the lower level (usually limited to Amtrak staff). Car can accommodate (seat) 72 passengers at the dining tables. Each dining table location has a two-piece [sidewall] window, with each window measuring 24 inches [height] by 66 inches [overall length]. There are no [sidewall] windows on the lower level of the car (kitchen / food preparation area).	85 ft 0 inch	158,070 175,260 loaded	AAR S-034-69

[9] Ibid – see Footnote 7.

7	Lounge	33046	Bombardier [10] – Superliner II / July 1995	Car does not fill a role as a Coach car, and contains no revenue seating. The floorplan arrangement of the upper level consists of three seating configurations: - one end of the car is fitted with 8 fixed-in-place dining tables, as situated on either side of the center aisle, each table able to seat 4 occupants (32 passengers), - the center of the car is fitted with a lounge area, as situated on either side of the center aisle, comprised of the staircase, a wet bar, and a group of 15 seats which are facing the [sidewall] windows of the car (15 passengers) , - the other end of the car is fitted with 14 swivel chairs, as situated on either side of the center aisle, which are facing the [sidewall] windows of the car (14 passengers). The floorplan arrangement of the lower level consists of a lavatory, 2 ADA tables able to seta 4 occupants, and 1 wheelchair or 5 occupants (i.e., 10 passengers, total), 2 fixed-in-place	85 ft 0 inch	151,235 176,522 loaded	AAR S-034-69

[10] Ibid – see Footnote 7

				dining tables, each table able to seat 4 occupants (8 passengers), and a café area, all as situated on either side of the center aisle. Passenger seating capacity: Upper level: 61 seats Lower level: 18 seats Generally described, each seating area has an arrangement of [sidewall] windows as configured in the [conventional] Superliner coach cars, comprised of a two-piece window [panel], with each window measuring 24 inches [height] by 66 inches [overall length]. The car is also configured with additional 'curved' windows that are fitted to the top segment of the carbody sidewall [structure], which 'wrap upward' into the ceiling [roof plane] of the carbody (such to accommodate the [upper level] car occupants, in their having [essentially] an unobstructed view of passing scenery of the train trip). The car is also fitted with smaller, square-shaped windows, measuring 24 inches by 24 inches.			

8	Coach	34026	Pullman Standard [11] – Superliner I / July 1979	Seating in a [so-called] "2 + 2 configuration", with two passenger seats situated on either side of the center aisle on the upper-level, with additional seating and an ADA accommodations area, and lavatory facilities, on the lower-level. Passenger seating capacity: Upper level: 62 seats Lower level: 12 seats Each seat row has a two-piece [sidewall] window, with each window measuring 24 inches [height] by 66 inches [overall length]. The car is also fitted with smaller, square-shaped windows, measuring 24 inches by 24 inches.	85 ft 0 inch	157,000 171,640 loaded	AAR S-034-69
9	Coach-baggage	31029	Pullman Standard [12] – Superliner I / July 1980	Seating in a [so-called] "2 + 2 configuration", with two passenger seats situated on either side of the center aisle of the upper-level, with additional seating and an ADA accommodations area, and baggage storage and lavatory facilities, on the lower-level.	85 ft 0 inch	147,500 167,959 loaded	AAR S-034-69

[11] Pullman Standard was a rolling stock manufacturer, with headquarters located in Chicago, IL, which terminated operations in 1968, the assets of which were [eventually] acquired by Bombardier Transportation, which was further acquired by Alstom SA; ref, and further information, see [Internet] https://www.alstom.com/solutions/rolling-stock

[12] Ibid – see Footnote 11.

				Passenger seating capacity: Upper level: 62 seats Lower level: no seats Each seat row has a two-piece [sidewall] window, with each window measuring 24 inches [height] by 66 inches [overall length].			
10	Coach	34102	Bombardier [13] – Superliner II / July 1995	Seating in a [so-called] "2 + 2 configuration", with two passenger seats situated on either side of the center aisle of the upper-level, with additional seating and an ADA accommodations area, and lavatory facilities, on the lower-level. Passenger seating capacity: Upper level: 62 seats Lower level: 12 seats Each seat row has a two-piece [sidewall] window, with each window measuring 24 inches [height] by 66 inches [overall length]. The car is also fitted with smaller, square-shaped windows, measuring 24 inches by 24 inches.	85 ft 0 inch	151,235 171,640 loaded	AAR S-034-69
					Total length:	Total Weight, 'Loaded'	

[13] Ibid – see Footnote 7.

					~ 818 feet	Consist[14]: ~ 1.861 x 10^6 lbs., ≈ 930 tons	

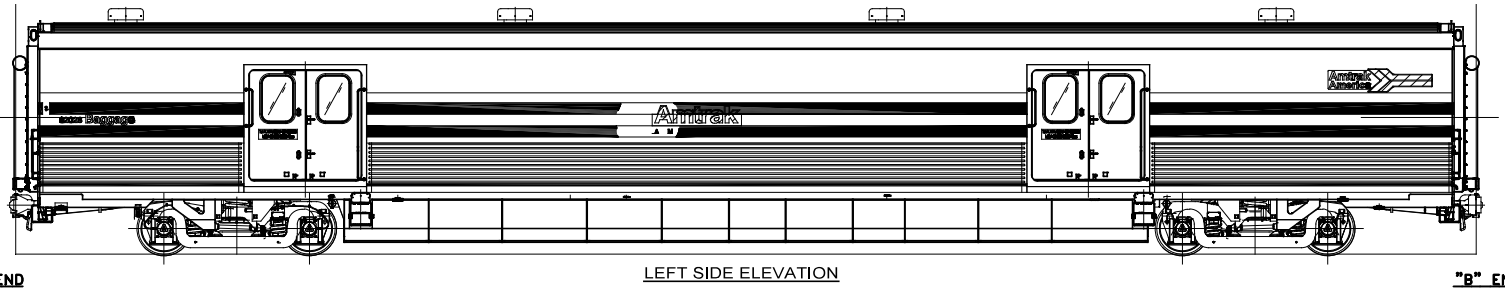
-- End of Exhibit --

[14] Note – Baggage car 61053 empty weight utilized ≈ 119,000 lbs., in which a loaded weight was not available.

Exhibit 3.

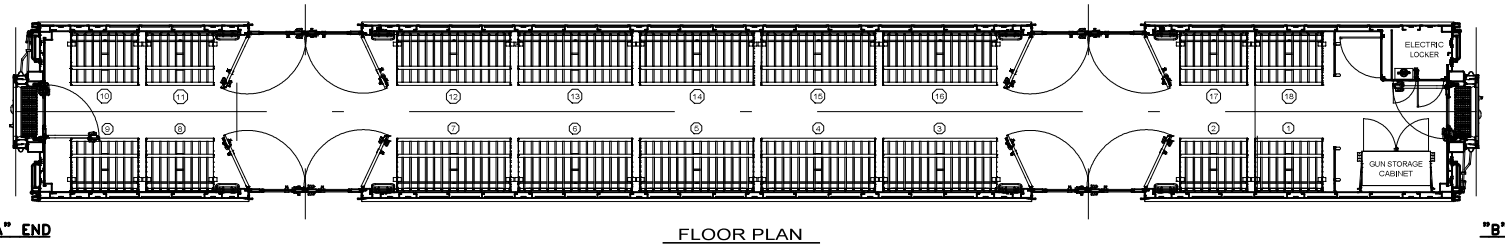
Engineering Diagrams of the Passenger Railcars of Amtrak Train No. 4 (25)

61053



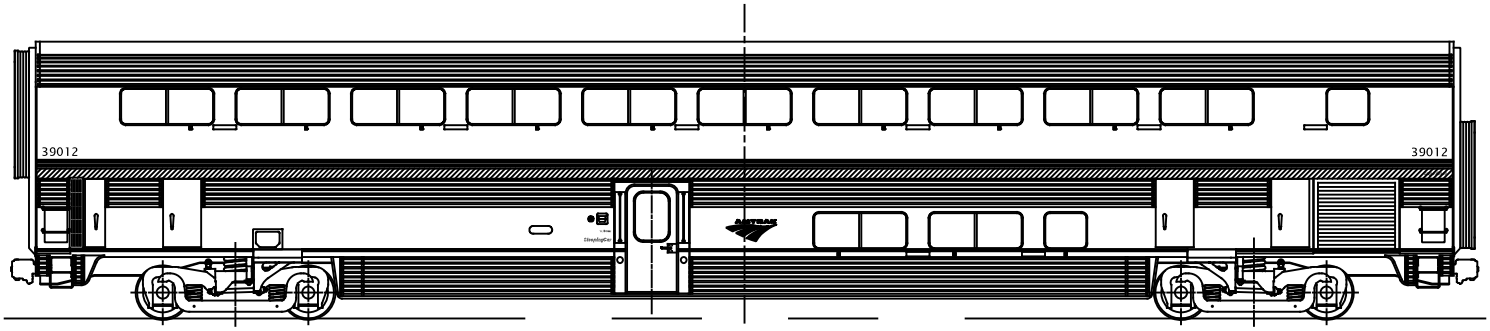
"A" END — LEFT SIDE ELEVATION — "B" END

"B" END — RIGHT SIDE ELEVATION (ROTATED 180°) — "A" END



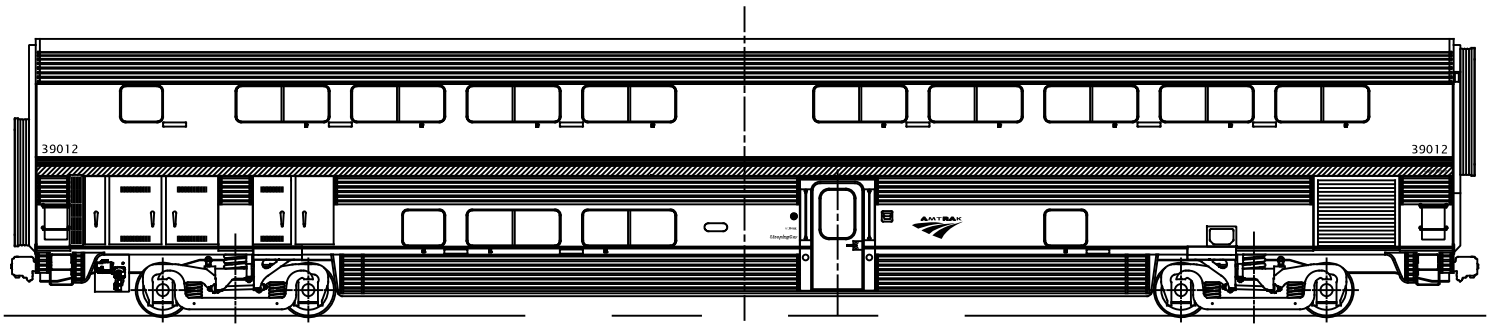
"A" END — FLOOR PLAN — "B" END

39045



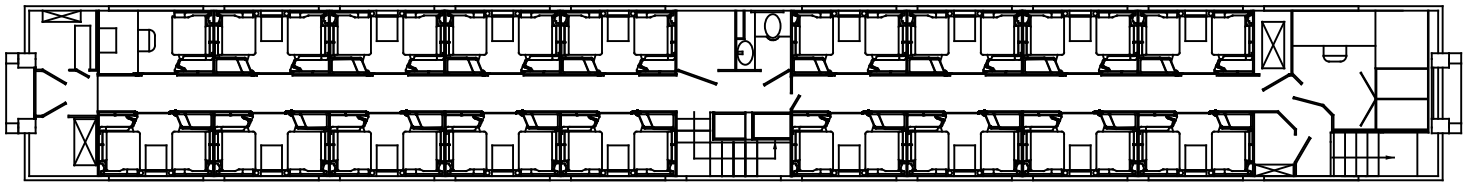
"A" END

"B" END



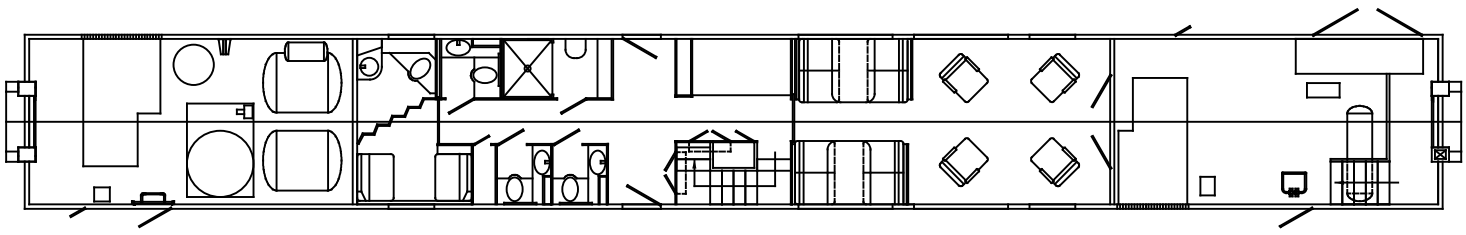
"B" END

"A" END

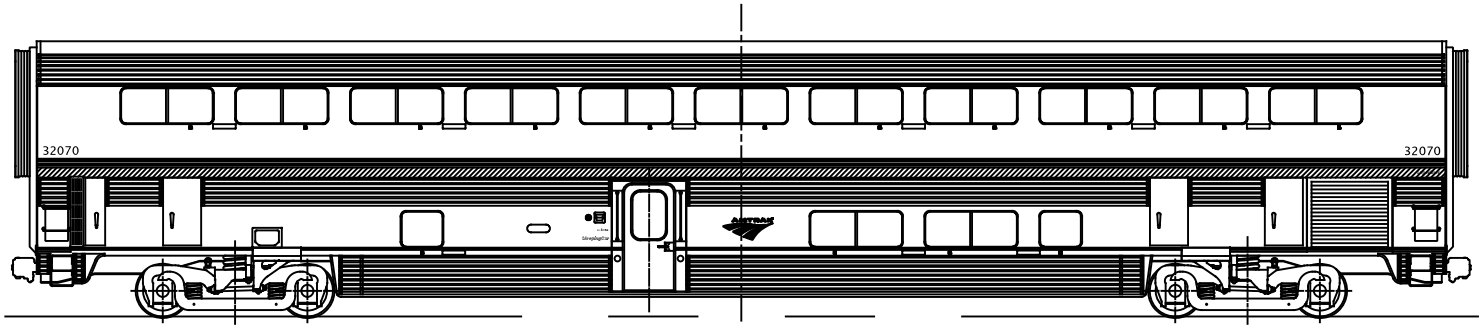


"A" END

"B" END

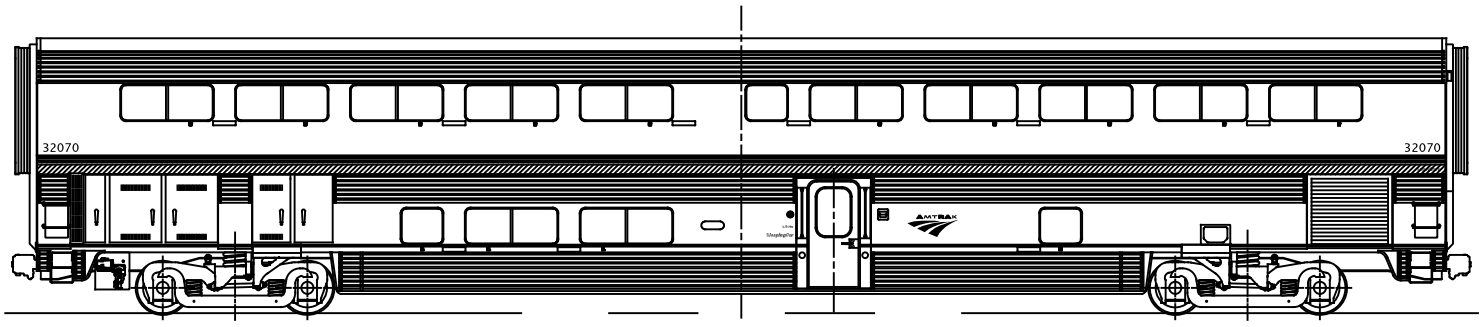


32104



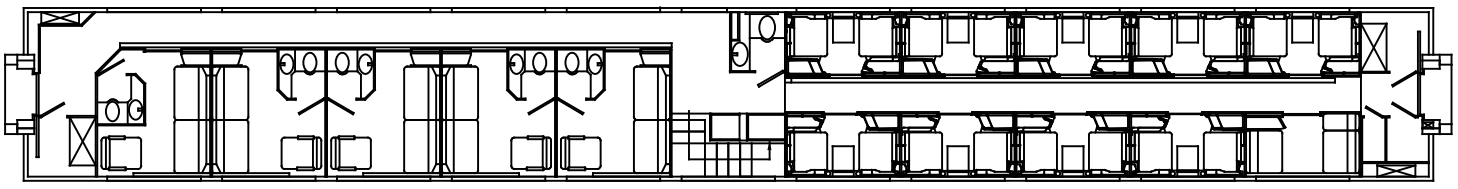
"A" END

"B" END



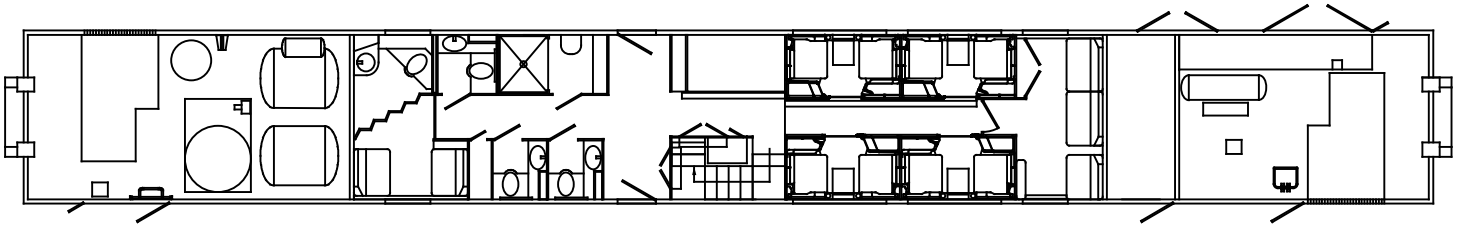
"B" END

"A" END

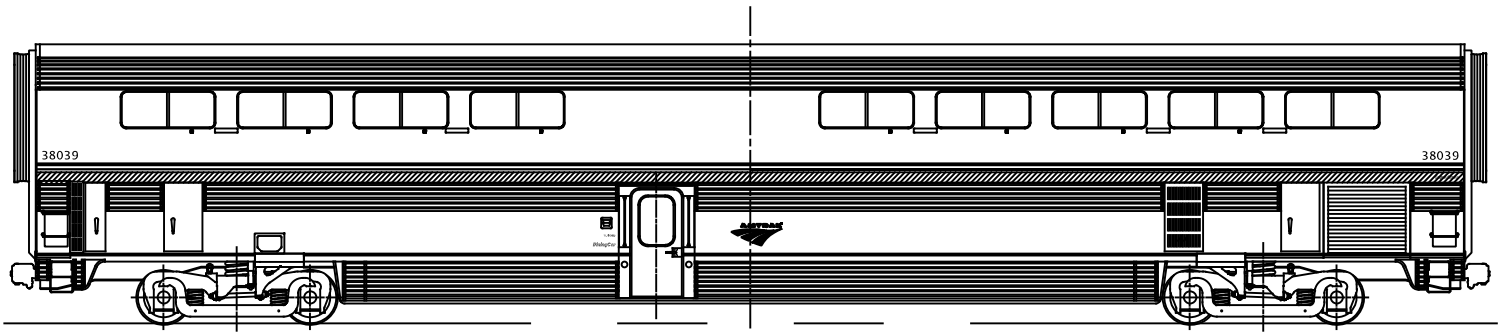


"A" END

"B" END

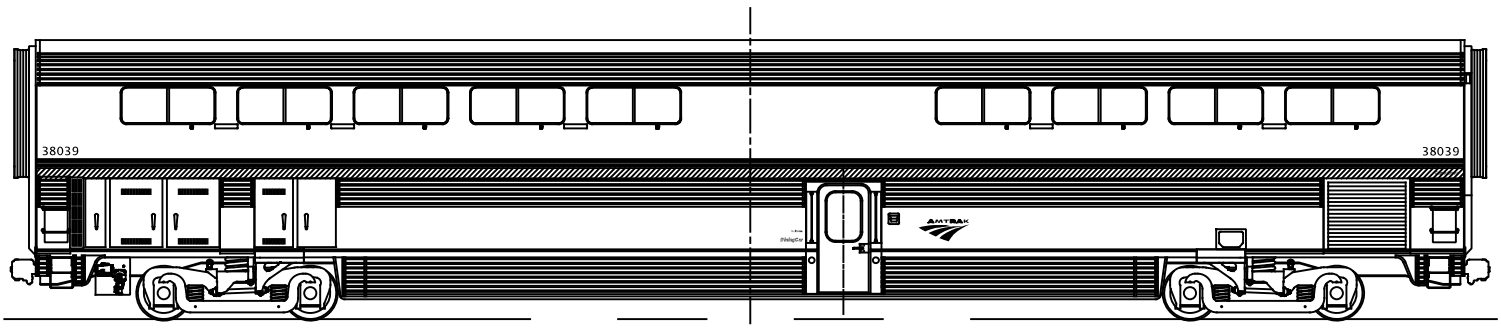


38060



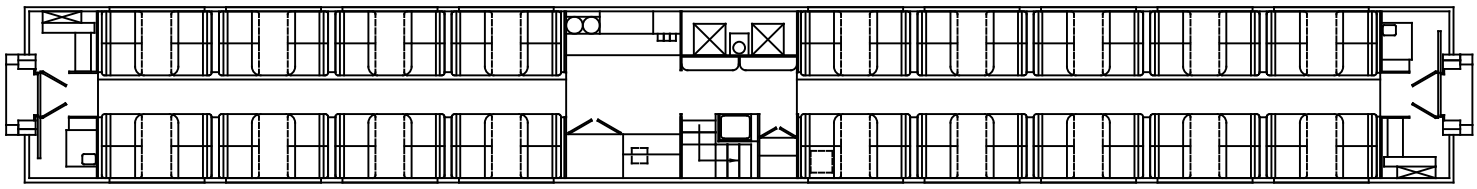
"A" END

"B" END



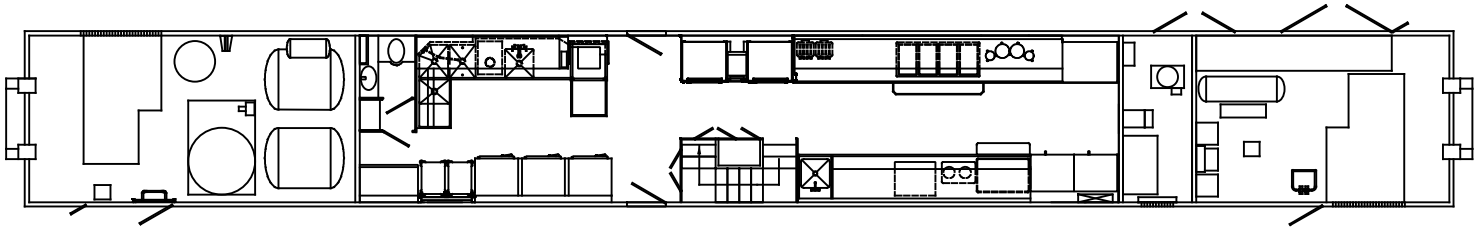
"B" END

"A" END

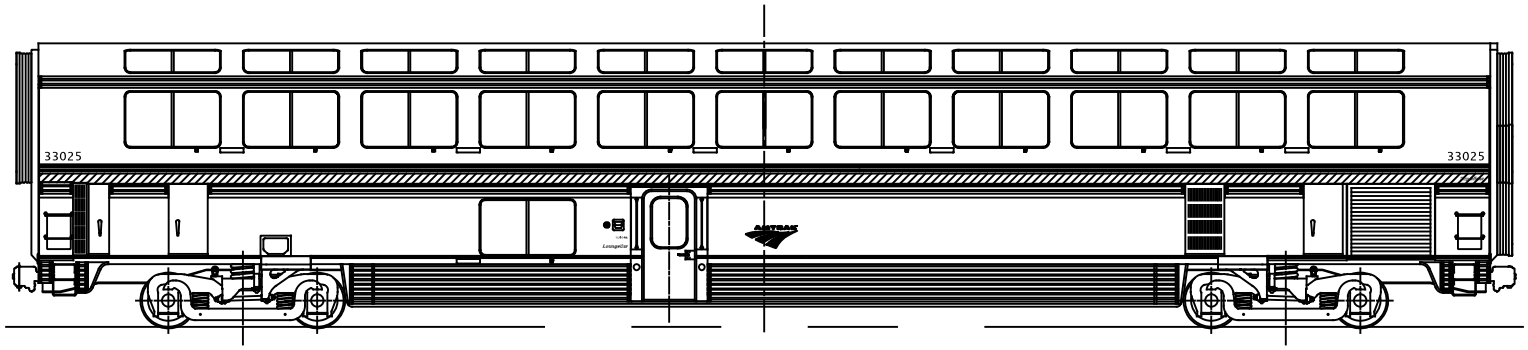


"A" END

"B" END

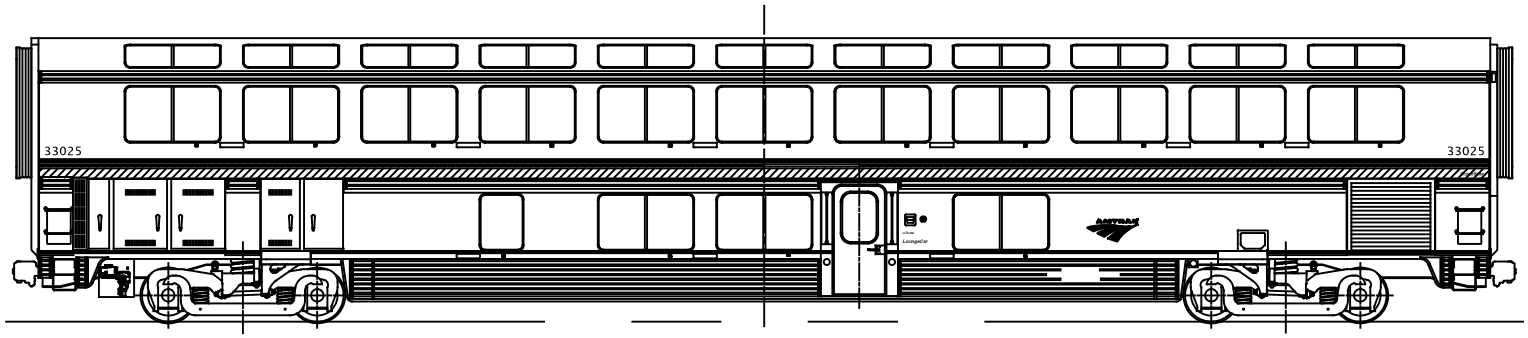


33046



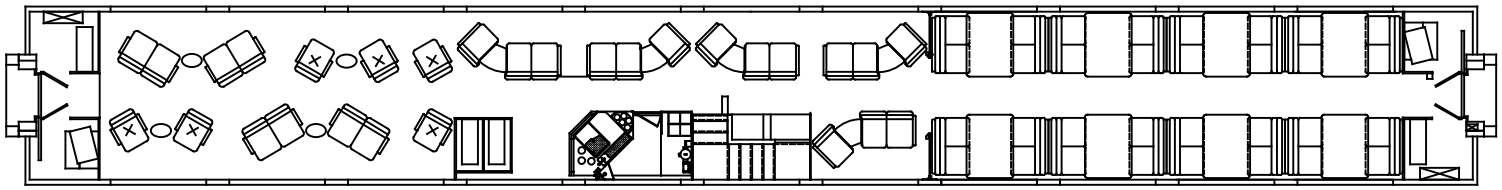
"A" END

"B" END



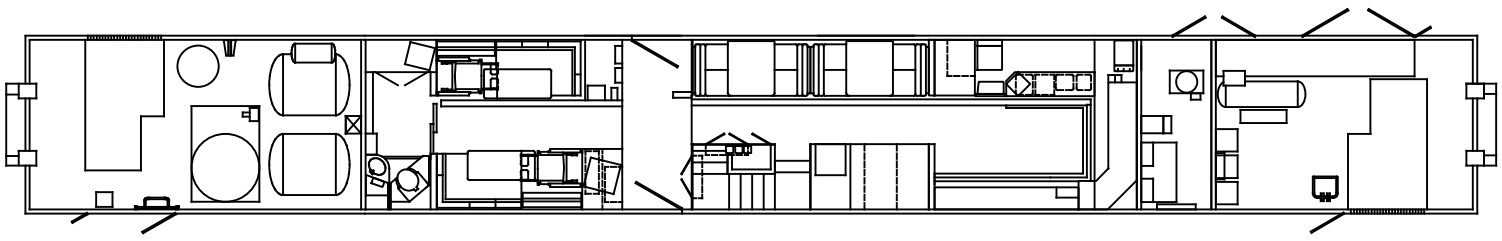
"B" END

"A" END

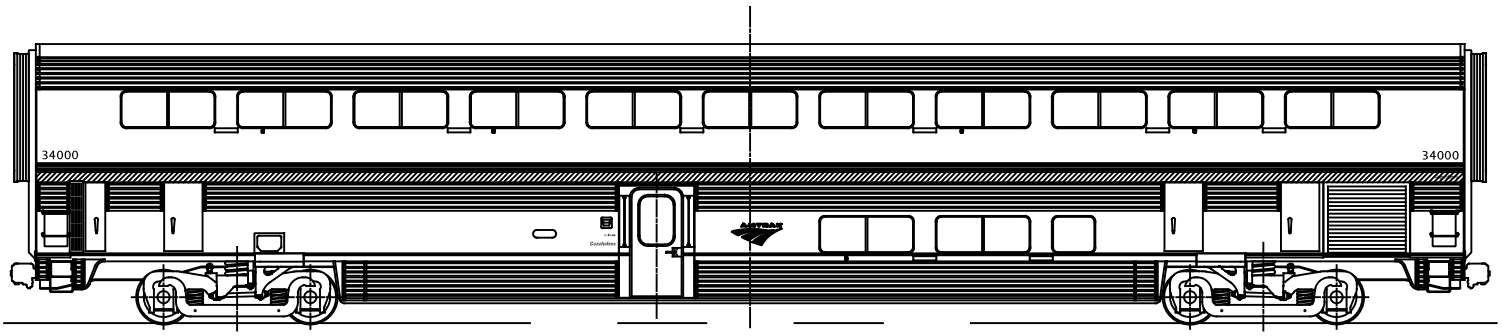


"A" END

"B" END

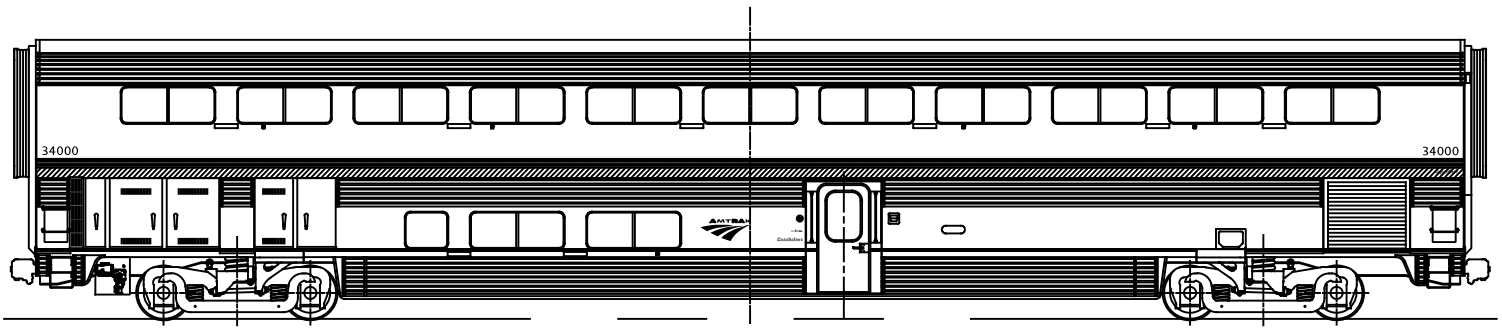


34026



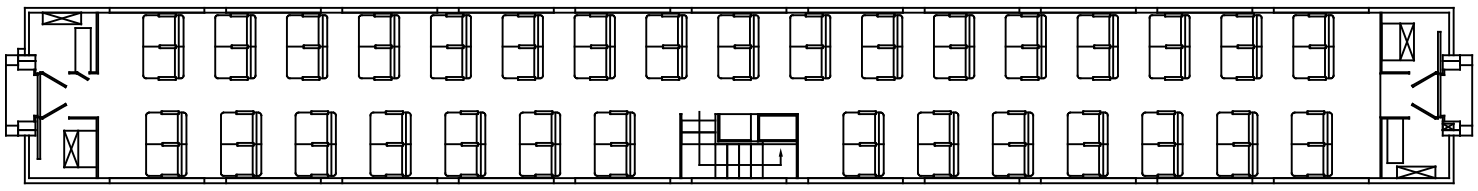
"A" END

"B" END



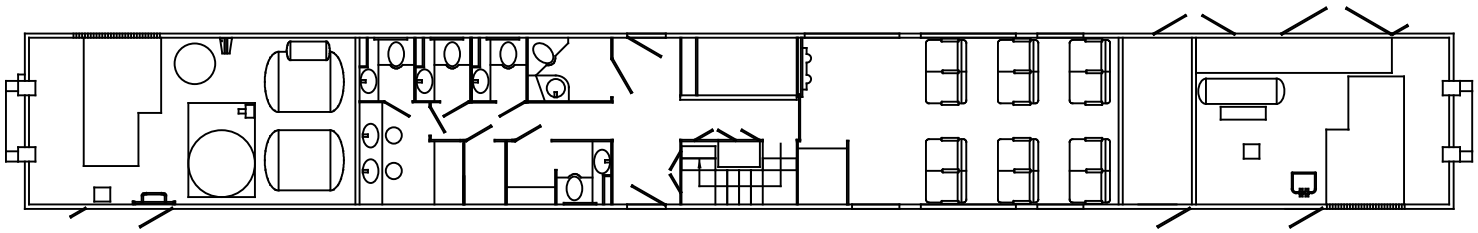
"B" END

"A" END

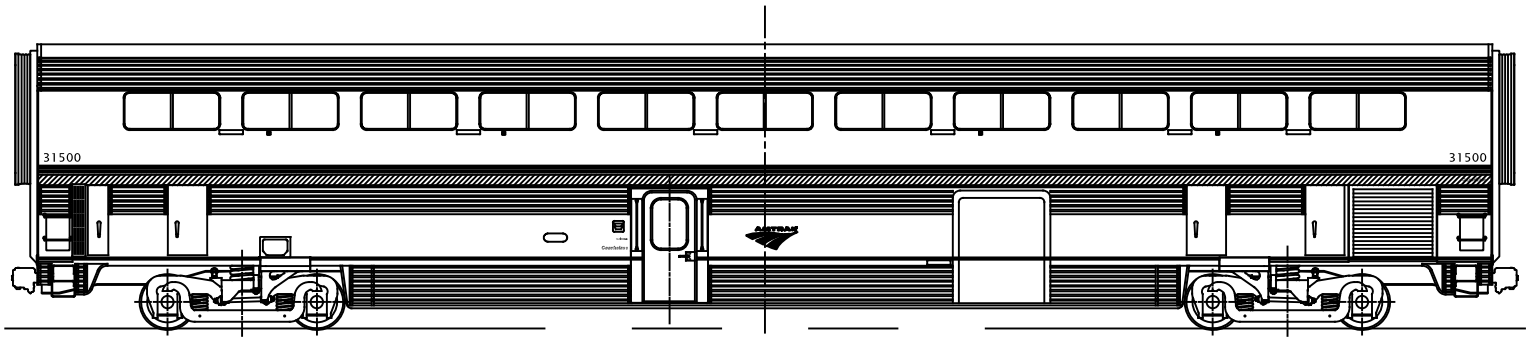


"A" END

"B" END

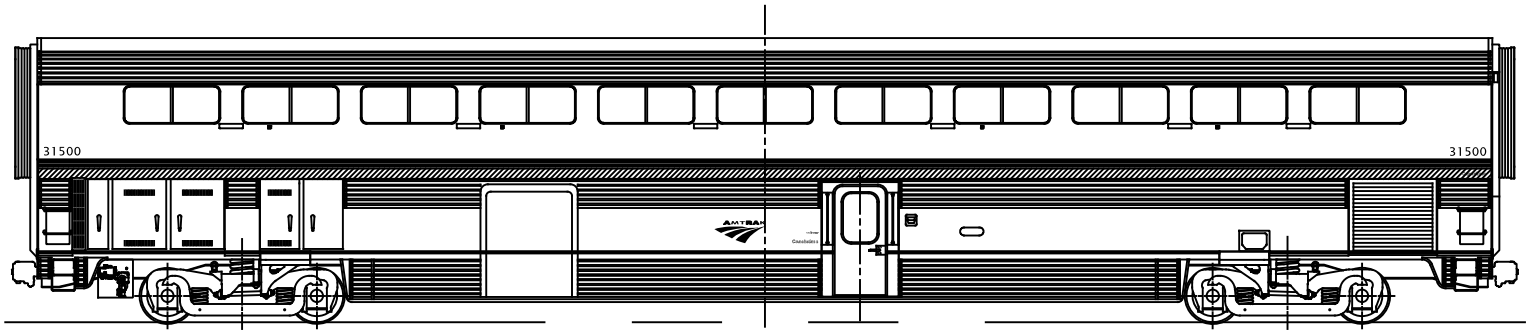


31029



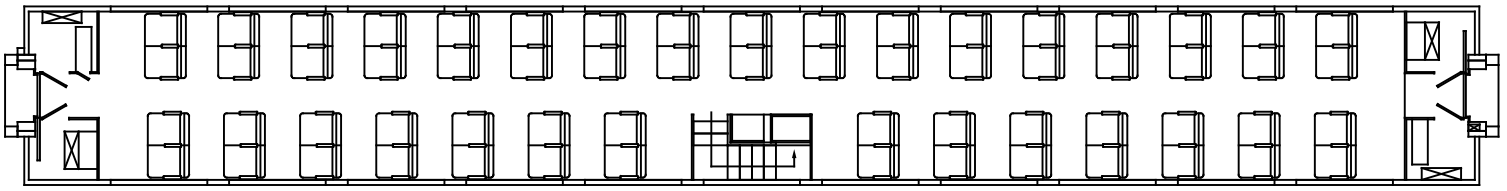
"A" END

"B" END



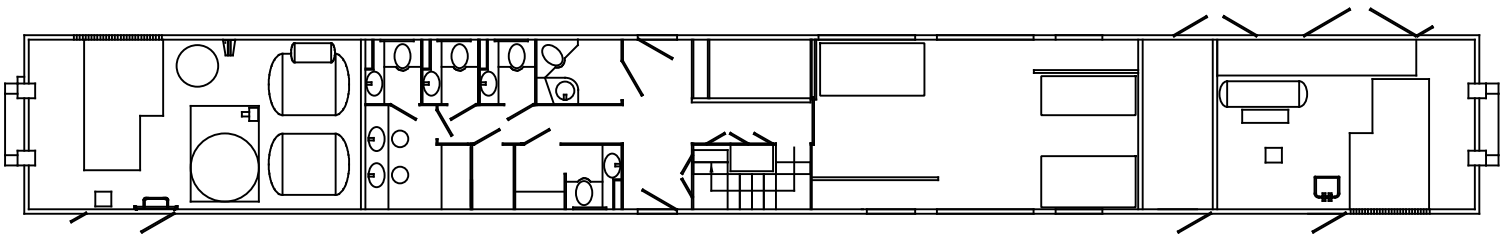
"B" END

"A" END

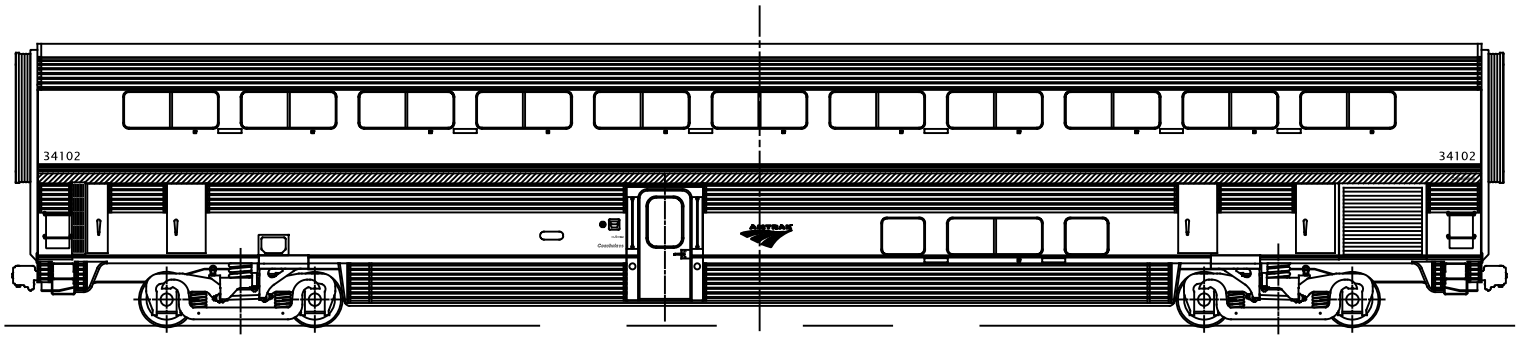


"A" END

"B" END

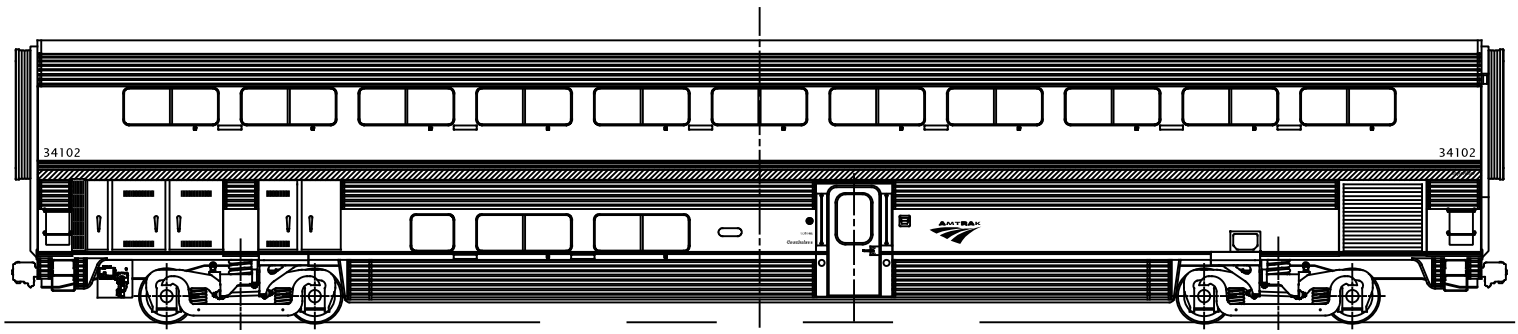


34102



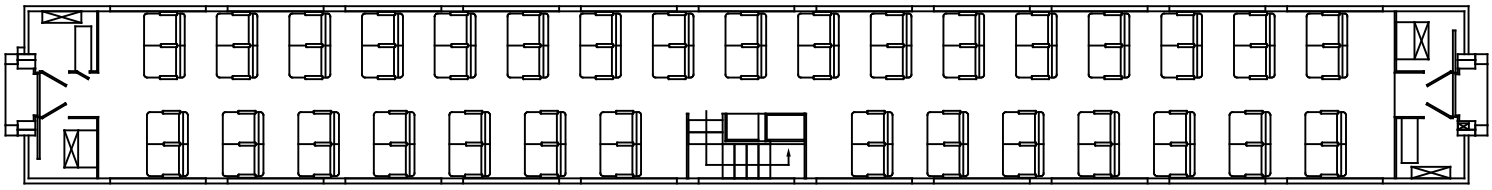
"A" END

"B" END



"B" END

"A" END



"A" END

"B" END

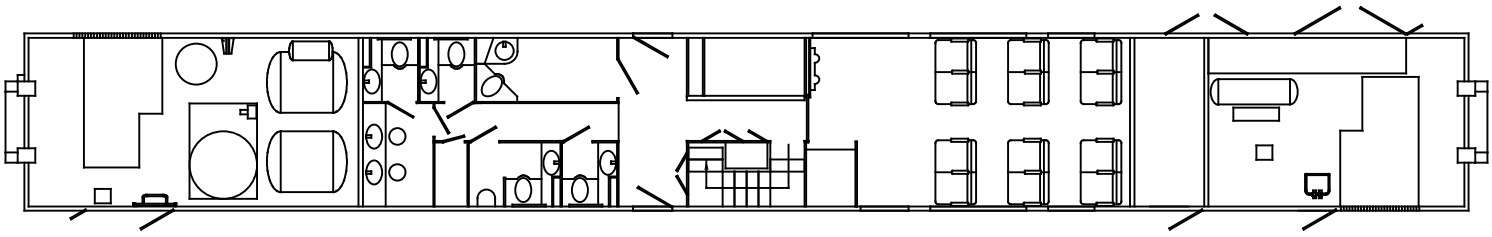


Exhibit 4. Pre-Recovery Railroad Equipment Examination

Notes of this Exhibit –

- left and right locational reference indicators are relative to the forward direction of travel (of the train).
- the FRA Forensic Team includes members of the FRA [on-scene] staff, and members of the field investigation team of the Volpe National Transportation Systems Center.

Tabulation of Summarized Damage Characterization

Seq.	Equipment type	Amtrak Road Number	Summarized Damage Characterization[1]	Source[2]
1	Locomotive	133	Operator's Cab was oriented at the 'front end' of the [locomotive] unit. Operator's Cab was occupied only by the locomotive operator / engineer (at the time of the accident). Leading end of this [locomotive] unit came to rest about 1,286 feet to the east of the grade crossing. [Locomotive] unit came to rest upright (i.e., essentially in a vertical orientation). Only # 2 axle of lead truck assembly derailed. Left side of front bulkhead structure sustained collision impact damage, but remained essentially intact (i.e., no substantial front bulkhead breach was visually apparent). Snowplow assembly and associated structural elements, located beneath front bulkhead structure, sustained substantial collision impact damage.	NTSB

[1] Examination conducted by the Crashworthiness Technical Working Group on June 28, 2022.

[2] Examination data source(s): NTSB = Crashworthiness - Technical Working Group Chairperson, FRA Forensic Team = FRA designated participant of Crashworthiness - Group, which would include participants of the Volpe Center Investigation Response Team (Volpe), Amtrak = Amtrak designated participant of Crashworthiness - Group

			Operator's cab left windshield panel was fractured, but not breached. Otherwise, no damage was observed to have been sustained to the Operator's Cab of this [locomotive] unit (i.e., the structural integrity of the Operator's Cab did not appear to be compromised.) Missing side-panel cover on left side of carbody, immediately preceding left side Cab entrance-door. No fuel leak [from the fuel tank areas of the unit] observed. No examination of the engine compartment was conducted.[3] [Locomotive] unit carbody appeared otherwise undamaged. The coupler at the trailing end of this [locomotive] unit remained coupled to the adjoining locomotive. ---------- Plow deformed down and under. Coupler intact but coupler lever broken. Superficial damage to front hood shell. No visible damage to collision posts. No intrusion into cab compartment. Examination of cab interior identified: - No damage to locomotive cab. - Lower door panel under operator's console askew.	------ FRA / Volpe
2	Locomotive	166	Operator's Cab was oriented at the 'front end' of the [locomotive] unit. Operator's Cab was vacant [unoccupied] at the time of the accident.	NTSB

[3] An examination of the engine compartment, and related equipment areas, was deemed unnecessary by the Crashworthiness investigation, given the degree of observed damage sustained by this locomotive unit.

			[Locomotive] unit came to rest leaning about 10º to the right [4] (i.e., relative to a 'vertical' [0º lean] orientation). Examination comprised only an inspection of the [locomotive] unit exterior surface elements (i.e., no Operator's Cab, or engine compartment examination).[5] The couplers, at both the leading end, and at the trailing end, of this [locomotive] unit remained coupled to the respective adjoining locomotive / railcar. ---------- Positioned at approximately 15-degree tilt relative to the locomotive. No significant damage observed.	------ FRA / Volpe
3	Baggage	61053	Railcar carbody came to rest leaning about 45º to the right [6] (i.e., relative to a 'vertical' [0º lean] orientation). Examination comprised only an inspection of the exterior surface elements (i.e., no interior examination).[7] The couplers, at both the leading end, and at the trailing end, of this railcar remained coupled to the respective adjoining railcars. No apparent [visible] damage sustained to roof of the railcar.[8]	NTSB
4	Transition Sleeper	39045	Railcar carbody came to rest fully on its right sidewall panel surface.	NTSB

[4] i.e., as visually estimated during the examination activity.

[5] An examination beyond what was conducted was deemed unnecessary by the Crashworthiness investigation, given the degree of observed damage sustained by this locomotive unit, and the consideration that this locomotive unit was unoccupied at the time of the accident (i.e., a Crashworthiness investigation typically does not focus resources on examination of unoccupied railroad motive power [locomotives] or rolling stock [passenger railcar] equipment, unless prospective data attained is supportive to evaluation of other aspects of the investigation).

[6] i.e., as visually estimated during the examination activity.

[7] Given the consideration that this railcar was unoccupied [at the time of the accident], and that a post-recovery examination would be subsequently conducted, examination beyond what was conducted was deemed unnecessary by the investigation. See also Footnote 5.

[8] Given that the railcar was tilted / fully on its sidewall panel, this allowed the roof segment of the railcar to be visually assessed for damage.

			No visibly apparent damage was evident on the exposed, bottom panel of this railcar. Given considerations of safety / inability of access, no interior pre-recovery examination of this railcar was conducted.[9] The couplers, at both the leading end, and at the trailing end, of this railcar remained coupled to the respective adjoining railcars. No apparent [visible] damage sustained to roof of the railcar.[10]	
5	Sleeper	32104	Railcar carbody came to rest fully on its right sidewall panel surface. No visibly apparent damage was evident on the exposed, bottom panel of this railcar. Given considerations of safety / inability of access, no interior pre-recovery examination of this railcar was conducted.[11] The couplers, at both the leading end, and at the trailing end, of this railcar remained coupled to the respective adjoining railcars. No apparent [visible] damage sustained to roof of the railcar.[12] ---------- Equalizer beams [later determined to belong to this railcar], [which had] separated from trucks [of this railcar, were] found along the cornfield ditch … alongside passenger car #34026.	NTSB --- FRA / Volpe
6	Diner	38060	Railcar carbody came to rest fully on its right sidewall panel surface. No visibly apparent damage was evident on the exposed, bottom panel of this railcar.	NTSB

[9] As a measure of time-resource conservation, field investigations must prudently utilize the time available to conduct equipment examination(s) in a time-efficient manner, focusing on inspection of perishable evidence, to which, in consideration that a post-recovery examination of this railcar will be later accommodated by the railroad (in the next day, or do), further examination of this railcar was deferred until the post-recovery examination.

[10] Given that the railcar was tilted / fully on its sidewall panel, this allowed the roof segment of the railcar to be visually assessed for damage.

[11] Ibid – see Footnote 9.

[12] Given that the railcar was tilted / fully on its sidewall panel, this allowed the roof segment of the railcar to be visually assessed for damage.

			Given considerations of safety / inability of access, no interior pre-recovery examination of this railcar was conducted.[13] The couplers, at both the leading end, and at the trailing end, of this railcar remained coupled to the respective adjoining railcars. No apparent [visible] damage sustained to roof of the railcar.[14]	
7	Lounge	33046	Railcar carbody came to rest fully on its right sidewall panel surface. Given considerations of safety / limited ability of access[15], a concise / succinct pre-recovery interior examination was conducted, which identified the following observations / characteristics. Upper level: - 1-window, on the 'down' side of the railcar (i.e., the carbody side-panel that came to rest on the track ballast / soil), sustained impact damage, but no track ballast incursion into the interior. - Many personal artifacts were scattered about the railcar interior. - Possible blood trauma was observed at several locations. - Volpe Center response team documented the interior in detail. Lower level: examination deferred until the railcar was upright (post-recovery). No visibly apparent damage was evident on the exposed, bottom panel of this railcar. The couplers, at both the leading end, and at the trailing end, of this railcar remained coupled to the respective adjoining railcars.	NTSB

[13] Ibid – see Footnote 9.

[14] Given that the railcar was tilted / fully on its sidewall panel, this allowed the roof segment of the railcar to be visually assessed for damage.

[15] Access to the interior of this railcar was accommodated by use of a portable ladder that was placed against the railcar undercarriage (as the railcar was lying on its right sidewall panel), which accommodated access to the left sidewall panel (which, as the railcar was lying on its right sidewall panel, had [temporarily] become the 'top' of the railcar), in which another ladder was placed through one of the opened ('pulled') sidewall panel windows, which allowed access down into the carbody interior.

			No apparent [visible] damage sustained to roof of the railcar.[16] --- Given considerations of safety / limited ability of access (as addressed / described by NTSB, above), a concise / succinct pre-recovery interior examination was conducted, which identified the following observation(s) / characteristic(s). Lower level: On the "down" side, at least two windows visibly dislodged, and side door deformed inward allowing 1-4 feet of mud and debris to be piled into the car.	--- FRA / Volpe
8	Coach	34026	Railcar carbody came to rest fully on its right sidewall panel surface. Given considerations of safety / limited ability of access[17], a concise / succinct pre-recovery interior examination was conducted, which identified the following observations / characteristics. Upper level: - No breached windows were observed on the 'down' side of the railcar (i.e., the carbody side-panel that came to rest on the track ballast / soil). - Many personal artifacts were scattered about the railcar interior. - Several 'pulled' emergency windows were observed. - Volpe Center response team documented the interior in detail. Lower level: examination deferred until the railcar was upright (post-recovery). No visibly apparent damage was evident on the exposed, bottom panel of this railcar. The couplers, at both the leading end, and at the trailing end, of this railcar remained coupled to the respective adjoining railcars.	NTSB

[16] Given that the railcar was tilted / fully on its sidewall panel, this allowed the roof segment of the railcar to be visually assessed for damage.

[17] Ibid – see Footnote 15.

			No apparent [visible] damage sustained to roof of the railcar.[18]	
9	Coach-baggage	31029	Railcar carbody came to rest fully on its right sidewall panel surface. No visibly apparent damage was evident on the exposed, bottom panel of this railcar. Given considerations of safety / inability of access, no interior pre-recovery examination of this railcar was conducted.[19] The couplers, at both the leading end, and at the trailing end, of this railcar remained coupled to the respective adjoining railcars. No apparent [visible] damage sustained to roof of the railcar.[20]	NTSB
10	Coach	34102	Railcar carbody came to rest fully on its right sidewall panel surface. No visibly apparent damage was evident on the exposed, bottom panel of this railcar. Given considerations of safety / inability of access, no interior pre-recovery examination of this railcar was conducted.[21] The coupler at the leading end of this railcar remained coupled to the preceding railcar. No apparent [visible] damage sustained to roof of the railcar.[22]	NTSB

-- End of Exhibit --

[18] Given that the railcar was tilted / fully on its sidewall panel, this allowed the roof segment of the railcar to be visually assessed for damage.

[19] Ibid – see Footnote 9.

[20] Given that the railcar was tilted / fully on its sidewall panel, this allowed the roof segment of the railcar to be visually assessed for damage.

[21] Ibid – see Footnote 9.

[22] Given that the railcar was tilted / fully on its sidewall panel, this allowed the roof segment of the railcar to be visually assessed for damage.

Exhibit 5. Pre-Recovery Highway Equipment Examination

Equipment type	Summarized Damage Characterization[1, 2]	Source[3]
Dump truck	The wreckage of this vehicle came to rest in an open-area location, a short distance to the approximate northeast of the grade crossing. The vehicle wreckage exhibited extensive collision impact damage, in which the cab elements, and the open box bed elements of the vehicle, each had individually separated from the vehicle chassis (i.e., the engine and frame-rail assembly). The vehicle chassis came to rest in an upright orientation (i.e., the wheels were resting on the ground), in which the open box bed element came to rest in an inverted (overturned) orientation. One of the axle-assembly sets (comprised of an axle and wheels) had separated from the [dump truck] vehicle, in which it came to rest on the railroad Right-of-Way, on the north side of Main Track # 1, a distance east of the grade crossing (i.e., this axle-assembly set was a short distance to the west of where the aft end of Amtrak railcar 34102 [the last railcar in the train Consist] came to rest).	NTSB

-- End of Exhibit --

[1] Examination conducted by the Crashworthiness Technical Working Group on June 28, 2022.

[2] See Vehicle Factors Group - Factual Report, and the Technical Reconstruction Group - Factual Report, for additional information detail on the highway vehicle, and the pre-recovery location / condition.

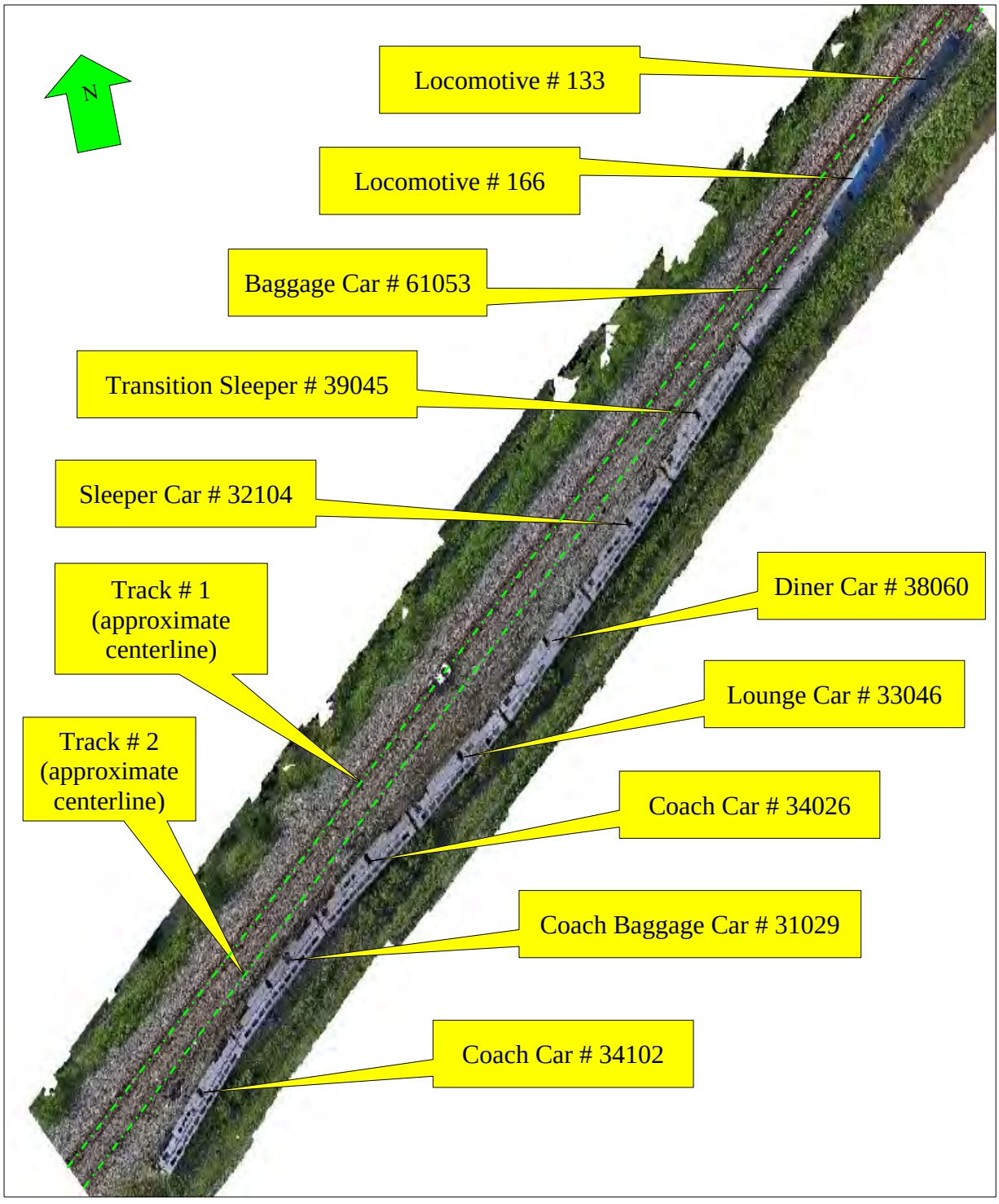
[3] Examination data source(s): NTSB = Crashworthiness - Technical Working Group Chairperson, FRA Forensic Team = FRA designated participant of Crashworthiness - Group, which would include participants of the Volpe Center Investigation Response Team, Amtrak = Amtrak designated participant of Crashworthiness - Group

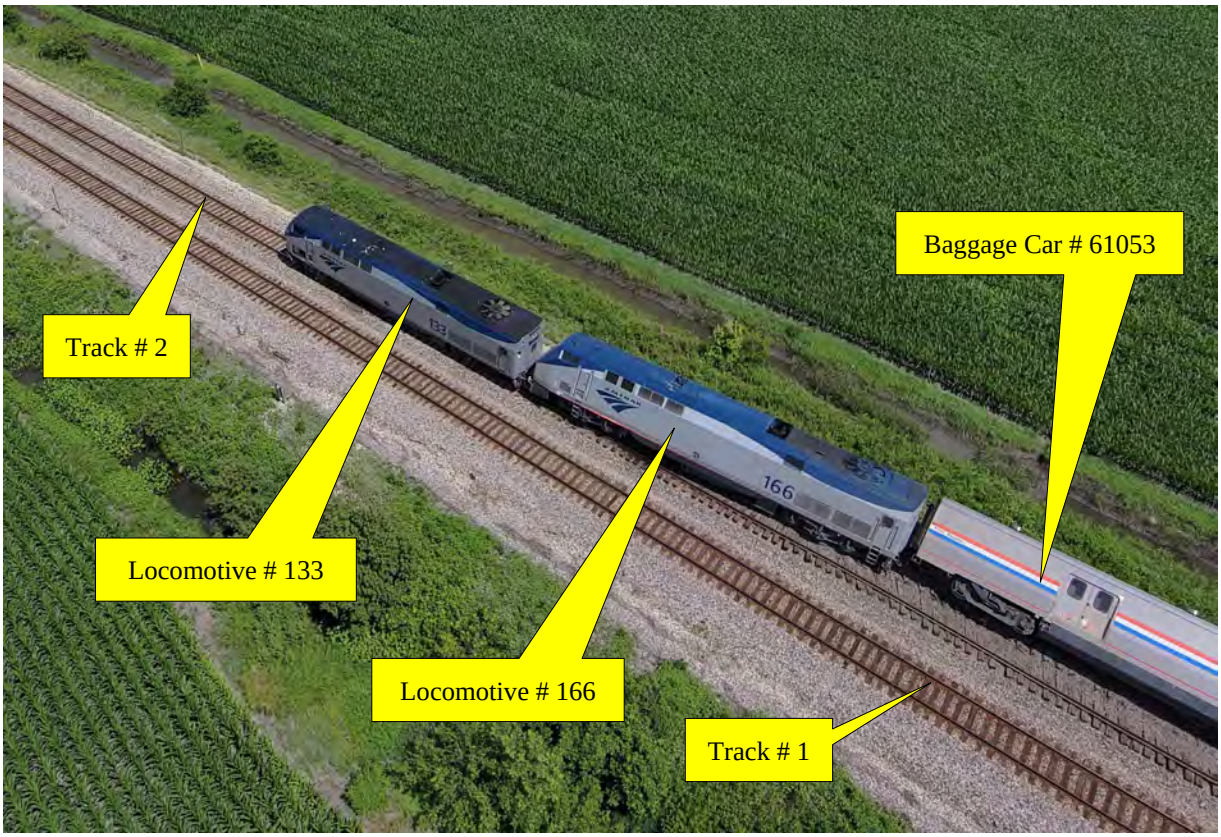
Exhibit 6. Annotated Aerial Imagery of the Wreckage Debris Field [1, 2]

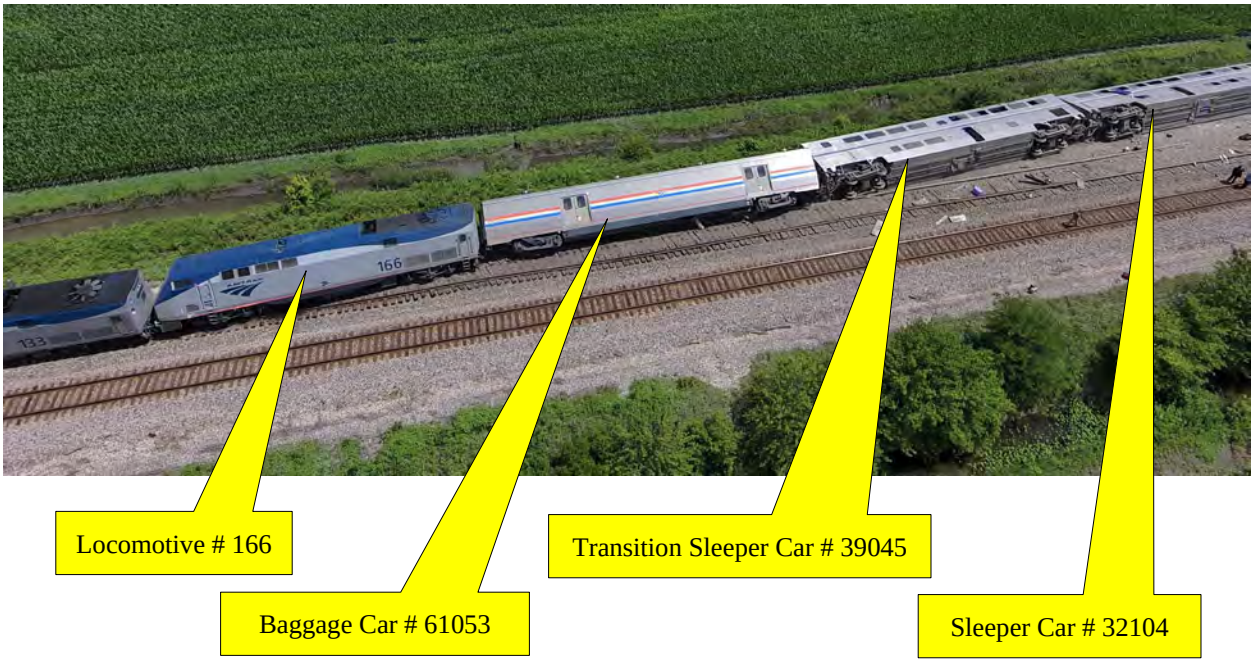
- Wreckage distribution in the wreckage debris field (see next page)
- Sequential segments of the derailed train (see subsequent pages)

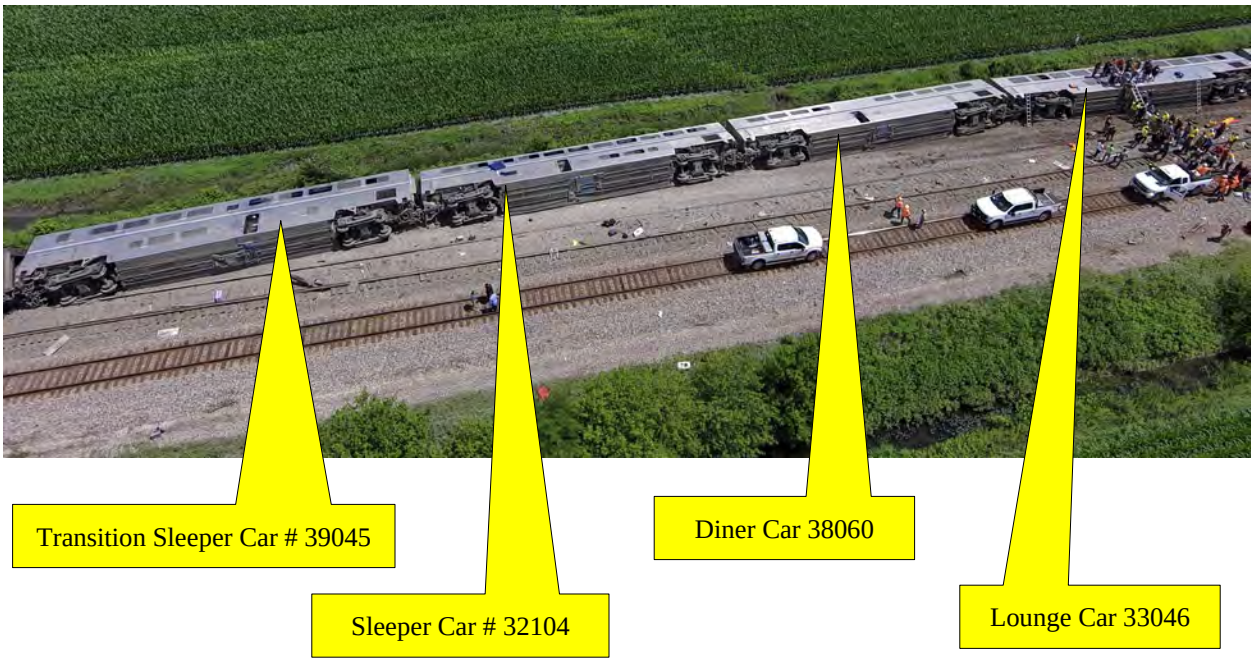
[1] Source: aerial imagery, sourced from [courtesy of] the Missouri State Highway Patrol (MSHP), as made available to the Technical Reconstruction Group of the investigation, in which select imagery was further made available to the Crashworthiness Group [for use in this Exhibit]. The aerial imagery [recovery] process utilized responded UAV [unmanned aerial vehicle] resources (also referred to as aerial 'drones'), to which annotated data (describing select attributes / physical elements of the site) are correspondingly inserted in the imagery, by NTSB staff (i.e., Crashworthiness Group Chairperson).

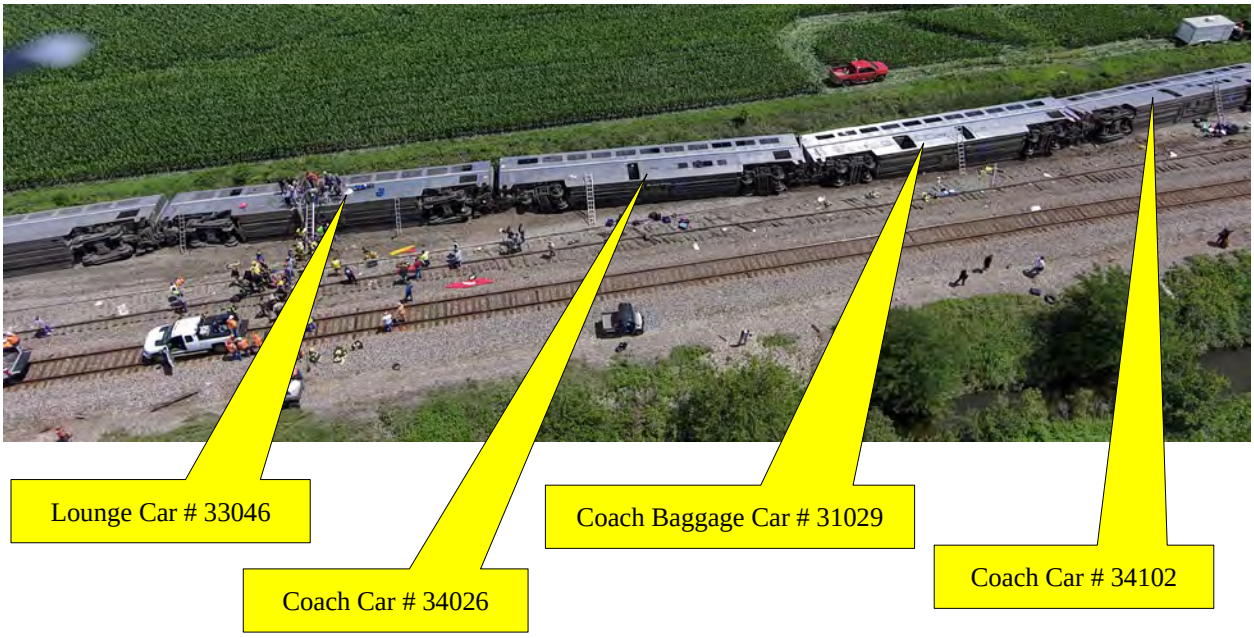
[2] See the Technical Reconstruction Group - Factual Report of the investigation, for additional imagery and accident site data / information.

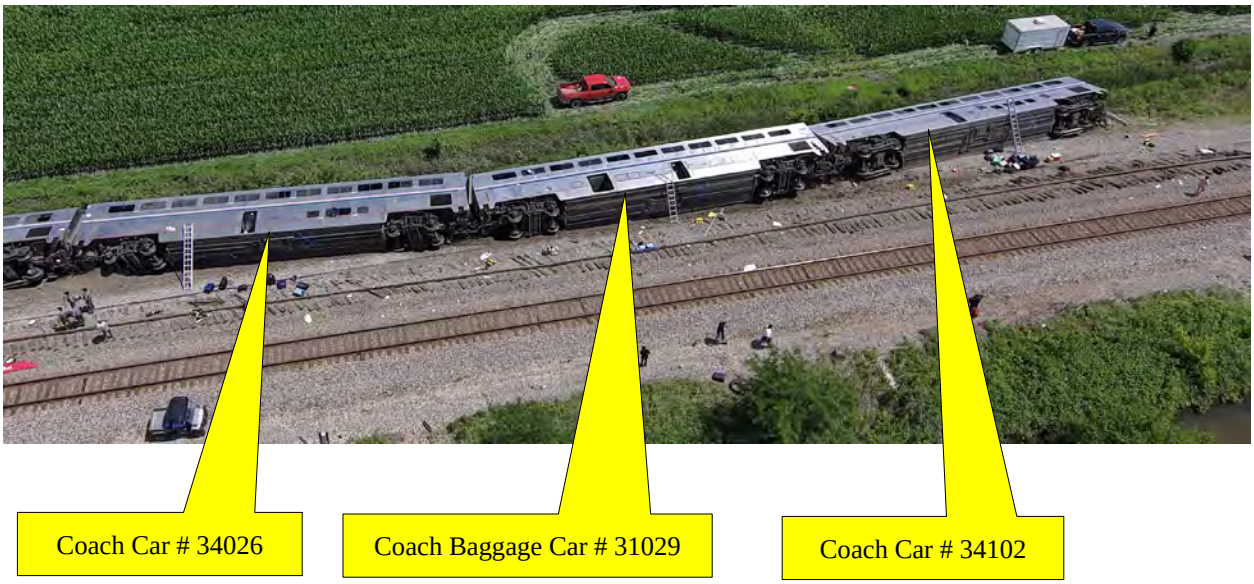

N
Locomotive # 133
Locomotive # 166
Baggage Car # 61053
Transition Sleeper # 39045
Sleeper Car # 32104
Track # 1 (approximate centerline)
Track # 2 (approximate centerline)
Diner Car # 38060
Lounge Car # 33046
Coach Car # 34026
Coach Baggage Car # 31029
Coach Car # 34102


Track # 2
Baggage Car # 61053
Locomotive # 133
Locomotive # 166
Track # 1


Locomotive # 166
Transition Sleeper Car # 39045
Baggage Car # 61053
Sleeper Car # 32104


Transition Sleeper Car # 39045
Sleeper Car # 32104
Diner Car 38060
Lounge Car 33046


Lounge Car # 33046
Coach Car # 34026
Coach Baggage Car # 31029
Coach Car # 34102



-- End of Exhibit --

Exhibit 7. Post-Recovery Railroad Equipment Examination

Notes of this Exhibit –

[1] left and right locational reference indicators are relative to the forward direction of travel (of the train).

[2] windows are numbered starting from the front end of a given railcar, relative to the forward direction of travel (of the train).

[3] damage description characterization(s) cited under the *Exterior* [category] of a given railcar may be duplicated under the *Interior* group of damage characterization(s) [category], for purposes of assuring a specific damage description item is at least minimally documented, rather than resulting in an inadvertent omission of a damage description element; e.g., a damage description [sustained], for a given railcar, at a certain window location, may be cited under both the Exterior and the Interior group of characterization(s) for that given railcar.

Select abbreviations and acronym nomenclature used in this Exhibit

~	approximate, or approximately
FRA Forensic Team	includes members of the FRA [on-scene] staff, and members of the Volpe Center field investigation team
Volpe Center	Volpe National Transportation Systems Center

Tabulation of Summarized Damage Characterization

Seq.	Equipment type	Amtrak Road Number	Summarized Damage Characterization[1] (Identified forward-end)	Notation Source[2]
1	Locomotive	133	No examination conducted; see Factual Report § 4.5.1.	

[1] Examination conducted by the Crashworthiness Technical Working Group [designated participants] on June 29, 2022.

[2] Examination data source(s): NTSB = Crashworthiness - Technical Working Group Chairperson, FRA Forensic Team = FRA designated participant of Crashworthiness - Group, which would include participants of the Volpe Center Investigation Response Team, Amtrak = Amtrak designated participant (plus Amtrak field-support staff) of the Crashworthiness – Group.

2	Locomotive	166	No examination conducted; see Factual Report § 4.5.1.	
3	Baggage	61053	Exterior: (B-end forward) Right Side [carbody wall-panel, windows, doors, etc.]: ▫ minor apparent ground [soil] contact / ballast contact abrasion damage sustained to the carbody sidewall panel, for the entire length of the railcar, commencing [approximately] at a horizontal line about one-half the distance to the car top sill, and extending downward to the lower edge of the carbody sidewall panel sill, with pieces of track ballast and clumps of soil adhering to the carbody sidewall panel surface at various locations. Left Side [carbody wall-panel, windows, doors, etc.]: ▫ one (1) access panel cover observed dislodged (apparent broken hinge), but still attached to (hanging from) the carbody. ▫ otherwise, no apparent [visible] damage sustained. Leading End [bulkhead panel]: ▫ soil adhering to cervices of the bulkhead panel. ▫ otherwise, no apparent [visible] damage sustained. Trailing End [bulkhead panel]: ▫ buffer plate tilted upward. Interior: Right Side [carbody wall-panel, windows, doors, etc.]: ▫ no apparent [visible] damage sustained. Left Side [carbody wall-panel, windows, doors, etc.]:	NTSB

			▫ no apparent [visible] damage sustained. Door panels [sidewall] ▫ no apparent [visible] damage sustained. Floor areas [overall] ▫ both doorway floor panels dislodged ▫ otherwise, no apparent [visible] damage sustained. Leading End [bulkhead panel]: ▫ no apparent [visible] damage sustained Trailing End [bulkhead panel]: ▫ no apparent [visible] damage sustained	
4	Transition Sleeper	39045	Exterior: (B-end forward) Right Side [carbody wall-panel, windows, doors, etc.]: ▫ considerable apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the carbody sidewall panel, for the entire length of the railcar, commencing [approximately] at a horizontal line about two-thirds the distance to the car top sill (i.e., just below the upper window / lower edge line), with abrasion indications higher progressing toward the aft end of the car, and extending downward to the lower edge of the carbody sidewall panel sill, with pieces of track ballast and clumps of soil adhering to the carbody sidewall panel surface at various locations. Left Side [carbody wall-panel, windows, doors, etc.]: ▫ muddy footprints [sourced to emergency responders ?] on the entire sidewall panel,	NTSB

			▫ otherwise, no apparent [visible] damage sustained. Leading End [bulkhead panel]: ▫ no apparent [visible] damage sustained. Trailing End [bulkhead panel]: ▫ no apparent [visible] damage sustained. Interior: Lower level: ▫ lead-end, right side, 3 window-sets all breached, with ballast accumulated on floor. ▫ aft-end sleeping room, window breached, with ballast accumulated on floor. ▫ baggage storage area – no damage. ▫ restrooms on both left and right (total 4) – all no damage. Vestibule [mid-car / lower level]: ▫ right side door displaced inward and ‘panel ‘twisted’, small amount of ballast accumulated on floor. Staircase: ▫ no apparent [visible] damage sustained. Upper level: ▫ crew / conductor room – no damage. ▫ lead-end staircase (to carbody end door) – no damage, but accumulated dirt ▫ Rooms 1 through 8, inclusive, interior (overall) – no damage.	

			▫ Rooms 23; broken aisle window glazing, pulled window, otherwise no damage. ▫ Rooms 24; interior (overall) – no damage. ▫ Rooms 21; pulled window, otherwise no damage. ▫ Rooms 22; door window missing, remnants of broken windowpane on seats, glass shards on windowsill. ▫ Rooms 19; 2 pulled windows, otherwise no damage ▫ Rooms 20; broken aisle window glazing (‘spider’ fracture), otherwise no damage. ▫ Rooms 17 and 18; interior (overall), no damage. ▫ Rooms 15; pulled window, otherwise no damage. ▫ aft end restroom - no damage ---------- Crew Area, LL FWD [lower level, forward] ▫ R [right] Windows gave way, ballast/rock in space ▫ Restroom, no obvious displacement, door forced from outside ▫ Crowbar and hammer not in locker Vestibule ▫ R [right] door forced, door window gapped but still latched DS Café Seating, 3 ▫ 3 of 4 windows forced, no tags removed Café ▫ Window forced, gravel inside, structure torn, blood on ceiling Upstairs	------ Amtrak

			▫ Aft L [left] Window removed	
5	Sleeper	32104	Exterior: (A-end forward) Right Side [carbody wall-panel, windows, doors, etc.]: ▫ considerable apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the carbody sidewall panel, for the entire length of the railcar, commencing [approximately] at a horizontal line about three-quarters the distance to the car top sill (i.e., just below the upper window / lower edge line), with abrasion indications higher in the middle area of the car (i.e., that would include damage to several windows), and extending downward to the lower edge of the carbody sidewall panel sill, with pieces of track ballast and clumps of soil adhering to the carbody sidewall panel surface at various locations. --- Exterior: Right Side [carbody wall-panel, windows, doors, etc.]: ▫ side door pushed in ▫ Lower Window #1, Single window missing ▫ Lower Window #2-3, askew and pushed in ▫ Lower Window #4, missing ▫ Upper level Window #1-4 missing ▫ Upper level Window #5, front portion of gasket lifted Left Side [carbody wall-panel, windows, doors, etc.]: ▫ Upper Window #10, Front single window pane removed ▫ Upper Windows #8, 10 & 11, half window only on #10	NTSB --- FRA Forensic Team

			Leading Truck Assembly: ▫ right side, spring and equalizer beam missing (these parts were found at car #34026, about three car-lengths back) Interior: Lower level: ▫ Room 12 – compartment room window pane cracked ▫ Room 13 – hallway door window pane cracked ▫ Rearmost Room 15? – ballast built up in right side of occupant compartment Vestibule [mid-car / lower level]: ▫ side door pushed in; significant [amount of] accumulated ballast observed against deformed door and inside vestibule. Upper level: ▫ Room B – Signs of trauma in the form of significant pool of blood located on interior room wall closest to hallway pocket door and on interior of pocket door. ▫ Room B, C & D – One window pane removed in each ▫ Room E – full window removed ▫ Room 4 – room compartment window pane shattered and laying in hallway ▫ Room 8 - hallway door window pane shattered and laying in hallway and pocket door wall bowed inward ---------- ▫ Right side lower (level) windows pushed in ▫ Right side door pushed in and bent ▫ Right side A-end 3 upper windows pushed in	------ Amtrak

			▫ Room B signs of injury (indicated by) blood ▫ (interior) room door glass broken out	
6	Diner	38060	Exterior: (A-end forward) Right Side [carbody wall-panel, windows, doors, etc.]: ▫ considerable apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the carbody sidewall panel, for the entire length of the railcar, commencing [approximately] at a horizontal line about three-quarters the distance to the car top sill (i.e., just below the upper window / lower edge line), with abrasion indications higher in the middle and aft area of the car (i.e., that would include damage to several windows), and extending downward to the lower edge of the carbody sidewall panel sill, with pieces of track ballast and clumps of soil adhering to the carbody sidewall panel surface at various locations. ---------- Exterior: Right Side [carbody wall-panel, windows, doors, etc.]: ▫ Right side front step well deformed back. ▫ Right side door pushed in. ▫ Upper Window #1, Front emergency window missing. ▫ Upper Window #2, zip strip hanging but window intact. ▫ Upper Window #4, zip strip hanging and window pushed in. ▫ Tie plate attached to side wall just behind Window #4 ▫ Upper Windows #5-8, partially displaced ▫ Upper Window #9, fully displaced Left Side [carbody wall-panel, windows, doors, etc.]:	NTSB ------ FRA Forensic Team

			▫ Window #4, Front emergency window removed Interior: Lower level: Kitchen [area] ▫ A red substance present under cabinets above sink. It is difficult to determine what this liquid is due to the amount of food mess in the kitchen. Vestibule [mid-car / lower level]: ▫ Right side door pushed in. ▫ Significant accumulated ballast observed against deformed door and inside vestibule. Staircase: Upper level: ▫ right side Window #1, Front emergency window missing ▫ right side Window #2, zip string hanging but window intact ▫ right side Window #4, zip string hanging and window pushed in ▫ right side Windows #5-8, partially displaced ▫ right side Window #9, fully displaced ▫ left side Window #4, Front emergency window removed Patron seating [area]: ▫ Left window #1 pushed inward and blood present above window frame at Table 1. ▫ Blood on tissue wedged underneath light fixture and smeared on wall.	

			▫ Forward-facing bench seat for Table 11 cracked, likely from a significant force applied to the cantilevered seat during emergency egress. ---------- ▫ Lower level (kitchen area) food supplies not secured and thrown about (as car rolled and moved) ▫ Upper-level table #11 fiberglass bench broken ▫ B-end right side upper window pushed in.	------ Amtrak
7	Lounge	33046	Exterior: (B-end forward) Right Side [carbody wall-panel, windows, doors, etc.]: ▫ considerable apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the carbody sidewall panel, for the entire length of the railcar, commencing [approximately] at a horizontal line about two-thirds the distance to the car top sill (i.e., just below the upper window / lower edge line), and extending downward to the lower edge of the carbody sidewall panel sill, with pieces of track ballast and clumps of soil adhering to the carbody sidewall panel surface at various locations. Left Side [carbody wall-panel, windows, doors, etc.]: ▫ no apparent [visible] damage sustained. Leading End [bulkhead panel]: ▫ minor damage sustained to the diaphragm components. ▫ apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the lower left edge of the bulkhead panel. ▫ track ballast and soil adhering to cervices of the bulkhead panel. Trailing End [bulkhead panel]:	NTSB

			▫ damage sustained to diaphragm. Interior: Lower level: ▫ B-end, crew lounge – right side window assembly yielded; ballast inside compartment ▫ restroom [overall inspection]; no obvious wall panel displacement ▫ restroom door jamb and lock damage Vestibule [mid-car / lower level]: ▫ right side-door – showing inward displacement [damage], with ballast accumulated on floor. ▫ rear lower lounge – window panels yielded (inward displacement -damage], with ballast accumulated on floor and on tables. ▫ crew kitchen – window panels yielded (inward displacement -damage), with ballast accumulated on floor. Staircase: ▫ no apparent [visible] damage sustained. Upper level: ▫ Round-shaped shatter of curved window panel [in a shape suggesting a head impact] ▫ otherwise side [wall panel] windows, and curved windows intact ▫ some seat-sets rotated, several emergency windows ‘pulled’ ---------- Exterior:	------

			Right Side [carbody wall-panel, windows, doors, etc.]: ▫ Right side door deformed and tilted in ▫ Lower level, Window #1, Full window askew and tilted inward but individual window panes intact in gasket ▫ Upper level, Window #2, Vertical center mullion deformed outward ▫ Lower level, Window #3, Rear window pane askew within window frame ▫ Lower level, Window #4, Rear window missing ▫ Lower level, Window #5 to galley, Rear window missing (see damage described in interior section). Left Side [carbody wall-panel, windows, doors, etc.]: ▫ Upper level, Lower Window #2, Rear emergency window removed ▫ Upper level, Lower Window #6, Front emergency window removed ▫ Upper level, Lower Window #11, Rear emergency window removed Interior: Lower level: ▫ Lower level, Window #1, Full window askew and tilted inward but individual window panes intact in gasket ▫ Lower level, Window #3, Rear window pane askew within window frame ▫ Lower level, Window #4, Rear window missing ▫ Lower level, Window #5 to galley, Rear window missing. ▫ [in the area of Window #5 to galley] Significant accumulation of ballast filled the crew's galley workspace. ▫ Significant accumulation of ballast filled the crew's galley workspace.	FRA Forensic Team

			▫ [in] Galley and areas with tables: behind the register (in an employee only area) - Signs of trauma in the form of blood dripping down ceiling. ▫ [in] Galley and areas with tables: Window displaced inward and significant accumulation of ballast and mud. ▫ [in] Galley and areas with tables: Carbody window opening shows signs of structure damage. Unclear if the damage took place during the derailment or during first responders' recovery efforts. ▫ [in] Galley and areas with tables: Plexiglass partition bent 90 degrees downward at time of inspection. Unclear whether occurred during first responders' recovery efforts. Vestibule [mid-car / lower level]: ▫ Right side door deformed and tilted in ▫ significant accumulation of ballast filled the [right side area of the] entrance vestibule Upper level: (Observatory and Lounge [areas]) ▫ Upper level, Lower Window #2, Rear emergency window removed ▫ Upper level, Lower Window #6, Front emergency window removed ▫ Upper level, Lower Window #11, Rear emergency window removed ▫ Window #2, Vertical center mullion deformed outward ▫ Single window pane found on upper level with abrasions on outer pane that correlated with missing windows on the lower level. ▫ Window #7 near open bay seats – Signs of trauma in the form of blood stains near a window distinctly cracked in a radial pattern. At time of inspection, before the cars had been moved, observed a black baseball hat located directly on cracked window. ----------	------

			Side Inspection ▫ Sets (were) all in place on (the) upper level. ▫ Looked as though there was an injury from falling when the car rolled ▫ Lower level damaged with windows pushed in ▫ Suspect injury from (the) window coming in and pinning (an) employee ▫ Large amount of ballast and dirt from doors and windows (that were) opened (and/or) pushed in	Amtrak
8	Coach	34026	Exterior: (A-end forward) Right Side [carbody wall-panel, windows, doors, etc.]: ▫ apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the carbody sidewall panel, for the entire length of the railcar, commencing [approximately] at a horizontal line about two-thirds the distance to the car top sill (i.e., just below the upper window / lower edge line), and extending downward to the lower edge of the carbody sidewall panel sill, with pieces of track ballast and clumps of soil adhering to the carbody sidewall panel surface at various locations. Left Side [carbody wall-panel, windows, doors, etc.]: ▫ no apparent [visible] damage sustained. Leading End [bulkhead panel]: ▫ damage sustained to the diaphragm. ▫ apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the lower left edge of the bulkhead panel. ▫ track ballast and soil adhering to cervices of the bulkhead panel. Trailing End [bulkhead panel]:	NTSB

			▫ damage sustained to diaphragm. ---------- Exterior: Right Side [carbody wall-panel, windows, doors, etc.]: ▫ Lower level, Window #1-3, askew ▫ Upper level, Window #6, Front window pane removed via emergency pull handle (no evidence of damage or abrasions on the outside) Left Side [carbody wall-panel, windows, doors, etc.]: ▫ Lower level, Window #2, Rear emergency window removed ▫ Upper level, Window #1, Full window and gasket removed ▫ Upper level, Window #9, Both window panes removed ▫ Upper level, Window #10, Front window pane removed Interior: Lower level: ▫ Window #1-3, askew ▫ ballast inside the car on seat #75/76, #79/80 & #83/84 (see interior notes description of blood) ▫ rear section of seats – Tissue with blood located between seat pairs 83/84 and 79/80 Upper level: ▫ Window #6, Front window pane removed via emergency pull handle (no evidence of damage or abrasions on the outside) ▫ Blood found on the side of seat back/side at seat pair 25/26	------ FRA Forensic Team

			▫ Emergency handle deformed at Window #8/Seat pair #43/44, likely from interior impact	
9	Coach-baggage	31029	Exterior: (B-end forward) Right Side [carbody wall-panel, windows, doors, etc.]: ▫ apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the carbody sidewall panel, for the entire length of the railcar, although the damage was more severe in the first half of the car, commencing [approximately] at a horizontal line about two-thirds the distance to the car top sill (i.e., a short distance below the upper window / lower edge line), and extending downward to the lower edge of the carbody sidewall panel sill, with pieces of track ballast and clumps of soil adhering to the carbody sidewall panel surface at various locations. Left Side [carbody wall-panel, windows, doors, etc.]: ▫ no apparent [visible] damage sustained. Leading End [bulkhead panel]: ▫ damage sustained to the diaphragm. ▫ apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the lower left edge of the bulkhead panel. ▫ track ballast and soil adhering to cervices of the bulkhead panel. Trailing End [bulkhead panel]: ▫ damage sustained to diaphragm. ---------- Exterior: Right Side [carbody wall-panel, windows, doors, etc.]:	NTSB ------ FRA Forensic Team

			▫ Upper Right Side #1 (Forward), #6 (Both), #7 (Both), #9 (Rear) and #11 (Both) windows removed from inside. Left Side [carbody wall-panel, windows, doors, etc.]: ▫ Upper Left Side #2 (Rear), #3 (Rear) and #4 (Forward) windows removed from inside. Interior: Lower level: ▫ Left Side Baggage door pushed inward with ballast accumulation. Vestibule [mid-car / lower level]: ▫ Left Side Vestibule door pushed inward with ballast accumulation. Upper level: ▫ Upper Left Side #2 (Rear), #3 (Rear) and #4 (Forward) windows removed from inside. ▫ Upper Right Side #1 (Forward), #6 (Both), #7 (Both), #9 (Rear) and #11 (Both) windows removed from inside.	
10	Coach	34102	Exterior: (A-end forward) Right Side [carbody wall-panel, windows, doors, etc.]: ▫ apparent ground [soil] contact / ballast contact abrasion and batter damage sustained to the carbody sidewall panel, for the entire length of the railcar, although the damage was more severe in the center area of the car, commencing [approximately] at a horizontal line about two-thirds the distance to the car top sill (i.e., just below the upper window / lower edge line), and extending downward to the lower edge of the carbody sidewall panel sill, with apparent damage sustained to several windows, as well as apparent damage sustained to the top sill area of the	NTSB

			car, with pieces of track ballast and clumps of soil adhering to the carbody sidewall panel surface at various locations. Left Side [carbody wall-panel, windows, doors, etc.]: ▫ no apparent [visible] damage sustained. Leading End [bulkhead panel]: ▫ damage sustained to the diaphragm. Trailing End [bulkhead panel]: ▫ no apparent [visible] damage sustained. ---------- Exterior: Right Side [carbody wall-panel, windows, doors, etc.]: ▫ Upper Right Side #3, #5, #6, #7 Outer window gasket damaged with windows remaining in tack. ▫ Lower Right Side #1 and #2 windows dislodged and in window space. ▫ Lower Right Side #3 window dislodged and not in window space. Left Side [carbody wall-panel, windows, doors, etc.]: ▫ Upper Left Side #1 (Forward), #4 (Rear), #5 (Both), #6 (Rear), #9 (Rear), # and #11 (Both) windows removed from inside. ▫ All Lower Left Side windows removed from inside. Interior: Lower level: ▫ Tissue with blood found in the vestibule luggage compartment.	------ FRA Forensic Team

			▫ Blood and tissue found adjacent to seats 75/76 near the wheel chair area. Vestibule [mid-car / lower level]: ▫ Right Side Vestibule door pushed inward with ballast accumulation. Upper level: ▫ Left Side #1 (Forward), #4 (Rear), #5 (Both), #6 (Rear), #9 (Rear), # and #11 (Both) windows removed from inside. ---------- ▫ Left side door pushed in and bent ▫ Lower (level) left side all windows pushed in ▫ Upper (level) left side all windows in (not pushed in or removed)	------ Amtrak

-- End of Exhibit / End of Report --